Version 1.1

THE CRC ROBOTICS COMPETITION
RULEBOOK

Outlining the full rules for

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 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, parents, mentors and volunteers 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 Invicta 2021, our 20th annual competition.

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

The 2020-2021 CRC Robotics season will have a lot to offer: a never-before-seen completely virtual competition to ensure everyone's health and safety during the COVID-19 pandemic, a significant enhancement of our live streaming capabilities, a revamp of certain legacy rules and evaluation criteria, and the full implementation of the CrcDuino, an Arduino-based robot control platform that was fully developed in-house in collaboration with E.D.A.P.I Inc.

Good luck to all and we will see you (virtually) at Invicta 2021 from February 18 to 20, 2021.

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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 a non-profit 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 teams from coast to coast in a 3-day, action-packed event held annually, in February.

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 high schools, CEGEPs and professional vocational centres 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.).

The CRC Robotics Competition has seen an increasing number of female student participants over the years, who have also continued their studies in STEM fields! To further expand the participation of girls in STEM, CRC Robotics also organizes an annual networking event for high school and CEGEP girls and non-binary students, entitled *Aim Together*, with the goal of inspiring girls to consider a career in STEM. Our mission is to brand STEM fields, which are thought of primarily as masculine environments, as welcoming to women, in the hopes that girls will consider STEM as a viable career path. For more information on this event, please contact the organizers at conference@sciencetech.ca.

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 school, 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:

2021 Team Number	School Name	Division
1	Collège Citoyen	1
2	John Abbott College	2
3	Collège Sainte-Marcelline #1	1
4	Collège Sainte-Marcelline #2	1
5	Dawson College	1
6	École secondaire Curé-Antoine-Labelle	2
7	Lower Canada College	1
8	École secondaire Monseigneur-Richard #1	2
9	École secondaire Monseigneur-Richard #2	2
10	Cégep Vanier College	1
11	West Island College	2
12	Collège de Bois-de-Boulogne	1
13	Kells Academy	2
14	École secondaire Jules-Verne	2
15	Champlain Regional College	2
16	La Cité Collégiale	2
17	Collège André-Grasset	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.

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	The CRC Robotics Organizing Committee is always available to meet you and present a detailed explanation of what the Competition is all about and what it entails for students, teachers and their school. Interested parties may contact us via info.crc@sciencetech.ca.
Registration Period	September 2, 2020 to October 16, 2020	Registration is opened to all high schools, CEGEPs and professional vocational centres in Canada. Late registration may be possible. Please contact info.crc@sciencetech.ca for more information.
Training Day	November 2020	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. The Training Day is organized according to the demand. Interested parties may contact us via info.crc@sciencetech.ca.
Preliminary Rulebook Release	October 26, 2020	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.
Kickoff	November 2, 2020 at 7pm EST Virtual Zoom Conference *Entry allowed as of 6:30pm* *(Meeting link to be shared by email to team mentors)*	The Kickoff officially marks the beginning of the season for the participants. The complete rulebook and the game specifics are revealed here! The participant kit (which includes the Arduino board and legal power motors and batteries) will be distributed to the teams in the days following the Kickoff.

CRC Workshops	November 2020 to January 2021 *Exact dates and subjects covered will be posted on the CRC website and Managr.*	The CRC Robotics Workshops are events intended to provide specific training to participants in their field of interest. All webinars will also be recorded and made available on our YouTube channel and social media platforms.
Website, Video, and Tutorial Submission, and Programming Component Opt-In Deadline	February 1, 2021 at 11:59:59pm EST Using Managr: https://managr.crcrobotics.com	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. The Submission Form will be made available as of January 25, 2021.
Deadline to make Website, Video and Tutorial Public	February 18, 2021 at 7:59:59am EST	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.
20th Annual CRC Robotics Competition **INVICTA 2021**	February 18 to 20, 2021 Virtual Competition *(Details on the logistics and streaming links will be shared at a later date)*	Join us in the pinnacle of the 2020-2021 CRC Robotics season. After over three months of hard work and countless hours of design and construction, over 15 teams will show off what their robot can do. Also, the students will be showcasing their school and accomplishments on their website and in their video and participating in a completely virtual robotics challenge. An exciting, action-packed, 3-day event not to be missed!

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Rule Modifications

Rule	Description of the change
2.4.01	Clarification on how the game pieces need to be placed at the beginning of the heat.
2.7.04	Addition of the rule stating that the structure cannot be supported in any way.
2.8.06	Clarification on junk penalty for liquid.
2.9.09	New rule regarding attaching the robot to objects.
3.6.02	Clarification on the robot having to return to initial size limits if asked.

1. The Competition

The Competition is a three-day event that takes place annually, in the month of February, usually at one of the participating schools. This year, the Competition will be held virtually in order to respect public health guidelines related to the COVID-19 pandemic. The final Competition rules are made public at Kickoff, approximately 3 and a half months before the Competition.

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

- Thursday Morning: Team Preparation and Setup
- Thursday Afternoon: Opening Ceremony and Preliminary Heats
- Thursday Evening: Preliminary Heats and Evaluations

- Friday Morning: Preliminary Heats and Evaluations
- Friday Afternoon: Preliminary Heats and Evaluations
- Friday Evening: Preliminary Heats and Evaluations

- Saturday Morning: Knock-Out Rounds
- Saturday Afternoon: Quarterfinals, Semi-Finals and Finals
- Saturday Evening: 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 Invicta 2021. The teams must participate in a tournament with their own autonomous 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 CRC Pitch

The CRC Pitch replaces the Kiosk component for this year's competition. This component will be executed in an extended elevator pitch format where the students will describe their season and present the challenges and obstacles they encountered and overcame. It involves the application of art and communication and is an opportunity for the students to market their robotics team to others and truly sell the CRC experience. More information on the CRC Pitch can be found in Section 4 of this rulebook.

1.1.04 Programming

The programming component is designed to foster and hone the skills and thinking process required to code professionally. In a truly unique way, participants will tackle various online programming challenges at the Competition in a "Capture the Flag" style game. Each challenge will provide participants with the required tools to succeed, and challenges will become more complex as teams move forward. 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 follow a storyline and present a description of this year's game. It must also, among others, demonstrate and elaborate on the construction of the robot, the challenges encountered during the build process and the solutions implemented by the students. 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 roster 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. 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. CRC Pitch
   d. Video
   e. Website Content
   f. Website Design

1.2.02 Teams are divided among high school and CEGEP/Vocational centre for the Programming component.

1.2.03 There is no division of teams for the Tutorial component. All teams compete against each other.

1.2.04 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.

1.2.05 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.

1.2.06 The divisions are re-assigned every year.

1.2.07 New high schools are automatically placed in Division 2 while new CEGEPs and vocational centres are automatically placed in Division 1.

1.2.08 A team in Division 2 can win the Overall Ranking award.

1.2.09 The best teams will receive separate awards for the components based on the ranking for each component.

1.2.10 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.

1.2.11 A Division 2 team can request to be upgraded into Division 1.

1.2.12 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 or school type system is used for the ranking of a particular component, then awards are presented to the most performing team(s) in each division or school type for the component. Refer to Section 1.2 for details on components for which teams will be ranked by division or school type. 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 CRC Pitch

The CRC Pitch award is presented to the three teams that received the greatest scores from our CRC judges and that were deemed to have the best executed pitch of the CRC Robotics experience.

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 code to accomplish 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 from a marketing standpoint.

1.3.09 Tutorial

The Tutorial recognition is presented to the three teams that received the greatest scores from the CRC Robotics Organizing Committee and that were deemed to have the best explanation of the task selected.

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 barriers. 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:

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

2. CRC Pitch, 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 Competition Award

The Competition award is presented to the three teams that receive the greatest overall 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. The Game

The game component requires robots to score the greatest number of points by completing challenges individually this year. 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 sub-sections at any time throughout the season. All teams will be promptly notified if a modification is made.

2.1 Teams

2.1.01 There are no teams in this year's game. Robots will play each heat individually and attempt the challenge within that heat.

2.2 Playing Field

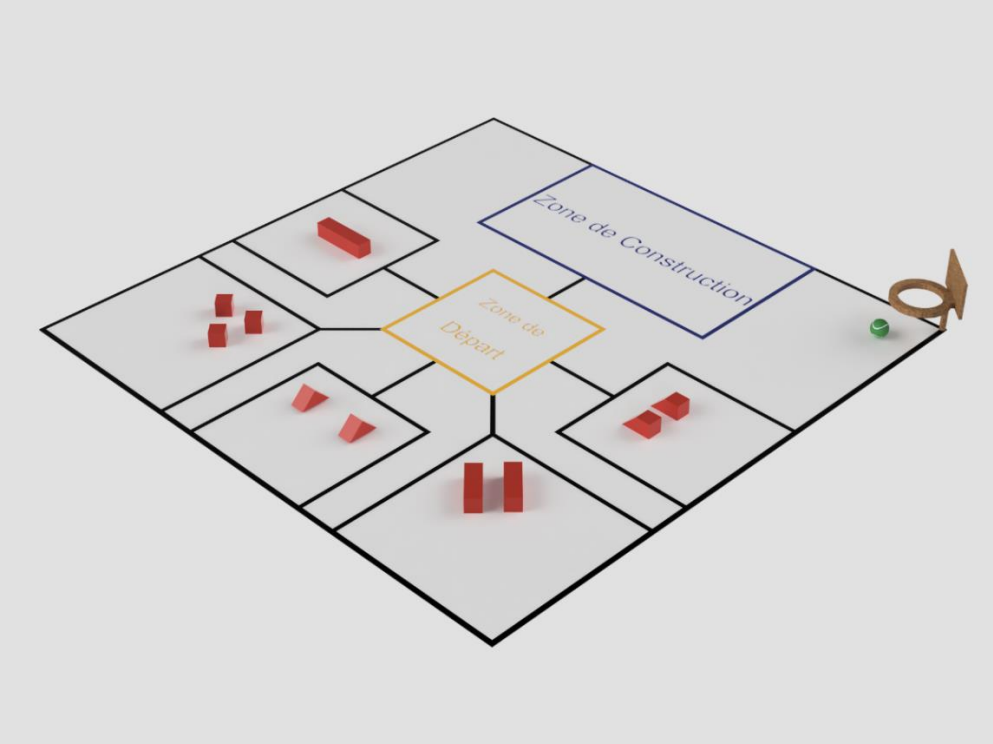
2.2.01 The playing field is a single-level rectangle composed of different sections, maneuverable by one robot at a time.

2.2.02 There is only one available starting zone, which is in center of the field and is represented by the yellow tile in the figures below.

2.2.03 Several types of game pieces (GPs) are found on the playing field, each found in a separate zone on the field.

2.2.04 Unless otherwise communicated by the CRC Robotics Organizing Committee in the event of a modification, measurements of the playing field provided in Appendix I will be considered accurate.

2.2.05 The image below shows a view (not to scale) of the playing field.



2.3 Game Pieces

2.3.01 This year's GPs are several wood blocks of different shapes and sizes.

2.3.02 The wood blocks have the following shapes and sizes:

- A cube
- A short square-based prism identified by a red CRC logo
- A long square-based prism identified by a black CRC logo
- A triangular-based prism
- A trapezoidal-based prism

2.3.03 The number of GPs available during a heat depends on the Construction Plan selected for that heat.

2.3.04 There is no limit to the number of GPs a robot can hold at any given time during the heat.

2.4 Putting Game Pieces into Play

2.4.01 Before the beginning of each heat, the GPs needed to execute the chosen Construction Plan must be placed in the respective zones by a team member as per the figure illustrated in rule 2.2.05. The GPs can be placed in any way within their

respective zones as long as they are completely within the zone and one surface is touching the playing field at the beginning of the heat.

2.4.02 The location of the GPs in their respective zones can be outlined by any adhesive tape.

2.4.02 GPs that are not necessary to execute the chosen Construction Plan must be removed from the playing field before the beginning of the heat.

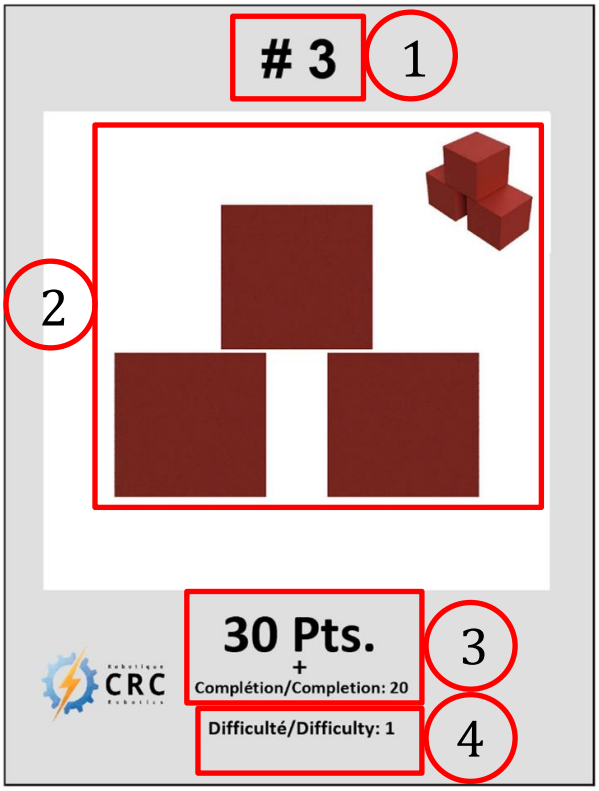
2.4.04 It is prohibited to place more GPs of any type on the playing field than necessary to execute the chosen Construction Plan.

2.4.05 At the beginning of the heat, the tennis ball can be placed in or on a robot, or anywhere on the playing field. However, the ball cannot touch the Ring.

2.4.06 The GPs that fall outside the playing field for whatever reason are considered out of play and can no longer be used during the heat.

2.5 The Construction Plans

2.5.01 A Construction Plan consists of a plan number (1), a front view and isometric view of the structure to be built (2), the score attributed to the plan (3) and the level of difficulty (4).



2.5.02 The Construction Plan executed during a heat is chosen at the beginning of the heat.

2.5.03 The team must choose among the 25 available Construction Plans.

2.5.04 A Construction Plan that has been successfully executed cannot be reused during the same heat block in which it was successfully executed. The heat blocks are illustrated in the table below.

Heat Block	Rounds
1	Preliminary
2	Knock-Out
3	Quarterfinals, Semi-Finals, Finals

2.5.05 There is no limit to the number of times a team can select a Construction Plan that has not been successfully executed during any given heat block.

2.6 The Ring

2.6.01 The Ring acts as a multiplier of the total number of points and is calculated using the following formula. It is compatible with most spreadsheets, including Microsoft Excel. The variable "*elapsed_time*" represents the time, in minutes, that has elapsed during a given heat. The formula FLOOR.MATH rounds the result of the calculation in brackets down to the lowest integer unit.

$$MAX(FLOOR.MATH(5-elapsed\_time),1)$$

2.6.02 To obtain the multiplier, the robot must put the tennis ball provided by CRC Robotics in the Participant Kit into the Ring by the top.

2.6.03 Once the tennis ball is placed through the Ring, the heat ends immediately.

2.7 Scoring Points

2.7.01 A team scores points if GPs are placed in the construction zone in the correct layout according to the Construction Plan selected at the end of the heat.

2.7.02 Each GP that is correctly placed will be attributed a certain number of points based on its type. The points for each GP type are illustrated in the table below.

Game Piece Type	Score
Cube	10
Trapezoidal-based prism	25
Short square-based prism	30
Triangular-based prism	35
Long square-based prism	40

2.7.03 If a robot places all the GPs of the selected Construction Plan in the correct layout, meaning the Construction Plan is fully executed, the team will receive a point bonus based on the level of difficulty attributed to the Construction Plan. The point bonus for each difficulty level is illustrated in the table below.

Difficulty Level	Point Bonus
1	20
2	30
3	45
4	60
5	100
6	200

2.7.04 If the Construction Plan is not fully executed or GPs fall from the structure by themselves, the team will not obtain the point bonus. Only a team whose robot executes a structurally stable layout at the end of the heat will obtain the point bonus. A structure cannot be supported in any way, by anyone or by anything other than itself.

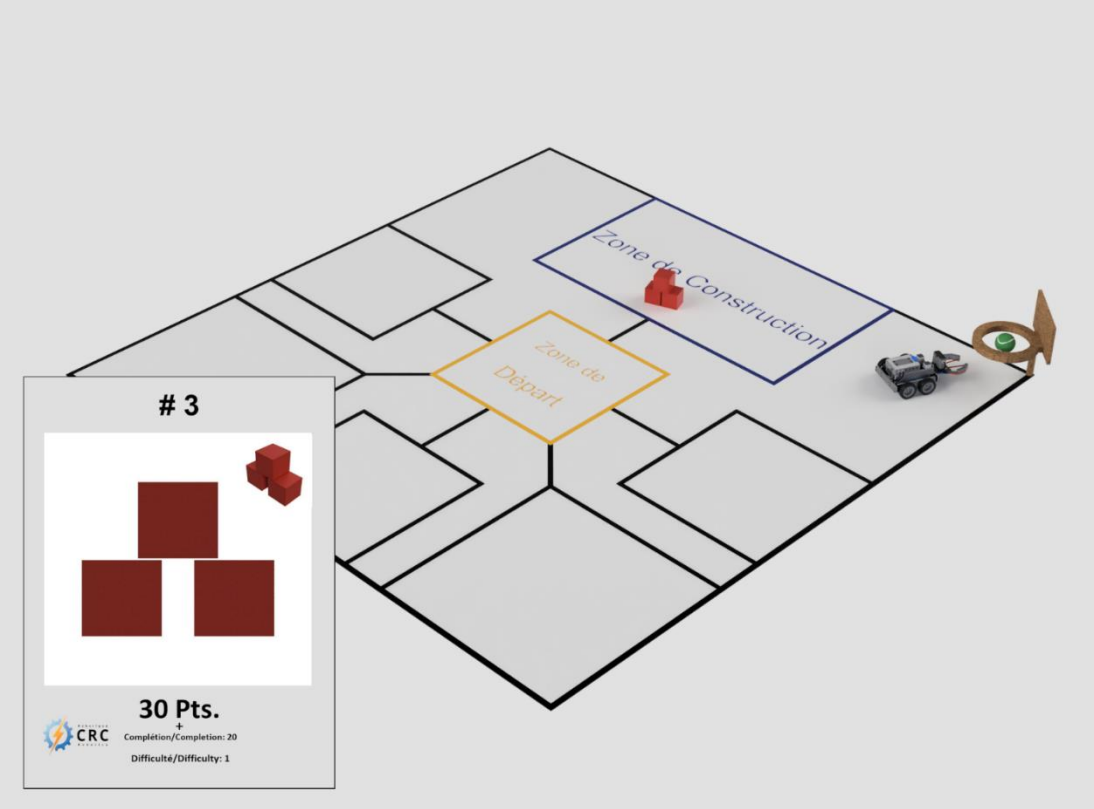
2.7.05 If more than one layout of GPs is present in the Construction Zone at the end of the heat, only the layout that is attributed the highest number of points will contribute to the team's score.

2.7.06 The tennis ball allows the team to multiply their points according to the elapsed time on the clock when the ball is placed through the Ring. The value of the multiplier for each range of elapsed time is illustrated in the table below.

Elapsed Time (mins)	Multiplier
0 to 1	x4
1 to 2	x3
2 to 3	x2
3 to 5	x1

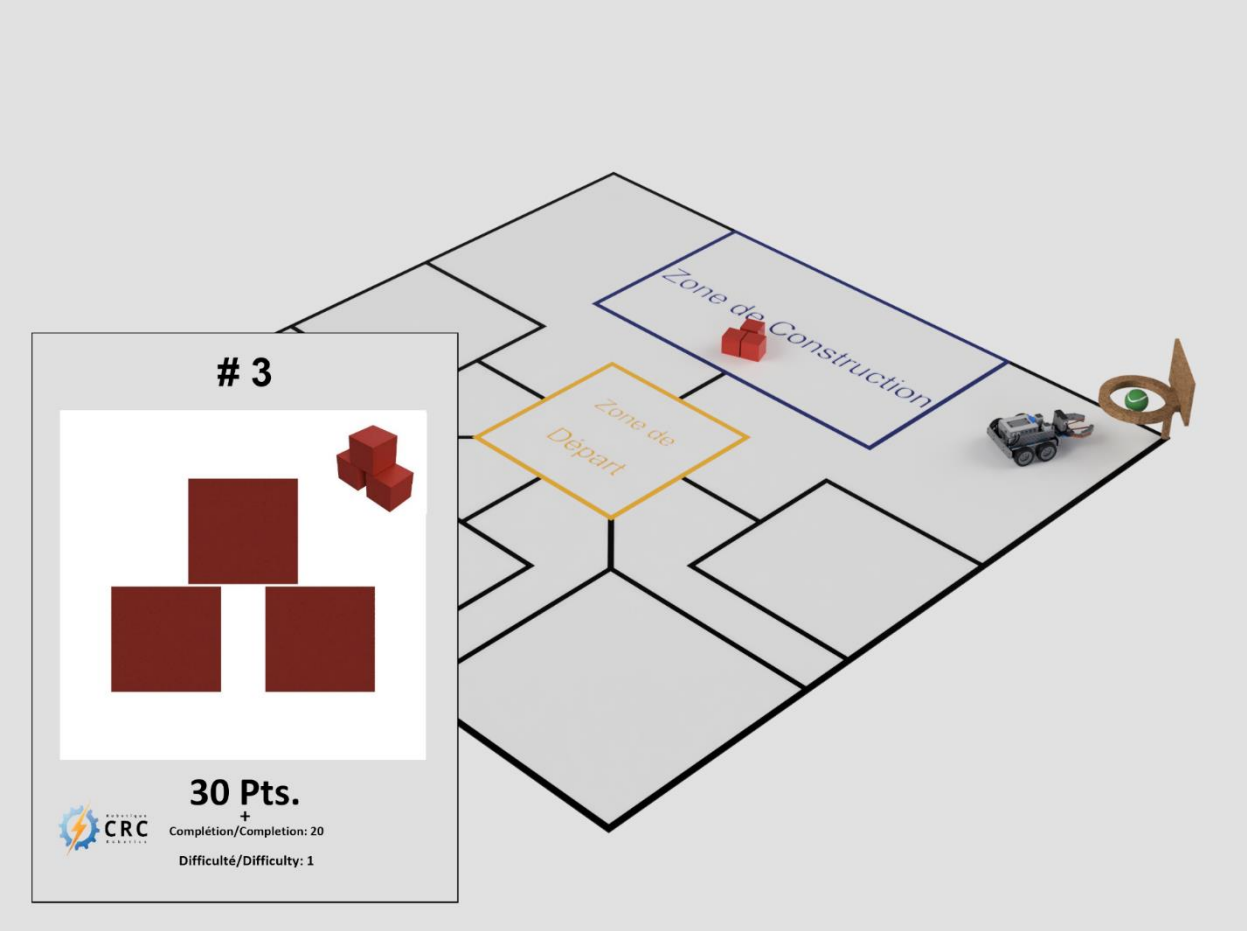
2.7.07 The following is a scoring example. It constitutes an integral part of the rules and acts as a reference for scoring disputes. Please note that this image does not represent the real playing field to scale, the various elements of the field or the positioning of the starting zones. This image is simply to help understand the scoring system.

- Fully executed construction plan



Category	Additional Information	Result
Correctly placed GPs	3 Cubes	3 * 10 pts.
Bonus Points	Difficulty = 1, Fully Executed	20 pts.
Time Multiplier	3min 20sec elapsed	x1
Total Points		((3 * 10) + 20) * 1 = **50 pts.**

- Partially executed construction card



Category	Additional Information	Result
Correctly placed GPs	2 Cubes	2 * 10 pts.
Bonus Points	Difficulty = 1, Not Fully Executed	0 pts.
Time Multiplier	1min 40sec elapsed	x3
Total Points		((2 * 10) + 0) * 3 = **60 pts.**

2.8 Arbitration and Penalties

2.8.01 Our referees are experts in calling and assessing penalties and always have the final word during each heat. However, during the 10 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 their right to challenge if they find it is unnecessarily abusing it.

2.8.02 The referees have full authority to judge all aspects of the game.

2.8.03 Any robot that is deemed dangerous (based on its design or behavior) by any of the referees runs the risk of being disqualified.

2.8.04 While we trust that all participants will provide clear intentions, certain conducts may occur that require sanctions. To avoid such penalties, remain courteous. 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 behavior that signal a lapse of sportsmanlike behavior are:

- Inappropriate behavior directed at an official, another participant or a spectator
- A deliberate attempt to disrespect social distancing guidelines

2.8.05 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.

2.8.06 If liquid seeps from a robot onto the playing field or any GP, the robot's final score for the heat will be reduced to 0.

2.8.07 Various robot parts (items) 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 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.

2.8.08 If a team judges that its robot needs assistance on the playing field during a heat, a team member may ask the referee if they can assist their robot. The assisted robot will be liable to an assistance penalty of 20% of its total score for the heat. The student must not touch any GP in the Construction Zone when assisting the robot. The referees reserve the right to not allow the team members to assist the robot even if asked.

2.9 Heat Progress

2.9.01 The robot starts the heat in the starting zone located in the center of the playing field.

2.9.02 At the start of the heat, a team member must press the button provided by CRC Robotics on the robot to launch the execution of the program.

2.9.03 The team may start each heat with a maximum of 1 GP pre-loaded in their robot.

2.9.04 All heats are 5 minutes in duration. When the heat time is over, all parts of the robot must stop moving and the Kill Switch must be activated by a student. GPs will be considered only when they stop moving, even if that occurs after the heat time is over. All the points generated by a 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.

2.9.05 The heat will end prior to the 5-minute mark if the robot is stopped by a call from a CRC Robotics referee or if the tennis ball is passed through the Ring.

2.9.06 Team members may not interfere with or touch any element of the playing field, robot, or GPs during the heat.

2.9.07 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 spectators, referees and animators. 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.

2.9.08 Following the buzzer signaling the end of play, team members are not allowed to enter the field, to touch the 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 remains intact for scoring purposes. The head referee will indicate how the place the camera to validate the layout of the structure and will advise when the team members are allowed to enter the playing field.

2.9.09 The robot cannot be in contact with any object or person inside or outside of the playing field other than the GPs, the tennis ball, the Ring and the playing field itself at any point during the heat. The robot must touch the playing field at all times unless it can levitate by itself.

2.10 Tournament Progress

2.10.01 Given the current situation, the exact format of the tournament (sequence of different heats of the same team) will be announced at a later date. However, each team must prepare for the worst-case scenario, including the construction of a

playing field (at their school or another appropriate place) and remote evaluations, by video-conference, of the performance of its robot during the heats.

2.10.02 The tournament consists of 5 stages:

a. **Preliminary Round:** These heats are played throughout the day 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 on Managr (https://managr.crcrobotics.com/).

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 Survival Guide for tips and suggestions. The evaluation rubrics used by the judges to evaluate the robot design and robot construction may be found in Appendix A and Appendix B of this rulebook, respectively. The Robot Certification Form may be found in Appendix C of this rulebook.

If in doubt about the legality of a sensor, motor or servo, contact the CRC Robotics Coordination Team before using it to avoid unpleasant surprises during robot certification.

3.1 Transmission and Controls

3.1.01 Authorized Controller

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

3.1.02 Remote Control

Robots participating in INVICTA 2021 cannot be remote-controlled. They must act autonomously on the playing field, with the exception of the button press starting the robot sequence at the beginning of the heat.

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 on the robot if and only if no motor, servomotor or actuator of other type or 12V motor controller is 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 all sensors and servos powered through a controller pin.

3.2.01 Low-Voltage Sensors

Usage of any onboard sensors to give feedback to the controller is 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 pin. 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 motor, VEX EDR 2-wire 393 motor, VEX EDR 2-wire 269 motor, POWER HD 1501MG, FEETECH FS0403 and HITEC HSR-1425CR. Hundreds of different models are available on the market.

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 pin. 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. Hundreds of different models are available on the market.

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 not equipped with an internal motor controller: VEX EDR 2-wire 393 motor and VEX EDR 2-wire 269 motor. Low-voltage servo controllers must be powered through a 5V robot controller pin.

3.2.05 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-

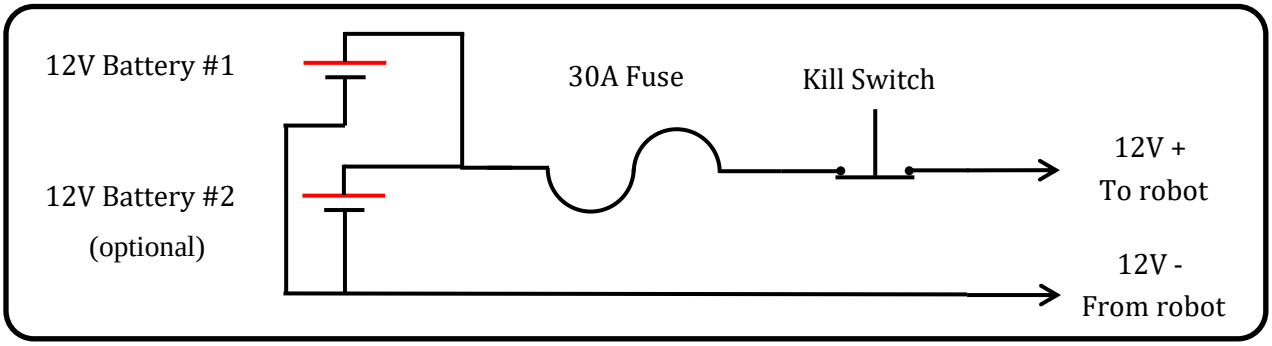
circuit when the switch is pushed down, not pulled. The kill switch that must be used on all robots is the NPB22-J, or a switch deemed equivalent by CRC Robotics.

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
Banebot Motor	RS555 and/or RS550
goBilda Motor	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 6, 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 4.

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 electrical 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 robot 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

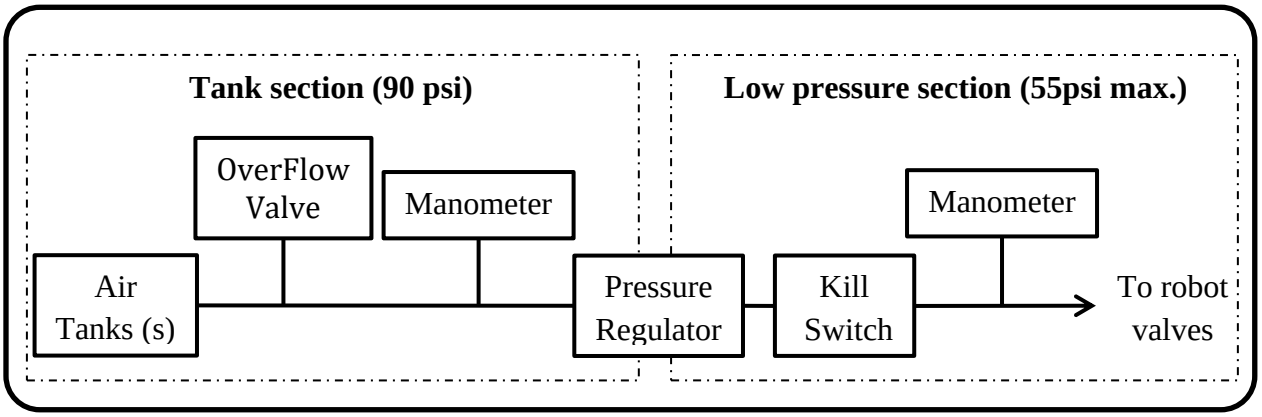
A manometer must be installed in both low- and high-pressure sections.

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 Electromagnets

Electromagnets are allowed if they are powered by the low-voltage control circuit.

3.5.08 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 60.96cm x 60.96cm (2ft x 2ft) (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 over the initial size limit. The maximum dimension limit during a heat is 137.16cm x 137.16cm (4.5ft x 4.5ft). Robots do not have to return to the initial size limits at the end of the heat but must be designed to do so without human assistance.

3.6.03 Moving Parts

Moving robot parts are allowed as long as they do not reach beyond the dimensions and height limits specified in the 2 previous rules, depending on the situation.

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 (virtually, at the Competition) in order to be judged and play a heat. Robots may be subject to random verifications during the Competition. 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 Appendix C of this rulebook for the certification criteria and safety checklist.

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 Judging

3.8.01 Language

The robot design and construction presentations to judges can be executed in the students' language of preference (English or French). However, they must be ready to answer questions asked in both official languages by the judges.

3.8.02 Judges

Preliminary and final presentations will take place virtually. The preliminary jury will be composed of existing CRC Robotics mentors and teachers. The final jury will be composed of industry experts and professionals. Details on the presentation platform will be shared closer to the Competition date.

3.8.03 Schedule

Presentations occur during the Competition. Teams will be provided with the timeslot in which they will be scheduled to present at least 1 hour before the start of each evaluation period. Only teams who advance to the finals will be advised of the timeslot for their final presentation.

3.8.04 Structure

The presentations must abide by the following structure:

Length	Action
5min	The team executes (without interruption from the judges) the robot presentation for the design or construction component, depending on the situation.
5min	The judges ask their questions to the evaluated team.
5min	The judges give feedback, rank teams, discuss and move on to the next team.

4. CRC Pitch

The CRC Pitch component requires the execution of a presentation in an extended elevator pitch format that demonstrates the team's accomplishments and obstacles overcome throughout the season to viewers 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 and selling the CRC experience to the audience. The evaluation rubric used by the judges to evaluate the CRC Pitch may be found in Appendix D of this rulebook.

4.1 Requirements

4.1.01 CRC Season Presentation

The team must present the accomplishments they have achieved and the obstacles they have overcome throughout the season and how they prepared for the Competition.

4.1.02 Team and School Description

The team must present their school and their team/sub-teams in a relevant fashion.

4.1.03 Kiosk

A physical construction or a 3D model of a kiosk may be created and used as a tool to create a more attractive CRC experience.

4.2 Judging

4.2.01 Language

The CRC Pitch presentations to judges can be executed in the students' language of preference (English or French). However, they must be ready to answer questions asked in both official languages by the judges.

4.2.02 Judges

Preliminary and final presentations will take place virtually. The jury will be composed of members of the CRC Robotics Organizing Committee. Details on the presentation platform will be shared closer to the Competition date.

4.2.03 Schedule

Presentations occur during the Competition. Teams will be provided with the timeslot in which they will be scheduled to present at least 1 hour before the start of each evaluation period. Only teams who advance to the finals will be advised of the timeslot for their final presentation.

4.2.04 Visual Support

Visual support is permitted.

4.2.05 Structure

The presentations must abide by the following structure:

Length	Action
5min	The team executes the CRC pitch (without interruption from the judges).
5min	The judges ask their questions to the evaluated team.
5min	The judges give feedback, rank teams, discuss and move on to the next team.

5. Programming

The programming component allows teams to develop and showcase their programming ability. Teams are evaluated based on their performance in the programming challenge. Refer to the Survival Guide for tips and suggestions.

5.1 Scope

5.1.01 Goal

The Programming component is intended primarily as a learning experience. Based simply on analysis and problem solving through programming, it will allow participants to learn 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 according to the best practices.

5.1.02 Challenge

Participants will face several online programming challenges in a competition in the form of "Capture the Flag" that will take place during the Competition. The link to the programming platform will be available via Managr (https://managr.crcrobotics.com/) on the first day of the Competition.

5.2 Rules

5.2.01 Final Score

The score obtained by a team in the challenge determines the team's ranking in the Programming component of the Competition.

5.2.02 Tie-Breaker Logic

The time taken to resolve the challenge in question will be the deciding factor in the event of equalities in the score. The advantage will go to the team that solved the challenge in the least amount of time.

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:

- Login to the account of opposing teams
- Break the Capture the Flag application
- Mislead another team

5.3 Judging

5.3.01 Language

Any programming language can be used to complete the challenges.

5.3.02 Evaluation

The evaluation of the outputs to each challenge will be performed by an automatic system designed to assess Capture the Flag competitions.

5.3.03 Schedule

Teams will be advised of the start and end time of the programming component on the first day of the Competition.

6. Video

The following section outlines the rules and regulations of the video component. Refer to the Survival Guide for tips and suggestions. The evaluation rubric used by the judges to evaluate the video may be found in Appendix E of this rulebook.

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 and name of this year's Competition during its run time.

6.2.02 Game Strategies

The video must explain the strategies the team has identified to overcome this year's game in an original fashion and in enough detail such that the game can be understood from an outsider's perspective.

6.2.03 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.

6.2.04 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.

6.2.05 Forbidden Content

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

6.2.06 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 the CRC Robotics Coordination Team.

6.3 Submission & Judging

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 after 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 name of this year's CRC Robotics Competition, and show a hyperlink to the following URL: www.robo-crc.ca.

6.3.04 Judges

Preliminary and final evaluations take place prior to the Competition days. The preliminary judges are members of the CRC Robotics Organizing Committee and the jury for final evaluations are composed of external field experts and professionals.

7. Website

The following section outlines the rules and regulations of the website content and design components. Refer to the Survival Guide for tips and suggestions. The evaluation rubrics used by the judges to evaluate the website design and the website content may be found in Appendix F and Appendix G of this rulebook, respectively.

7.1 Technical Requirements

7.1.01 Compatibility

The website must be device-agnostic (compatible on different devices such as desktop, mobile and tablet) and functional in 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 or better (https://www.w3.org/standards/techs/css#stds & https://jigsaw.w3.org/css-validator/) with little to no errors.

7.2 Website Content

7.2.01 Bilingualism

The website content must be fully bilingual, but English and French text should not appear on the same page simultaneously.

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 date 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 CRC Season

The website must detail the progress in each component of the CRC Robotics Competition throughout the season. Such elements are, but are not limited to:

a. the steps in the design and construction of the robot
b. conception and prototype plans and drawings
c. photos of the robot, at various stages of construction
d. the evolution of the website and video

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 and accomplished
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 the CRC Robotics Coordination Team.

7.2.09 Forbidden Content

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

7.3 Submission & Judging

7.3.01 Online Accessibility

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

7.3.02 Post-Submission Changes

Once the submission deadline has passed, the ability to make any changes to the website will be restricted.

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 after the deadline will be evaluated; however, this team will not be able to rank within the "Top 3" for the website design and 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.

7.3.05 Judges

Preliminary and final evaluations take place prior to the Competition days. The preliminary judges are members of the CRC Robotics Organizing Committee and the jury for final evaluations are composed of external field experts and professionals.

8. Tutorial

To promote the sharing of knowledge and to encourage a spirit of cooperation between the CRC Robotics Competition teams, all tutorials of adequate quality will be added to the CRC Robotics website permanently, each with credit to the team that submitted it. The following section outlines the tutorial constraints on which all submitted tutorials will be evaluated. Refer to the Survival Guide for tips and suggestions. The evaluation rubric used by the judges to evaluate the video may be found in Appendix H of this rulebook.

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 on the CRC Robotics Wiki.

8.1.02 Format

The tutorial must be a video running no more than 3 minutes, not including end credits.

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 the CRC Robotics Coordination Team.

8.1.05 Bilingualism

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

8.1.06 Copyright Law Adhesion

There must not contain copyrighted material in the tutorial video, unless the team has expressed permission from the content creator to use it in such a fashion. If the tutorial 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 tutorial video does not violate YouTube's Copyrighted Content policy.

8.1.07 Forbidden Content

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

8.2 Submission & Judging

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 tutorial. The specific URL pointing to the tutorial video's YouTube page must be provided at the time of submission. Tutorial upload must be done by the deadline. A team that submits a tutorial within a day after 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 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.

8.2.03 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.

8.2.04 Tutorial Video Description Content

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

8.2.05 Judges

Evaluations take place prior to the Competition days. The jury is composed of members of the CRC Robotics Organizing Committee.

9. Appendices

Appendix A – Robot Design Evaluation Rubric

The evaluation of a team's robot design is divided into three levels of requirements: primary, secondary, and tertiary. Primary requirements serve as a foundation for the robot design. Secondary requirements serve as a creative steppingstone. Tertiary requirements will set a team apart from the rest. The evaluation of each requirement is not point-based. Rather, the preliminary evaluation of a team's robot design is subjective, and the robot design is ranked against the design of the other robots, based on the opinion of existing CRC Robotics teachers and mentors. Similarly, the final evaluation of a team's robot design is subjective, and the robot design is ranked against the other finalists, based on the opinion of industry professionals, that act as CRC Robotics judges, and a team's final rank for the Robot Design component will be the rank assigned by the set of CRC Robotics judges.

Topic	Requirement Level	Criterion
Design & Creativity	Primary	The robot is designed to play this year's game and is able to move freely around the field in relation to the game.
	Secondary	The robot can adopt efficient game strategies.
	Secondary	The robot is designed with creative concepts, ingenious details and "out-of-the-box" thinking.
	Tertiary	The robot is efficient in terms of concept; it uses minimal resources for a maximal output.
	Tertiary	The robot's intended mechanisms are compatible with speed, stability, and precision with regards to the given overall approach.
Presentation	Primary	The team can explain how it approached this year's game, highlighting their technical expertise, team size, and challenges.
	Secondary	The team can present their design and technical drawings or prototypes in a professional and concise presentation.
	Secondary	The team can justify the thought process regarding the design of the robot and justify why they chose the final design.
	Tertiary	When faced with questions, the team can confidently answer them and defend their decisions.

Appendix B – Robot Construction Evaluation Rubric

The evaluation of a team's robot construction is divided into three levels of requirements: primary, secondary, and tertiary. Primary requirements serve as a foundation for the robot construction. Secondary requirements serve as a creative steppingstone. Tertiary requirements will set a team apart from the rest. The evaluation of each requirement is not point-based. Rather, the preliminary evaluation of a team's robot construction is subjective, and the robot construction is ranked against the construction of the other robots, based on the opinion of existing CRC Robotics teachers and mentors. Similarly, the final evaluation of a team's robot construction is subjective, and the robot construction is ranked against the other finalists, based on the opinion of industry professionals, that act as CRC Robotics judges, and a team's final rank for the Robot Construction component will be the rank assigned by the set of CRC Robotics judges.

Topic	Requirement Level	Criterion
Robot Structure	Primary	Appropriate materials are used in their proper context and the robot is robustly assembled.
	Secondary	The robot has low mechanical tolerance and is well-calibrated.
	Tertiary	The robot is reliable/resilient and can withstand multiple heats without repair.
Robot Movement	Primary	The robot's driving mechanism operates smoothly.
	Primary	The robot's ancillary systems are stable and make precise movements.
	Secondary	Utilization of motors and mechanisms are logical and appropriate for the task at hand.
	Tertiary	The robot moves with intricacy and efficiency.
Robot Maintenance	Primary	All components are easy to access.
	Primary	The electrical system is protected and accessible.
	Primary	The appropriate wire gage is used for the amperage run through the wire.
	Secondary	The wire management prevents accidental disconnect and impact.
	Secondary	The robot parts can be swapped easily.
	Tertiary	Maintenance required on the robot is minimal.
Presentation	Primary	The team can describe the build process and describe the tools that were available to them.
	Secondary	The team can justify the allocation of motors and choice of material and point out any outstanding qualities of their robot.
	Secondary	The team can present their robot in a professional and concise presentation.
	Tertiary	When faced with questions, the team can confidently answer them and defend their decisions.

Appendix C – Robot Certification Sheet and Safety Checklist

Certification: _____

School Name: _____

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:

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_____ _____

CRC Robotics Signature Team Signature

Appendix D – CRC Pitch Evaluation Rubric

The evaluation of a team's CRC Pitch is divided into three levels of requirements: primary, secondary, and tertiary. Primary requirements serve as a foundation for the pitch. Secondary requirements serve as a creative steppingstone. Tertiary requirements will set teams apart from the rest. The evaluation of each requirement is not point-based. Rather, the preliminary evaluation of a team's pitch is subjective, and the pitch is ranked against the other pitches, based on the opinion of CRC Robotics Organizing Committee members. Similarly, the final evaluation of a team's pitch is subjective, and the CRC pitch is ranked against the other finalists, based on the opinion of the CRC Robotics Organizing Committee members, and a team's final rank for the CRC Pitch component will be the rank assigned by the set of CRC Robotics judges.

Topic	Requirement Level	Criterion
Content	Primary	The information presented is organized in a logical manner.
	Secondary	The information presented is engaging and easily understandable to the public.
	Tertiary	A description of the school and the team is properly presented and relevant.
	Tertiary	A kiosk is built or designed using 3D modelling or online software in such a way that it is visually attractive to the audience.
Presentation	Primary	Students interact with the audience in a respectful and friendly way.
	Secondary	The presentation is conducted in such a way that it augments the viewer's experience (i.e. professional backdrop and formal attire).
	Tertiary	The presentation is creative, interactive and linked to the team's theme, if any.

Appendix E – Video Evaluation Rubric

The evaluation of a team's video is divided into three levels of requirements: primary, secondary, and tertiary. Primary requirements serve as a foundation for a video. Secondary requirements serve as a creative steppingstone. Tertiary requirements will set teams apart from the rest. The evaluation of each requirement is not point-based. Rather, the preliminary evaluation of a team's video is subjective, and the video is ranked against the video of the other teams, based on the opinion of CRC Robotics Organizing Committee members. Similarly, the final evaluation of a team's video is subjective, and the video is ranked against the other finalists, based on the opinion of industry professionals, that act as CRC Robotics judges, and a team's final rank for the Video component will be the rank assigned by the set of CRC Robotics judges.

Topic	Requirement Level	Criterion
Video	Primary	The length of the video does not exceed 5 minutes (excluding credits).
	Primary	The video is posted on YouTube and the video description refers to the CRC Robotics Competition, with a link pointing to the CRC Robotics website.
	Primary	The video is fully bilingual (through dialogue or subtitles, excluding YouTube's closed-captioning feature).
Content	Primary	The video includes a description of the CRC Robotics Competition and this year's game. The video visually shows the date and name of this year's Competition.
	Primary	The video includes a description of the strategies the team has identified to overcome this year's game.
	Secondary	Quality of the acting and narration.
	Secondary	Presence of a well-integrated central theme or storyline that presents the mandatory content.
	Tertiary	Entertainment value of the video based on the execution, creativity, and originality of the concept as a whole.
Technical	Primary	Quality of the base picture and audible voice.
	Primary	Presence of a basic editing and voice mixing process.
	Secondary	Creativity and mastery of the camera usage (i.e. creative angle, multi-angle filming, etc.).
	Secondary	Creative usage of sound effects, music, and other auditory cues that enrich the viewer experience and support the plot.
	Secondary	The editing process is seamless to the viewer and the flow of the video is remarkable.
	Tertiary	Creativity and mastery in the film-making process (i.e. quality of the image, original artwork, visual effects, unique music, mastery of the editing process, etc.).

Appendix F – Website Design Evaluation Rubric

The evaluation of a team's website design is divided into three levels of requirements: primary, secondary, and tertiary. Primary requirements serve as a foundation for the website design. Secondary requirements serve as a creative steppingstone. Tertiary requirements will set teams apart from the rest. The evaluation of each requirement is not point-based. Rather, the preliminary evaluation of a team's website design is subjective, and the website design is ranked against the design of the other teams, based on the opinion of CRC Robotics Organizing Committee members. Similarly, the final evaluation of a team's website design is subjective, and the website design is ranked against the other finalists, based on the opinion of industry professionals, that act as CRC Robotics judges, and a team's final rank for the Website Design component will be the rank assigned by the set of CRC Robotics judges.

Topic	Requirement Level	Criterion
Aesthetics	Primary	The overall design, including choice and combination of colors, fonts, and layout are appealing and conducive of a pleasant user experience.
	Primary	English and French text should not appear on the same page simultaneously.
	Secondary	The site structure, page structure, and menu design allow the user to find information quickly and easily.
	Secondary	The website is constructed using valid CSS 3.0 or better and validated against HTML5 Standards.
	Secondary	Proper use of CSS animations.
	Tertiary	The website uses accessibility features to make it available to people who are visually impaired (e.g. ARIA, alt attribute on img tags, etc.).
	Tertiary	Presence of user/social interaction.
Technical	Primary	There are no bugs, including, but not limited to, malformed links, missing images, or actions that cause a "500" error.
	Primary	The website is functional in both mobile and desktop versions of Google Chrome, Firefox and Safari.
	Secondary	The site's code is well-formed and validated.
	Tertiary	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).

Appendix G – Website Content Evaluation Rubric

The evaluation of a team's website content is divided into three levels of requirements: primary, secondary, and tertiary. Primary requirements serve as a foundation for the website content. Secondary requirements serve as a creative steppingstone. Tertiary requirements will set teams apart from the rest. The evaluation of each requirement is not point-based. Rather, the preliminary evaluation of a team's website content is subjective, and the website content is ranked against the content of the other teams, based on the opinion of CRC Robotics Organizing Committee members. Similarly, the final evaluation of a team's website content is subjective, and the website content is ranked against the other finalists, based on the opinion of industry professionals, that act as CRC Robotics judges, and a team's final rank for the Website Content component will be the rank assigned by the set of CRC Robotics judges.

Topic	Requirement Level	Criterion
Content	Primary	The website includes a description of the CRC Robotics Competition and this year's game. The website shows the date and name of this year's Competition.
	Primary	The website includes a description of the progress in each component of the CRC Robotics Competition throughout the season.
	Primary	Each page of the website is available in English and French.
	Primary	No grammar, syntax or spelling errors should be visible, including blatant translations performed using Google Translate or other similar services.
	Secondary	The website includes a page that presents the team members and describes their role(s).
	Secondary	Experience-driven content should be present (e.g. student experience, challenges, tutorials, interviews, vlog of season highlights, etc.).
	Secondary	Usage of pictures, schematics or any other graphic communication tools are used in a logical and sound manner.
	Secondary	The content is creatively wrapped around a compelling theme that is carried throughout all sections in a linguistic and artistic fashion.
	Tertiary	The content conveys a story in which the reader gets invested while navigating from page to page.
	Tertiary	The content inspires people to know more about the team, the CRC Robotics Competition and robotics in general.

Appendix H – Tutorial Evaluation Rubric

The evaluation of a team's tutorial is divided into three levels of requirements: primary, secondary, and tertiary. Primary requirements serve as a foundation for the tutorial. Secondary requirements serve as a creative steppingstone. Tertiary requirements will set teams apart from the rest. The evaluation of each requirement is not point-based. Rather, the evaluation of a team's tutorial is subjective, and the tutorial is ranked against the tutorial of the other teams, based on the opinion of CRC Robotics Organizing Committee members. A team's final rank for the Tutorial component will be the rank assigned by the set of CRC Robotics judges.

Topic	Requirement Level	Criterion
Technical	Primary	The tutorial is presented in a video that is no more than 3 minutes long (excluding credits) and is posted on YouTube.
	Primary	The tutorial is fully bilingual (through dialogue or subtitles, excluding YouTube's closed-captioning feature).
	Secondary	The link to the tutorial is easily visible and accessible on the team's website.
Content	Primary	The tutorial is related to one or more components of the CRC Robotics Competition.
	Primary	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.
	Secondary	Usage of pictures, schematics or any other graphic communication tools are used in a logical and sound manner.
	Tertiary	The content inspires people to know more about the topic and refers them to specific resources where they can learn more on the subject.

Appendix I – Playing Field Dimensions

Please note that all dimensions on the following playing field plan are provided in inches.