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1. THE GAME

1.1 Introduction

The Game section of the 1999 FIRST Robotics Competition Manual provides a comprehensive description of the game, playing field layout and construction, match scoring, and competition rules.

1.2 Game Description

Section 1.2 provides an overview of the 1999 FIRST Robotics Competition Game. See Appendix A for the complete list of rules.

1.2.1 Competition Structure

The competition is composed of two phases: the qualification matches and the elimination matches. For both phases, four teams will participate in each match, paired to create alliances of two teams each. An alliance will work together to try to win a match. Alliances will win or lose as a single unit. Points and/or victories will apply equally to both teams within an alliance.

Phase I: Qualification Matches

During the qualification matches, alliances will be formed just prior to the start of each match, and will last only for the duration of the match. Thus, teams will change allies after every match. All teams will play an equal number of qualification matches.

Following the conclusion of the qualification matches, the cumulative results of each team's qualification matches will be used to rank the teams. The eight highest ranked teams qualify to move on to the elimination matches.

Phase II: Elimination Matches

Prior to the start of the elimination matches, each of the eight qualifying teams will select an ally from the remaining teams. The eight alliances formed at this stage will stay together for the remainder of the elimination matches, which will be a best 2-of-3 series of elimination matches to determine the winning alliance.

1.2.2 Basic Gameplay

During a match, each alliance works to score points by positioning "floppies", their robots, and the "puck" on the playing field. Each alliance will compete using two team-built robots, four robot operators, two human players, and four coaches.

Floppies are light weight, pillow-like objects with Velcro-loop material located in its center and around its perimeter. The puck is a short, octagonal platform that rolls freely on caster wheels. Information on construction of the playing field, floppies, and puck is included in the field parts list documentation that is supplied with the manual at the Kick-Off Workshop.

Only human players and robots may directly interact with the floppies. The robots will compete within the bounds of the playing field, while the human players will be

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located at stations just outside the playing field. Basic information about the layout of the playing field is located below in Section 1.2.3.

Each match will last two minutes. In order to win a match, an alliance must score more points than the other alliance. See section 1.2.4 for information on scoring.

1.2.3 Playing Field Layout

At the start of each match, each human player station will contain three of the alliance's floppies. Four floppies per alliance will be located on the playing field. The ten floppies belonging to each alliance will be color coded to identify alliance ownership.

In addition to the floppies and robots, a puck will be located on the playing field.

The placement of teams' robot operator stations, human player stations, and starting locations of the floppies, puck, and robots are shown in Figure 1.1. Please note that Figure 1.1 may not be drawn to scale and is not intended for use during playing field construction. For playing field dimensions, please refer to the field parts list documentation that is supplied with the manual at the Kick-Off Workshop.

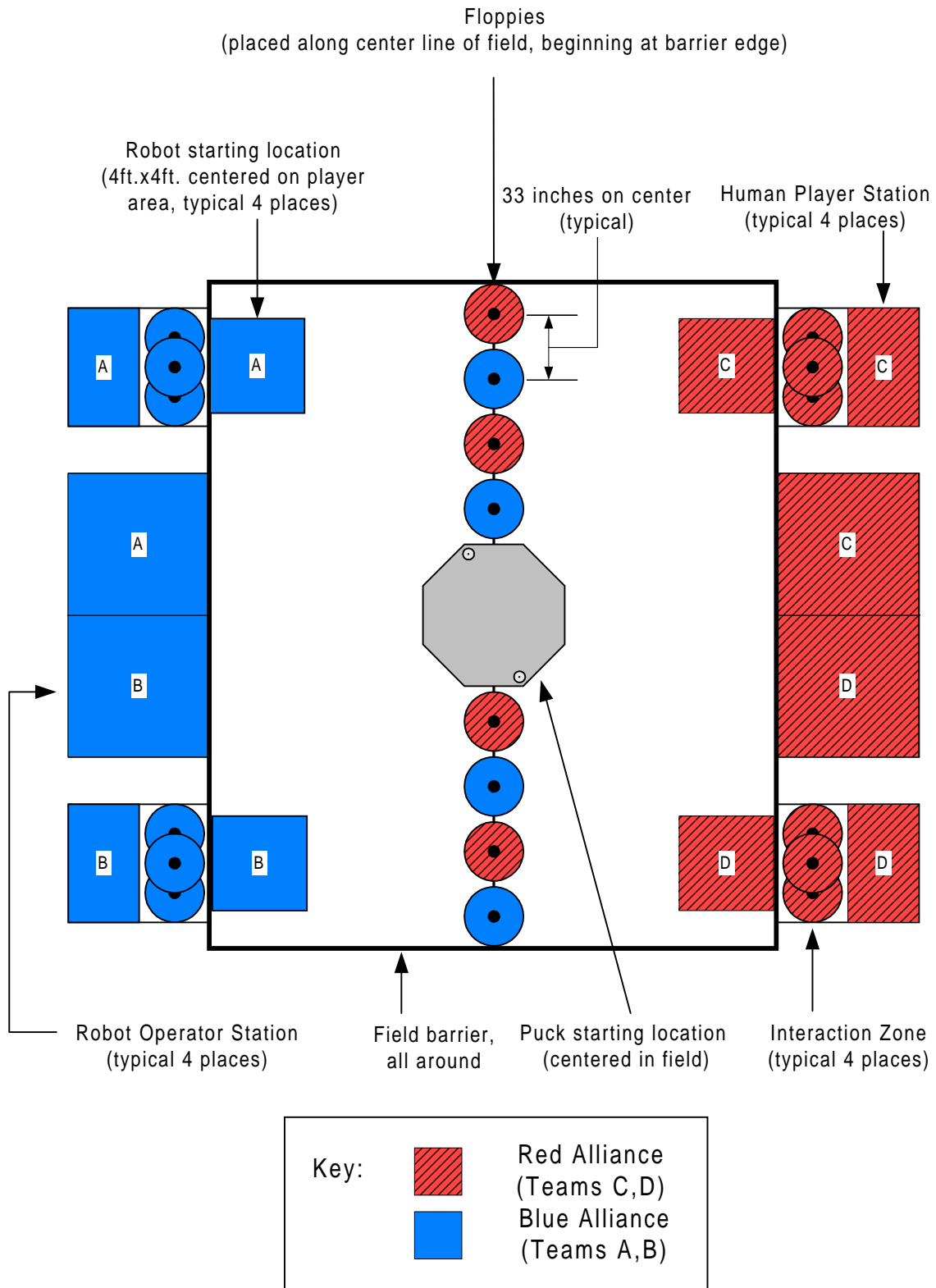


Figure 1.1: Playing Field Layout

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1.2.4 Match Scoring

At the end of each two-minute match, points will be awarded to alliances based on the criteria outlined below. The complete list of scoring and tie breaking criteria is contained in Appendix A.

Each alliance will receive one point for each of its floppies that is over the playing field, not in contact with the surface of the playing field, and less than eight feet above the surface of the playing field. Each alliance will receive three points for each of its floppies eight feet or higher over the surface of the playing field. The human player stations are not considered part of the playing field for purposes of scoring.

Figure 1.2 below illustrates floppies in various positions over the playing field and shows the point value for each floppy.

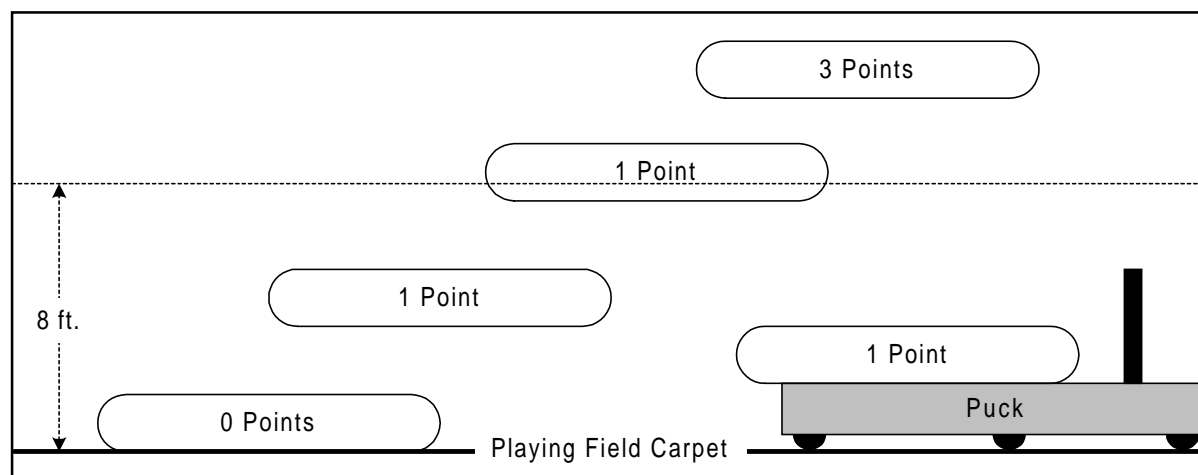


Figure 1.2: Floppy Positions and Values

Any robot on the puck will multiply its alliance's score by three.

An alliance is awarded a score multiplier of two if the puck is positioned wholly within the opposing alliance's end of the field.

All multipliers are cumulative. Thus, if an alliance had all ten floppies above eight feet, had both robots on the puck, and the puck was positioned wholly within the opposing alliance's end of the field, their score would be $30 \times 3 \times 3 \times 2$ or 540 points. Note that 540 is the highest possible score.

The alliance with the most points wins the match. Please read Appendix A for the complete list of game rules including tie breakers.

1.2.5 Qualification Point Accumulation

During the qualification matches, all teams accumulate Qualification Points (QPs) which will later be used to help rank the teams. For a given match, each team that belongs to a winning alliance will receive three times their alliance's match score in QPs. For the same match, each team that belongs to a losing alliance receives their alliance's match score in QPs.

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At the conclusion of the qualification matches, the teams will be ranked according to total QPs accumulated. Please read Appendix A for the complete list of game rules including team ranking and ranking tie breakers.

1.3 Playing Field Construction

1.3.1 Playing Field Description

The playing field is a carpeted, rectangular area with an octagonal rolling platform. Around the perimeter of the field are four stations for human players, and four stations for robot operators and coaches. Prior to the start of each match, the puck and floppies are placed in specific starting locations on the playing field and at the player stations, as shown in Figure 1.1.

FIRST requires the ceiling height at all events be a minimum of 20' above the playing field.

1.3.2 Playing Field Border

The perimeter of the field is defined by four sections forming a curb made of 4x6 lumber, and four 1x4 boards which join these sections at the human player positions. These flat boards are used to provide rigid connections between the sections of 4x6 lumber that make up the field border and allow floppies to be passed from the field into the player stations. These boards are attached to recesses in the bottom of the 4x6 border such that the 4x6 lumber is not raised off the carpet. The border assembly rests directly on the carpet.

A barrier is constructed from 1-1/4 inch diameter schedule 40 steel pipe and connecting fittings, and is mounted to the tops of the 4x6 border by pipe flanges. The exact dimensions of the various sections, the assembly, and special hardware required are shown in the field and field parts list documentation that is supplied with the manual at the Kick-Off Workshop.

1.3.3 Human Player Stations

There are four human player stations located outside the perimeter of the playing field. The player stations are located near the corners of the field as shown in Figure 1.1. The playing field barrier extends across the player station locations at the breaks in the 4x6 playing field borders at the interfaces between the field and player stations. This barrier is just high enough to allow floppies to be pushed into the player station without allowing robots in. Aside from these barriers, the player stations have no physical structure. Player station borders are represented by tape on the floor.

Each player station is 5 feet wide (parallel to the field border), and 6 feet long (extending out perpendicular to the field border). Each station is divided into two areas, the human player zone where the player can sit/stand/kneel/etc., and the interaction zone. The interaction zone extends outward from the playing field border for a distance of 3 feet. The remaining player area extends 3 feet further from the interaction zone. The exact dimensions, assembly, and locations of the human player stations are specified in the field and field parts list documentation which is supplied with the manual at the Kick-Off Workshop.

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1.3.4 Robot Operator Stations

The robot operator stations are located outside the playing field. Robot operator stations consist of a table surface supported by an arrangement of the 1-1/4 inch diameter schedule 40 steel pipe and fittings. The team's Transmitter, the associated control equipment, and safety glasses are placed on this surface. At the events, FIRST will have power supplies, RNETs and ground planes pre-mounted around the playing field. Teams will just plug their transmitter box into the RNET and power supply at whichever robot operator station they are assigned to during a match. A transparent safety shield is mounted on the field side of the station for protection of the robot operators and coaches. The borders of the robot operator stations are represented by tape on the floor. The exact dimensions and locations of the robot operator stations are shown in the field and field parts list documentation.

If a team member has a physical disability (i.e. requires the use of a wheelchair etc.), please contact FIRST prior to the events. A special shorter control station will be made available at events as required.

1.3.5 Puck Description

The puck is a carpeted octagonal platform that rolls on ten 4 inch casters. It is constructed with a 1/2 inch plywood top with narrowed 2x8 boards underneath and on the sides as braces. The braces and sides of the platform extend nearly down to the floor with a clearance of approximately 1 inch minus the thickness of the covering carpet. The carpet is wrapped from the top of the platform, over the sides, and under the bottom lip. On top of the puck, in two opposite corners, are 16 inch sections of 1-1/4 inch schedule 40 steel pipe, mounted by pipe flanges bolted to the top of the puck. The exact dimensions of the puck, the assembly, and special hardware required are shown in the field and field parts list documentation that is supplied with the manual at the Kick-Off Workshop.

1.3.6 Playing Field Notes

The carpet used for the playing field surface and puck is available from S.S. Mills, Inc. in Dalton, Georgia. Contact information for S.S. Mills, Inc. is included in the supplier contact listings in "The Robot" section of the manual. The carpet used on the playing field surface is: BR20, Code 87509, Brassfield 20/Pewter. The carpet used on the puck is also Brassfield 20, color TBD.

APPENDIX A: GAME RULES

P Game Rules of Play

- P1. At least 2 minutes prior to the start of each qualification match, teams will be randomly assigned to alliances by FIRST.
- P2. At least 2 minutes prior to the start of each match, teams will be notified of their field positions, and alliances will be assigned a unique color. This color will be used to determine the placement of the alliances' robots, human players, and robot operators & coaches around the playing field. Figure 1.1 in Section 1.2.3 shows the color-based layout of the playing field.
- P3. All teams start each competition event with zero qualification points (QPs), and accumulate QPs throughout the qualification matches. At the end of each qualification match, all teams that participated in the match receive QPs. Both teams that belong to the winning alliance receive three times their alliance's match score in QPs. Both teams that belong to the losing alliance receive their alliance's match score in QPs.
- P4. At the conclusion of the qualification matches, teams will be ranked using the following hierarchy of criteria (in order from most to least important):
 - 1. Highest number of Qualification Points.
 - 2. Highest number of matches won during qualification matches.
 - 3. Highest match score.
 - 4. Flip of a coin.
- P5. The eight highest ranked teams will qualify to advance to the elimination matches.
- P6. The eight qualified teams will select their allies from the remaining (non-qualified) teams. Selection of allies will occur starting with the highest ranked team and proceed down the rank order until eight alliances have been formed.
- P7. Teams may decline any or all offers when asked to ally for the elimination matches.
- P8. Alliances formed for the elimination matches may not be changed for the duration of the event.
- P9. Teams will be allowed a maximum of 1 minute to set up their robots on the playing field and a maximum of 1 minute to remove all robot parts from the field following a match.
- P10. Teams will be allowed at least 4 minutes before their next scheduled match.
- P11. During the elimination phase of competition, if an alliance is not ready to setup both robots on the field, the 2 minute notification period is about to expire, and they do not wish to forfeit the match, then they must inform the head referee that they are invoking a time-out. Time-outs must be called in 1

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- minute increments. The cumulative time-outs for both alliances in a match may not exceed 5 minutes. No time-outs are allowed once play has begun.
- P12. A team that is unable to field its robot may still field its human player in order to help it's ally.
- P13. During setup for each match, robots may be placed in any orientation within the designated starting area, but may not touch the field border.
- P14. During a match, five members per team (two "robot operators", two "coaches", and one "human player") are allowed in the designated areas next to the field. Special badges will be supplied by FIRST at each event and must be worn by these team members for field access.
- P15. The two robot operators and the human player must be students from a pre-college team partner school.
- P16. During a match, the robots may be operated only by the robot operators and/or by software running in the on-board control system.
- P17. The robot operators and coaches must remain at the robot operator stations during the match. They may not reach over the playing field or player stations.
- P18. Human players must remain at the player stations during a match, and may not reach over the playing field. No part of a player's body may extend past the rail that divides the field from the interaction zone.
- P19. Inside the player station, adjacent to the playing field, is a three foot interaction zone. Although this is part of the player station, players may not apply weight (stand, sit, kneel, etc.) to this portion of the player station during a match. Reaching and/or leaning over the interaction zone, such as to grab or throw floppies, is OK. See V13 for the penalties imposed for a player encroaching into the interaction zone.
- The interaction zone is intended as a safety feature to help prevent potentially dangerous contact between robots and humans. Human players must exercise caution when reaching into the interaction zone.**
- P20. Robots are allowed to extend into the player station interaction zone. Incidental contact within the interaction zone is acceptable.
- P21. No robot will be allowed to steal floppies from an opponent's player station.
- P22. A human player may choose not to return floppies to the playing field. However, any floppies which leave the player's station, such as by rolling or being pushed out of the boundaries, will be returned to the playing field near the player's station without undue delay.
- P23. A human player may retain a maximum of 3 floppies at any one time within the player station. This includes opponent alliance floppies as well as their own. Floppies thrown from one player station to another player station on the same alliance without entering the playing field are considered "at" the player station from which they originated until they reach the other player station or land out of bounds.

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- P24. Human players may use only their bodies to interact with the floppies. Special clothing and/or equipment will only be allowed for those who demonstrate a need based on a physical disability.
- P25. Each alliance will start with 3 floppies in the interaction zone of each player station, and 4 floppies on the playing field. The playing field floppies will be arranged as shown in Figure 1.1 in Section 1.2.3.
- P26. Each match will last for two minutes. It will begin when the control system is enabled and end when it is disabled, unless the match is whistled dead by the referees.
- P27. Occasionally rematches will be run should the following Control System components or other specified items supplied by FIRST be found defective:
1. Transmitter
 2. Receiver
 3. Antennas
 4. RNets
 5. Data cable for Transmitting RNet
 6. volt DC Power Supply or associated field wiring
 7. Failures in the playing field
 8. Antenna cables
 9. Data cable for Receiving RNet
- Prior to exiting the field, alliances must notify the head referee that they may request a rematch
 - Alliances will have 15 minutes after their match to ask the head referee if a rematch is justified
 - Blown fuses will not constitute a reason for a rematch
- P28. It is acceptable for a robot to block the puck to prevent another robot from climbing on.
- P29. The puck may not be intentionally overturned. However, the puck may be tilted in a manner that does not violate rule P30. Tilting the puck will not be considered a violation of rule V5 even if there are one or more robots on top of the puck.
- P30. Robots must not intentionally protrude underneath the puck. Jamming devices aimed at preventing the free motion of the puck via anything between the bottom of the puck and the field are specifically prohibited.
- P31. If the puck leaves the playing field, it will be returned to the field nearest its point of exit without undue delay.
- P32. If the puck becomes hung up on the playing field border, such that some or all of its caster wheels are no longer in contact with the playing field carpet,

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then the match will be paused while the puck is returned to a nearby position where it can roll freely.

- P33. Robots may attach to the posts on the puck, or use them as braces.

V Game Violations

- V1. Referees have ultimate authority during the competition--their rulings are final. No recorded replays of the incident will be reviewed by the referees.
- V2. If an alliance is disqualified by a referee, their robots are turned off for the remainder of the match, the human players must cease interacting with floppies at the player stations, and any points scored by the disqualified alliance during that match will be forfeited.
- V3. If a robot is disabled by a referee, the robot is turned off for the remainder of the match, and any points scored during that match will count. The human player may continue to interact with floppies at the player station. Their allies may continue to play as normal.
- V4. An alliance may not win a match through an advantage gained by breaking a rule, even accidentally.
- V5. Strategies aimed solely at the destruction, damage, tipping over, or entanglement of opponents' robots are not in the spirit of the FIRST Robotics Competition and will not be allowed. Accidental tipping over of an opponent's robot is not considered damaging and will be allowed at the discretion of the referees. Intentional stabbing, cutting, etc., is illegal. If a breach of this rule occurs the contestant's control system may be disabled by the referees.
- V6. Robot shoving will be allowed and is expected to be quite common. It is very common for machines to run into each other at full speed and get into shoving matches, and for arms and various other mechanisms to experience the resultant forces. This should be taken into consideration when robots are designed and built.
- V7. If one alliance damages another alliance's robot in an apparently malicious act, it will result in disqualification of the alliance causing the damage. However, if the damaged alliance's robot is considered too flimsy, no disqualification will occur. The ultimate determination will be made by the referees. The safest strategy is to build a tough machine and try to win with strategies and moves that may be aggressive but are not mean spirited.
- V8. Deliberately damaging the playing field, controls, or floppies is strictly illegal and will result in disqualification. Robot wheels must not, for example damage the field carpet. Rounded screw heads implanted in rubber wheels may be OK but screw points are clearly not acceptable. This will be checked during robot inspection at registration on the first event day and during the competition. Bunching up or puckering the carpet will be considered as damage to the field.
- V9. If a robot damages the playing field, barriers, floppies, or another robot, even inadvertently, and the referees feel that further damage is likely to occur, the

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- referees may decide that corrective measures (such as eliminating a sharp edge) are required to allow the robot to continue competing. The robot will not be allowed to compete until corrective action is approved by the head referee.
- V10. A robot may not contaminate the playing field, floppies, puck, or another robot with lubricants. If so, the robot will not be allowed to compete, until corrective action and approval is given by the head referee.
- V11. After a match, team members are not allowed on the playing field until referees have completed the scoring procedure.
- V12. The outer field barriers are safety features of the playing field. Robots should not be designed to react against them. Incidental contact with the barriers is acceptable. Pushing a floppy against a barrier to allow pickup of the floppy or passage of the floppy to the human player under the barrier in front of the player station is acceptable if the forces applied are not sufficient to damage the barrier or otherwise deform the playing field.
- V13. A player must remain in the player station zone during play. It is acceptable for a player to reach over the Interaction Zone. If a player applies weight to the interaction zone, referees will use a progressive scale of penalties depending on the effect of the infraction (see below). If a player steps out of the player station for reasons of personal safety, no penalty will be imposed. If a player inadvertently steps over the line, and it does not affect the outcome of the match, then they will receive a minor penalty. If stepping over the line affects the outcome of the match, such as when throwing a floppy that scores or otherwise affects the outcome, then the alliance will be disqualified. Repeated minor infractions will result in increasingly severe penalties. Penalties will be indicated by Referees throwing down flags color coded to the team receiving the penalty. See rule P8.
- Minor Penalty #1: Warning
Minor Penalty #2: Lose 1 point (prior to point multiplication)
Minor Penalty #3: Lose additional 2 points (prior to multiplication)
Minor Penalty #4: Lose additional 4 points (prior to multiplication)
Minor Penalty #5/Major penalty: Disqualification of the alliance
- V14. Robots which become entangled in the barriers or puck will not be freed until after the match has finished, unless the entanglement represents a safety hazard.
- V15. For safety reasons, no part of a robot may touch the human players. If this occurs due to an intentional act, the alliance causing the safety hazard will be disqualified. If this occurs by accident, the robot may be disabled if the referee judges the situation to be a safety hazard.
- V16. For safety reasons, no robot may launch a projectile of any sort, including floppies, toward the player stations or robot operator stations, with the following exception: It is acceptable for a robot to launch floppies, but no other types of projectiles, toward the player stations assigned to the same alliance as the robot. If a violation of this rule occurs due to an intentional act, the alliance causing the safety hazard will be disqualified. If this occurs

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- by accident, the robot causing the safety hazard will be disabled. The referees will decide whether the violation was intentional or accidental.
- V17. Robots may not release any separate part of itself during a match. They must remain whole. If the referee determines a robot has released a part of itself intentionally, the robot will be disabled.
- V18. During a match, no team member may intentionally touch any robot, except for reasons of personal safety. If this happens, the alliance will be disqualified.
- V19. During a match, no robot operator or coach may intentionally touch a floppy, except for reasons of personal safety or to pass a floppy from one player station to the other player station on the same alliance. If a violation of this rule occurs, the alliance will be disqualified.
- V20. If a robot goes out-of-bounds to the point that it has to apply force to any out-of-bounds surface to rejoin play, its control system will be disabled. A machine should not be designed to react with an out-of-bounds surface for any reason. Refer to Section 2 for playing field boundaries.
- V21. If one team moves another robot out-of-bounds, the robot out-of-bounds will be disabled for the remainder of the match.
- V22. A robot cannot inhibit the movement of another robot by pinning against a field border, the puck, etc. for more than 10 seconds. The pinning robot will be told by the referee to release the robot and back away approximately 3 feet. If the referee determines this rule to be violated the violator will be disabled.
- V23. If a robot goes out-of-bounds while holding floppies, and is turned off, the floppies that are securely held by the robot will not be returned to the playing field. This is a practical matter designed to prevent damage to the robots and/or floppies. If the floppies are easily retrieved or fall from the robot to the floor, they will be returned to the playing field.
- V24. Floppies which are knocked out-of-bounds will be placed back into play next to the field border near the exit point without undue delay. Floppies returned to play will not be fed directly to a robot or human player.
- V25. Floppies which are severely damaged will be replaced without undue delay. If a floppy is severely damaged while being held by a robot, the referees may opt to pause the match and place the replacement floppy in the hold of the robot.
- V26. It is not the responsibility of the referees or field staff if they damage trapping devices while attempting to retrieve floppies. Please design your robot so that floppies may be retrieved quickly and easily after a match is over.
- V27. No remote communication devices, such as air phones, walkie-talkies, cellular phones, etc., may be used by team members at the playing field. These devices can cause interference of remote control signals and malfunction of robots. If such devices are used, the alliance will be disqualified from that

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match and the offending team will forfeit the next match. A remote camera is allowed if specific permission is granted by FIRST.

- V28. No team may build a device, even if it is from Kit parts, to hinder the operation of another team's control system. Disabling an opponent's control system is not in the spirit of the FIRST Robotics Competition, and any alliance caught doing so will be disqualified.
- V29. Any robot which causes a safety hazard during a match will be disabled.

SC SCoring

- SC1. Final scoring will begin when all floppies come to rest or approximately 10 seconds after the match ends, or upon a referees' decision. This will allow the referees to focus on the floppies once the match has ended. Prior to this, the referees may not see all the final positions of the floppies and cannot make accurate scoring decisions. Team members will not be allowed onto the field until all scoring is complete. If a robot sags once a match ends and the power is turned off, such that a floppy moves from a scoring position to a non-scoring position, the floppy will not score. FIRST recommends that teams should consider trying to design their robots so that they will not sag when the power is turned off in order to prevent the potential loss of points.
- SC2. All decisions regarding scoring will be made by the referees.
- SC3. The winner of a match is the alliance with the highest score. If the score is tied, the tie breaking conditions listed below will be used to determine the winner.
- SC4. Final Scoring:

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1. Each alliance will receive 1 point for each of their floppies that is over the playing field, not in contact with the surface of the playing field, and less than 8 feet above the surface of the playing field. The human player stations are not considered part of the playing field for purposes of scoring. The height is measured from the carpet on the floor of the playing field to the lowest point of the floppy.
 2. Each alliance will receive 3 points for each of their floppies that is over the playing field, and a minimum of 8 feet above the surface of the playing field. The height is measured from the carpet on the floor of the playing field to the lowest point of the floppy.
 3. Any robot on the puck will multiply its alliance's score by 3. A robot is considered "on" the puck if the robot is touching the puck and is a minimum of 2 inches higher than the surface of the playing field.
 4. If the puck is entirely on one side of the dividing line which extends down the middle of the playing field, the alliance who's robot operator stations are furthest from the puck will multiply its score by 2.
 5. All multipliers are cumulative. Thus, the highest possible score is $30 \times 3 \times 3 \times 2$ or 540 points.
- SC5. In the event of a tied score the following tie breaking conditions will be applied, in the order below, until the tie is broken:
1. The alliance with the least penalties or warnings during the match.
 2. The alliance with the most robots "on" the puck.
 3. The alliance receiving the score multiplier for puck position.
 4. The alliance with the most floppies above 8 feet.
 5. The alliance with the greatest number of floppies in a scoring position.
 6. The alliance with the most opponent's floppies in their player station.
 7. The alliance with the floppy closest to the center of the puck.

S Safety Rules

- S1. Safety first. Due to the nature of the event in which electrical equipment, springs and tools are used, safety will not be compromised.
- S2. Safety glasses must be worn by all team members in the robot operator stations during matches (robot operators and coaches).
- S3. Human players must wear the provided safety helmets with face shields properly positioned during matches.
- S4. Safety glasses must be worn by team members when working on their robot in the pit area. They are also highly recommended if adjacent neighboring team(s) are working on their robot(s).
- S5. Any robot which causes a safety hazard during a match will be disabled.

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- S6. If at any time, the referees determine that a robot is likely to cause safety hazards in future matches, the robot must be modified to the referees' satisfaction or it will not be allowed to compete.
- S7. Floppies are the only projectiles that may be launched.
- S8. Latex tubing may be used for the purpose of storing energy to launch floppies so long as no more than the quantity provided in the Kit is used.
- S9. **Do not tamper with the power supply, batteries, chargers, speed controllers, joysticks, or any other control system component except as noted in the control system rules.** Tampering could result in failure or malfunction of the control system, and lead to a safety hazard or damage to the robot.
- S10. Remove the battery from the robot while making adjustments to your robot. Due to the strength of the motors in the Kit, it is important to keep fingers away from the gears while your robot is connected to a power supply.
- S11. The battery can deliver more than 100 Amperes. Do not let the wires come into contact with any metal surfaces. Route wires carefully to avoid damage and short circuits, which may cause serious burns, fire, and/or permanent destruction of the batteries.

F Notes on Playing Field Construction

- F1. All field dimensions listed under Playing Field Construction are specified on the drawings provided with the Manual.
- F2. The playing field carpet will rest directly on the floor or a protective floor covering except where otherwise noted.
- F3. The puck will rest directly on the playing field carpet.