



VEX[®]
ROBOTICS
COMPETITION
SPIN UP

2022 - 2023
Game Manual
Version 2.3

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Changelog

Version 2.3 - December 6, 2022

- Expanded the note in rule <G15> to provide clarity
- Updated rule <R7j> to remove the required width for zip ties
- Update <R7e> to provide clarity
- Added two additional examples of permitted field modifications to Appendix A
- Updated the description of the Robot Skills Challenge in Appendix B to include that all *Rollers* start with the blue side up

Version 2.2 - November 1, 2022

- Updated the definition of *Disqualification* to include *Robot Skills Matches*
- Updated <S2> to state that *Teams* will receive a *Disqualification* for coming in contact with anything outside of the field during the *Endgame* or due to an early expansion
- Updated rule <SG2> to clarify *Preload* rules
- Updated rule <SG4> to state that a *Robot* in *Violation* of the rule and that cannot rectify the situation will not receive points for tiles *Covered* in the *Endgame*
- Updated rule <SG7> to state that a *Robot* that is in possession of too many *Discs* and can't rectify the *Violation* will not receive points for tiles *Covered* in the *Endgame*
- Updated <R7e> to clarify the minimum and maximum dimensions of string
- Added a red box to <R7> to provide clarity
- Updated <R17> to clarify intent
- Updated the Red Box in <RSC3> to provide clarity

Version 2.1 - October 4, 2022

- Updated <SG5> to include *Robots* momentarily driving over a *Disc*
- Updated <SG9b> to provide clarity for *Discs* that exit the field through the bottom of the *Net*
- Updated <R20c> to provide clarity
- Updated Appendix B to include Robot Skills Challenge Rankings for League Events
- Updated <RSC3> to clarify that all *Goals* are considered to belong to the same "neutral" *Alliance* in *Robot Skills Matches*
- Added a new rule, <RSC7>, to clarify the *Endgame* in *Robot Skills Matches*
- Updated <VUG7a> to clarify VEX U *Student* eligibility
- Updated <VUR9>, <VUR10>, and <VUR12> to provide clarity
- Minor typo fixes

Version 2.0 - August 2, 2022

- Added a note to <SG9> stating that most instances of a single *Disc* exiting the field are incidental, and should not be considered a Major Violation
- Updated <R15a> to include "unless otherwise noted in <R6c>"
- Updated <R20> clarify intent of legal motor modifications
- Updated the verbiage of <T24>, and added a new bullet stating that replacing opaque field walls with transparent walls is prohibited
- Updated Appendix A with a Permitted Field Modification to address *Low Goal Barriers* moving
- Added rules for Live Remote Skills to Appendix B
- Updated <VUR9> clarify intent of legal motor modifications

Version 1.1 - July 19, 2022

- Updated Appendix A to include Permitted Field Modifications
- Added a new line to the red box of <R11> stating that all mentioned specific dimensions are intended to be nominal references

Version 1.0 - June 28, 2022

- Updated the Red Box of <G3> to include Robot Rules
- Updated <G15> to clarify that there are no penalties for Traps which begin during the *Endgame*
- Updated <SG5> to clarify that there are no vertical expansion limits during the *Endgame*
- Added a new bullet to <SG5>, stating that *Robots* may not contact the *High Goal*, *Scored Discs* in the *High Goal*, or any *High Goal* supporting structures
- Updated <R3b> to state that *Robots* must be inspected in the same configuration in which they will play *Matches*
- Updated <R3e> to provide clarity for *Head Referees*
- Added a bullet to <R4> regarding safety risks towards humans
- Added a red box to <R4> regarding *Entanglement* risks
- Updated <R6> to clarify V5 Workcell and Cortex legality
- Updated <R7> to provide more detail regarding legal pneumatics
- Added two bullets to <R9> to clarify intent
- Updated <R11> to clarify intent of legal fasteners
- Updated <R13> to clarify intent
- Added a Red Box to <T8> to provide clarity for *Head Referees*
- Added a new figure to <T18> to provide clarity
- Updated <RSC2> to allow *Match Load Discs* in *Programming Skills Matches*
- Added a note to <VUR1> to state that <SG4> and <SG5> apply to both *Robots*
- Minor typo fixes

Version 0.2 - June 14, 2022

- Updated links for the Code of Conduct and Student-Centered Policy
- Updated the weight in the definition of *Disc*, to match Appendix A (± 20 grams)
- Updated <VUR7> to include spacers, standoffs and bushings
- Minor typo fixes

Version 0.1 - May 5, 2022

- Initial Release

Quick Reference Guide

Scoring Rules (Pages 18-22)

<SC1>	All Scoring statuses are evaluated immediately after the <i>Match</i> ends.
<SC2>	Scored in the <i>High Goal</i> criteria.
<SC3>	Scored in the <i>Low Goal</i> criteria.
<SC4>	<i>Owned Roller</i> criteria.
<SC5>	<i>Covered field tile</i> criteria.
<SC6>	<i>Autonomous Bonus</i> and <i>Autonomous Win Point</i> .

Safety Rules (Page 23)

<S1>	Be safe out there.
<S2>	Stay inside the field.
<S3>	Wear safety glasses.

General Game Rules (Pages 24-30)

<G1>	Treat everyone with respect.
<G2>	VRC is a student-centered program.
<G3>	Use common sense.
<G4>	<i>Robots</i> begin the <i>Match</i> in the starting volume.
<G5>	Keep your <i>Robots</i> together.
<G6>	The <i>Robot</i> must represent the skill level of the <i>Team</i> .
<G7>	Only <i>Drive Team Members</i> , and only in the <i>Alliance Station</i> .
<G8>	Controllers must stay connected to the field.
<G9>	Hands out of the field.
<G10>	Autonomous means "no humans".
<G11>	All rules still apply in the <i>Autonomous Period</i> .
<G12>	Don't destroy other <i>Robots</i> . But, be prepared to encounter defense.
<G13>	Offensive <i>Robots</i> get the "benefit of the doubt."
<G14>	You can't force an opponent into a penalty.
<G15>	No <i>Trapping</i> for more than 5 seconds.
<G16>	Don't clamp your <i>Robot</i> to the field.
<G17>	Use <i>Discs</i> to play the game.

Specific Game Rules (Pages 31-37)

<SG1>	Starting a <i>Match</i> .
<SG2>	<i>Robots</i> get two <i>Preloads</i> .
<SG3>	Stay away from the <i>Net</i> .
<SG4>	Horizontal expansion is limited until the <i>Endgame</i> .
<SG5>	Vertical expansion is limited.
<SG6>	<i>Match Load Discs</i> may be safely introduced during the <i>Match</i> under certain conditions.
<SG7>	<i>Possession</i> is limited to three (3) <i>Discs</i> .
<SG8>	Don't cross the <i>Autonomous Line</i> .
<SG9>	Keep <i>Discs</i> in the field.

Robot Rules (Pages 38-50)

<R1>	One <i>Robot</i> per <i>Team</i> .
<R2>	<i>Robots</i> must represent the <i>Team's</i> skill level.
<R3>	<i>Robots</i> must pass inspection.
<R4>	<i>Robots</i> must be safe.
<R5>	<i>Robots</i> must fit in a sizing box.
<R6>	<i>Robots</i> are built from the VEX V5 system.
<R7>	Certain non-VEX components are allowed.
<R8>	Give the radio some space.
<R9>	A limited amount of custom plastic is allowed.
<R10>	A limited amount of tape is allowed.
<R11>	Certain non-VEX fasteners are allowed.
<R12>	Decorations are allowed.
<R13>	New VEX parts are legal.
<R14>	<i>Robots</i> have one microcontroller.
<R15>	<i>Robots</i> use VEXnet.
<R16>	Motors are limited.
<R17>	Pneumatics are limited.
<R18>	Electrical power comes from VEX batteries only.
<R19>	One or two Controllers per <i>Robot</i> .
<R20>	No modifications to electronic components or pneumatics are allowed.
<R21>	Custom V5 Smart Cables are allowed.
<R22>	Most modifications to non-electrical components are allowed.
<R23>	Keep the power button accessible.
<R24>	Officially registered <i>Team</i> numbers must be displayed on <i>Robot</i> license plates.
<R25>	Use a "Competition Template" for programming.
<R26>	There is a difference between accidentally and willfully violating a <i>Robot</i> rule.
<R27>	Let go of <i>Discs</i> after the <i>Match</i> .

Tournament Rules (Pages 54-63)

<T1>	The <i>Head Referee</i> has ultimate and final authority on all gameplay ruling decisions during the competition.
<T2>	<i>Head Referees</i> must be qualified.
<T3>	The Drive Team is permitted to immediately appeal the <i>Head Referee's</i> ruling.
<T4>	The <i>Event Partner</i> has ultimate authority regarding all non-gameplay decisions during an event.
<T5>	A <i>Team's Robot</i> and / or <i>Drive Team Member</i> should attend every <i>Match</i> .
<T6>	<i>Robots</i> at the field must be ready to play.
<T7>	<i>Match</i> replays are allowed, but rare.
<T8>	The red <i>Alliance</i> places last.
<T9>	<i>Qualification Matches</i> follow the <i>Match Schedule</i> .
<T10>	<i>Qualification Matches</i> will be scheduled as follows.
<T11>	<i>Qualification Matches</i> contribute to a <i>Team's</i> ranking as follows.
<T12>	<i>Qualification Match</i> tiebreakers.
<T13>	<i>Disqualifications</i> .
<T14>	Send a <i>Student</i> representative to <i>Alliance Selection</i> .
<T15>	Each <i>Team</i> may only be invited once to join an <i>Alliance</i> .
<T16>	<i>Elimination Matches</i> follow the <i>Elimination Bracket</i> .
<T17>	Each <i>Elimination Alliance</i> gets one Time Out.
<T18>	<i>Elimination Matches</i> are a blend of "Best of 1" and "Best of 3."
<T19>	Small tournaments may have fewer <i>Alliances</i> .
<T20>	<i>Students</i> must be accompanied by an <i>Adult</i> .
<T21>	Fields at an event must be consistent with each other.
<T22>	There are three types of field control that may be used.
<T23>	There are two types of field perimeter that may be used.
<T24>	Fields may be repaired at the <i>Event Partner's</i> discretion.
<T25>	Be prepared for minor field variance.

Robot Skills Challenge Rules (Pages B3-B4)

<RSC1>	<i>Robots</i> may start the <i>Robot Skills Match</i> in any legal starting location for either <i>Alliance</i> .
<RSC2>	The <i>Team</i> may utilize fourteen (14) <i>Match Load Discs</i> .
<RSC3>	<i>Teams</i> play as if they are on a "neutral" <i>Alliance</i> .
<RSC4>	<i>Robots</i> must have moved to receive points for <i>Covering</i> field tiles.
<RSC5>	<i>Rollers</i> are considered <i>Owned</i> if they are <i>Owned</i> by the red <i>Alliance</i> .
<RSC6>	No requirement that Skills Challenge fields be consistent with Head-to-Head fields.
<RSC7>	The <i>Endgame</i> can begin early in <i>Robot Skills Matches</i> .

VEX U Game Rules (Page C2)

<VUG1>	VEX U Matches will be played 1-Team vs. 1-Team. Each Team will use two (2) Robots.
<VUG2>	Qualification Matches will be conducted in the same manner as in a VRC tournament.
<VUG3>	Elimination Matches will be conducted without an Alliance Selection.
<VUG4>	The Autonomous Period will be 45 seconds (0:45).
<VUG5>	The Driver Controlled Period is shortened to 75 seconds (1:15).
<VUG6>	Each Robot is allowed up to three (3) Drive Team Members in the Alliance Station.
<VUG7>	VEX U Student eligibility.

VEX U Robot Rules (Pages C3-C6)

<VUR1>	Teams must build two (2) Robots.
<VUR2>	Teams may use any official VEX Robotics products, other than the exceptions listed.
<VUR3>	Fabricated Parts may be made using the following processes.
<VUR4>	Fabricated Parts must be made from raw materials.
<VUR5>	Any Fabricated Parts must be accompanied by documentation.
<VUR6>	Teams may use commercially-available springs on their Robots.
<VUR7>	Teams may use any commercially available fastener on their Robot.
<VUR8>	Each Robot must utilize exactly one (1) V5 Robot Brain and (1) V5 Robot Radio.
<VUR9>	There is no restriction on the number of V5 Smart Motors that Robots may use.
<VUR10>	There is no restriction on sensors and other additional electronics that Robots may use.
<VUR11>	No radio communication is allowed between Robots.
<VUR12>	Teams may utilize an unlimited amount of the following pneumatic components.

VEX U Robot Skills Rules (Pages C7)

<VURS1>	Each Robot must use its two (2) Discs available as Preloads, or add them to Match Load Discs.
<VURS2>	Both Robots must start on the same side of the field, and all Drive Team Members must stand in the corresponding Alliance Station

Section 1

Introduction

Overview

This section provides an introduction to the VEX Robotics Competition (VRC) and VRC Spin Up.

The VEX Robotics Competition

Our world faces a serious problem. It's a problem that, without explicit and intentional action, will eventually stagnate global progress and lead to a workforce that is unmotivated and ill-equipped to solve its future problems. As the world grows more technologically complex, the challenges we face every day will continue to escalate along with it. A cell phone has more failure modes than a landline. The internals of an electric vehicle are more difficult to comprehend than a V8 combustion engine. Unmanned drone legislation is more nuanced than defining a maximum speed limit.

Dubbed "the STEM problem," the situation is simple to understand, yet difficult to solve. In many cases, the traditional methods of teaching science, technology, engineering, and math (STEM) will not be enough to adequately prepare students for this complex world. This is often coupled with the unfortunate reality that by the time they reach an age capable of grasping these critical topics, students may have already determined that they are "not cool" or "boring." Without the skills or passion necessary to approach these problems in an educated manner, you cannot possibly expect to be productive in making forward progress or even sustaining the status quo.

The VEX Robotics Competition exists to solve this problem. Through its uniquely engaging combination of teamwork, problem solving, and scientific discovery, the study of competitive robotics encompasses aspects of STEM. You're not building VEX robots because your future job will involve tightening shaft collars on a metal bar - you're executing an engineering design and problem-solving process that resembles

the mindset used by rocket scientists, brain surgeons, and inventors around the world. VEX Robotics Competition Spin Up is not just a game that we invented because it is fun to play - it is a vehicle for teaching (and testing) teamwork, persevering in the face of hardship, and practicing a methodology to approach and solve new challenges with confidence.

Contained in this manual are the rules that shape VRC Spin Up. These rules are designed to simulate the constraints that will outline any real-world project. They are intended to promote creativity without punishing innovation. They are balanced to promote fair play while encouraging competition.

We encourage you to keep in mind that a VEX Robotics Competition game is more than just a set of game objects worth varying amounts of points. It is an opportunity to hone the life-long skills that will characterize the problem-solving leaders of tomorrow.

Good luck, and we'll see you on the playing field!

Sincerely,

The VEX Robotics Game Design Committee (GDC), composed of members from the Robotics Education & Competition Foundation, DWAB Technology, and VEX Robotics

VEX Robotics Competition Spin Up: A Primer

VEX Robotics Competition Spin Up is played on a 12'x12' square field, set up as illustrated below and in figures throughout this game manual.

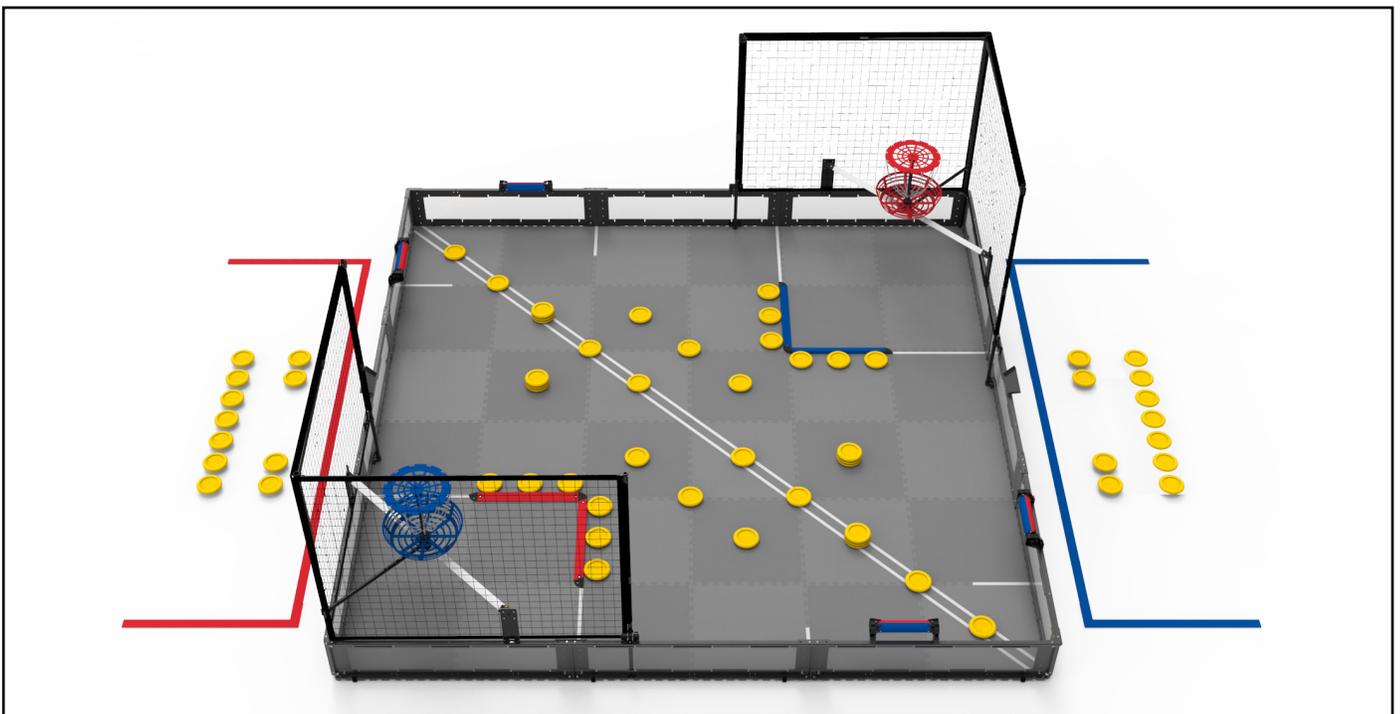
In Head-to-Head Matches, two (2) *Alliances* - one (1) "red" and one (1) "blue," composed of two (2) *Teams* each - compete in *Matches* consisting of a fifteen-second (0:15) *Autonomous Period* followed by a one minute and forty-five-second (1:45) *Driver Controlled Period*.

The object of the game is to attain a higher score than the opposing *Alliance* by Scoring *Discs* in *Goals*, *Owning Rollers*, and *Covering* field tiles at the end of the *Match*.

An *Autonomous Win Point* is awarded to any *Alliance* that *Owns* two *Rollers* and has *Scored* at least two *Discs* in the *High Goal* at the end of the *Autonomous Period*.

An *Autonomous Bonus* is awarded to the *Alliance* that has the most points at the end of the *Autonomous Period*.

Teams may also compete in *Robot Skills Matches*, where one (1) *Robot* tries to score as many points as possible. See Appendix B for more information.



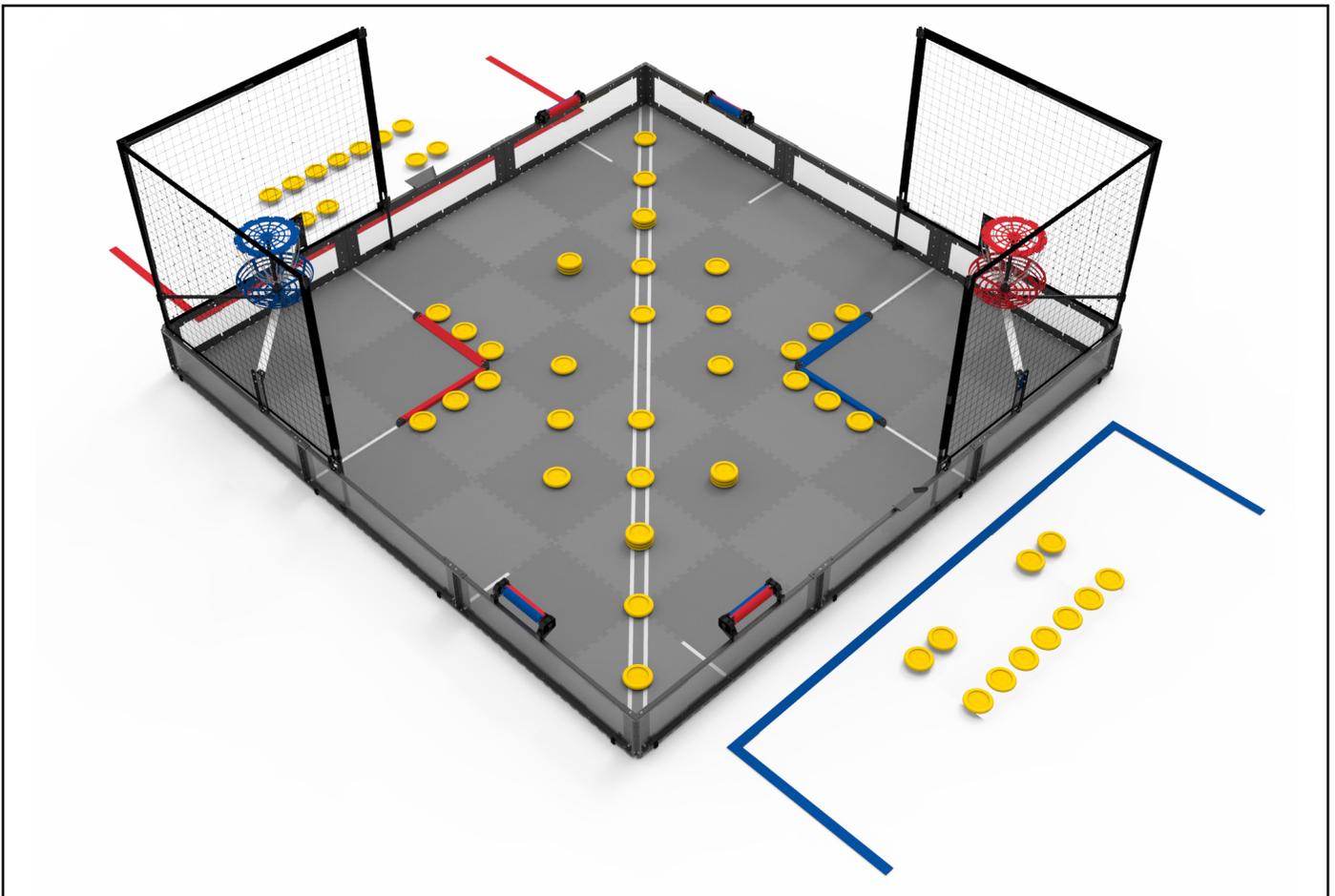
About the Game Manual - A Note from the GDC

This Game Manual and its appendices contain everything there is to know about this season's game, VRC Spin Up. It is intended to be a resource for all *Teams*, *Head Referees*, *Event Partners*, and other members of the VRC community.

The rules contained in the following pages can be thought of as "constraints" that define this game, just as engineers begin any design project by defining their constraints. At the beginning of a season, "constraints" are all we have. We don't know what the winning *Robot*, best strategy, or most frequently-violated rule will be any more than you do. Isn't that exciting?

When exploring a new game, please approach this Game Manual with that mentality and look at rules as "constraints." The Game Manual and its appendices contain the full and complete list of constraints that are available for a competitor to strategize, design, and build their *Robots*.

Obviously, all *Teams* must adhere to these rules, and any stated intents of these rules. However, beyond that, there is no "right" way to play. There are no hidden restrictions, assumptions, or intended interpretations beyond what is written here. So, it is up to you, the competitor, to find the path through these constraints that best suits your team's goals and ambitions.



Updates

This manual will have a series of “major” and “minor” updates over the course of the season. Each version is official and must be used in official VRC events until the release of the next version, upon which the previous version becomes void.

Known release dates are as follows:

May 5, 2022	Version 0.1	Initial game release
May 31, 2022	(N/A)	Official Q&A system opens
June 14, 2022	Version 0.2	Minor typographical errors or formatting issues found in the initial release; very few rule changes, if any
June 28, 2022	Version 1.0	May include critical gameplay or rule changes inspired by input from the official Q&A system and the VEX community
July 19, 2022	Version 1.1	Unscheduled update
August 2, 2022	Version 2.0	May include gameplay or rule changes inspired by early-season events
October 4, 2022	Version 2.1	Clarification update only
November 1, 2022	Version 2.2	Unscheduled update
December 6, 2022	Version 2.3	Clarification update only
January 31, 2023	Version 3.0	May include gameplay or rule changes inspired by mid-season events
April 4, 2023	Version 4.0	May include critical gameplay or rule clarifications pertaining specifically to the VEX Robotics World Championship

In addition to these known major updates, there may also be unscheduled updates released throughout the season if deemed critical by the VEX GDC. **Any unscheduled updates will always be released on a Tuesday, no later than 5:00 PM CST (11:00 PM GMT).** These updates will be announced via the VEX Forum, automatically pushed to the VRC Hub app, and shared via VEX Robotics / REC Foundation social media & email marketing channels.

Game Manual updates are effective immediately upon release; it is every *Team’s* responsibility to be familiar with all rules and updates. There are no “grace periods” if an update prohibits a previously legal part, mechanism, or strategy.

Note: REC Foundation Event Support Managers will contact Event Partners involved with multi-week league events that “cross over” an unscheduled update. If a rule change impacts their event (such as a Robot which previously passed inspection no longer being legal), these cases will be reviewed individually depending on the context of the event and the rule that has changed. This is the only possible “grace period” exception.

Questions?

When first reviewing a new robotics game, it is natural to have questions about situations which may not be immediately clear. Navigating the Game Manual and seeking out answers to these questions is an important part of learning a new game. In many cases, the answer may just be in a different place than you first thought - or, if there is no rule explicitly prohibiting something, then that usually means it is legal!

However, if a *Team* is still unable to find an answer to their question after closely reviewing the relevant rules, then every *Team* has the opportunity to ask for official rules interpretations in the VEX Robotics Question & Answer (Q&A) System.

All responses in this Q&A system should be treated as official rulings from the VEX Robotics Game Design Committee, and they represent the correct and official interpretation of the VEX Robotics Competition Rules. The Q&A system is the only source besides the Game Manual for official rulings and clarifications.

The VRC Challenge Q&A System can be found at <https://www.robotevents.com/VRC/2022-2023/QA>.

Before posting on the Q&A system, be sure to review the Q&A Usage Guidelines, which can be found at <https://www.robotevents.com/VRC/2022-2023/QA/guidelines>.

In brief:

1. Read and search the manual before posting.
2. Read and search existing Q&As before posting.
3. Quote the applicable rule from the latest version of the manual in your question.
4. Make a separate post for each question.
5. Use specific and appropriate question titles.
6. Questions will (mostly) be answered in the order they were received.
7. This system is the only source for official rules clarifications.

If there are any conflicts between the Game Manual and other supplemental materials (e.g., Referee Certification courses, the VRC Hub app, etc.), the most current version of the Game Manual takes precedence.

Similarly, it can never be assumed that definitions, rules, or other materials from previous seasons apply to the current game. Q&A responses from previous seasons are not considered official rulings for the current game. Any relevant clarifications that are needed should always be re-asked in the current season's Q&A.

Section 2

The Game

Overview

This section describes the 2022-23 VEX Robotics Competition game entitled VEX Robotics Competition Spin Up. It also lists the game definitions and game rules.

Game Description

Matches are played on a field set up as illustrated below and in figures throughout this game manual. Two *Alliances* one "red" and one "blue," - composed of two *Teams* - each compete in each *Match*. The object of the game is to attain a higher score than the opposing *Alliance* by *Scoring Discs*, *Owning Rollers*, and *Covering* field tiles at the end of the *Match*.

An *Autonomous Win Point* is awarded to any *Alliance* that *Owns* two (2) *Rollers* and has *Scored* at least two (2) *Discs* in their *Alliance-colored High Goal* at the end of the *Autonomous Period*.

An *Autonomous Bonus* is awarded to the *Alliance* that has the most points at the end of the *Autonomous Period*.

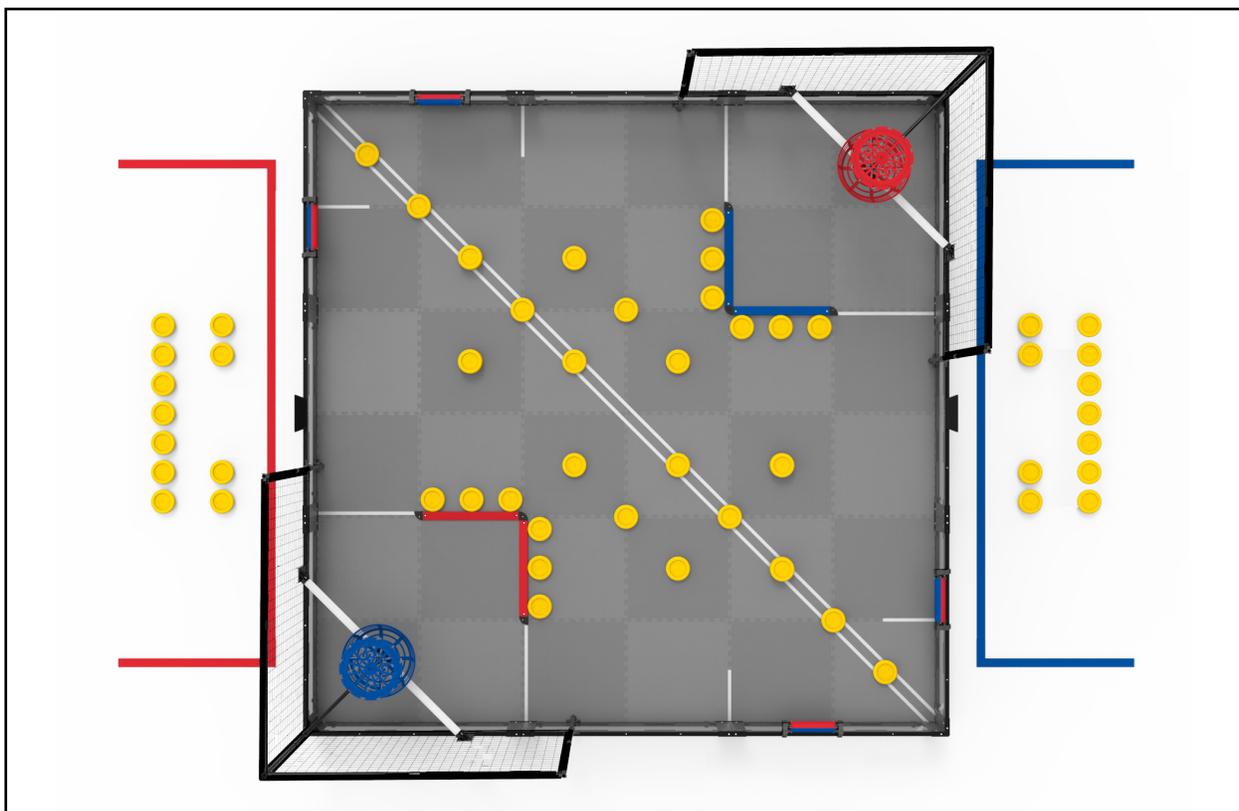


Figure 1: Top view of the field in its starting configuration

Note: The illustrations in this section of the manual are intended to provide a general visual understanding of the game. Teams should refer to official field specifications, found in Appendix A, for exact field dimensions, a full field bill of materials, and exact details of field construction.

Field Overview

The VEX Robotics Competition Spin Up field consists of the following:

- Sixty (60) *Discs*
 - Eight (8) that begin as *Preloads*, four (4) per *Alliance*
 - Fourteen (14) that are used as *Match Load Discs*, seven (7) per *Alliance*
 - Thirty-eight (38) that begin on the Field
- Four (4) *Rollers*
- Two (2) *High Goals*, one per *Alliance*
- Two (2) *Nets*, one behind each *High Goal*
- Two (2) *Loaders*, one in front of each *Alliance Station*

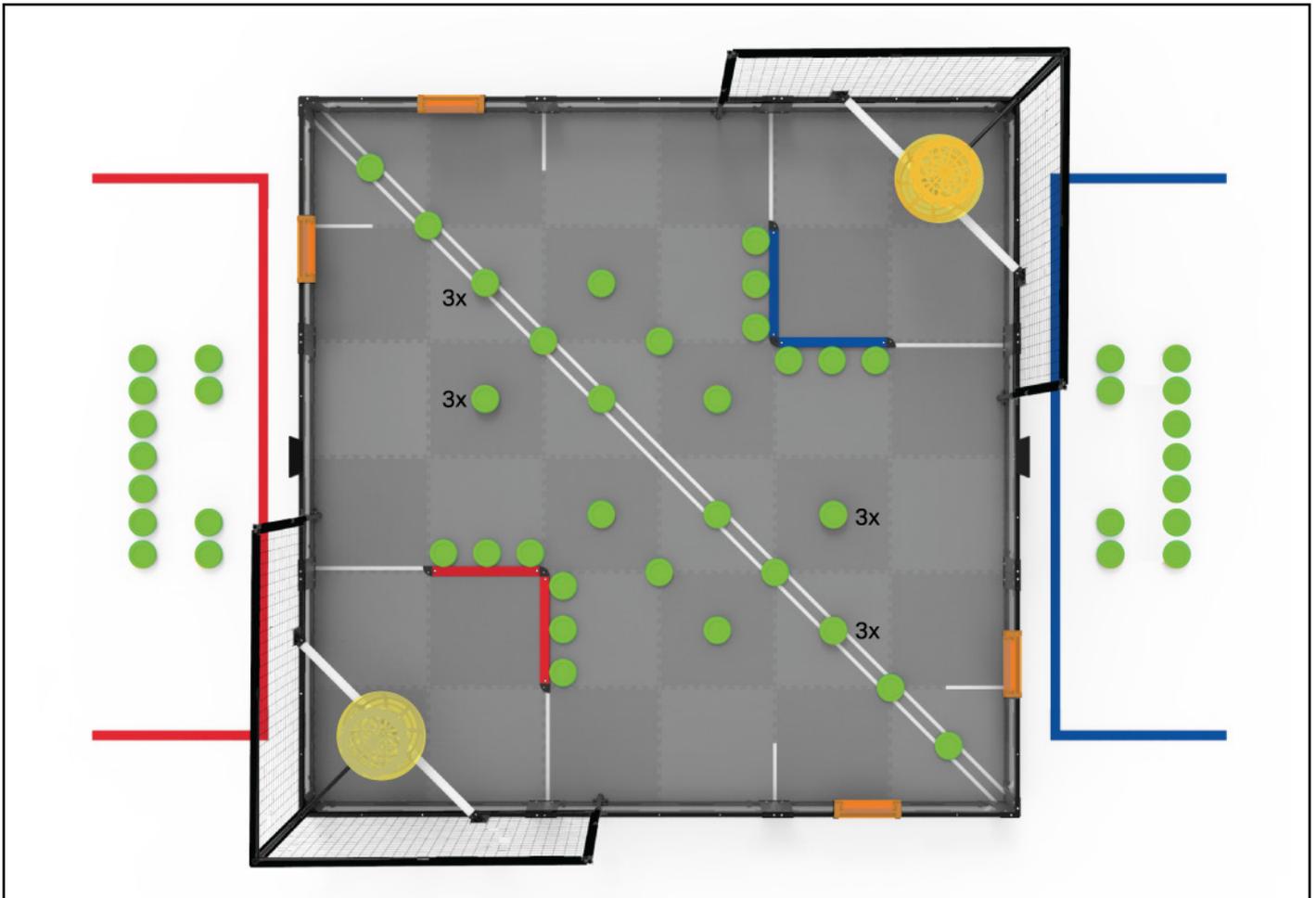


Figure 2: Top view of the field with highlighted Discs (green), High Goals (yellow), and Rollers (orange).
Stacks containing (3) discs are marked accordingly.

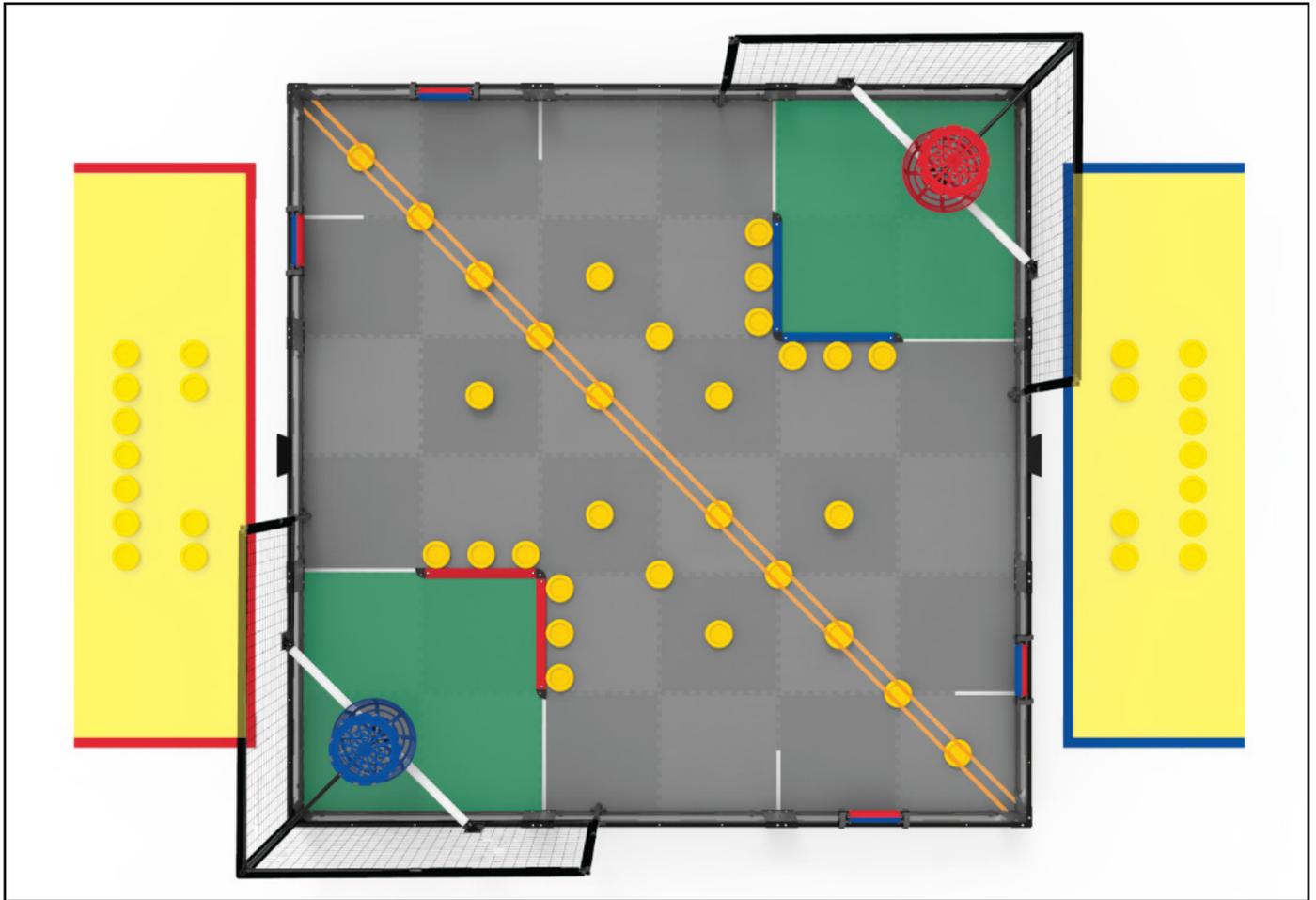


Figure 3: Top view of the field with highlighted Alliance Stations (yellow), Low Goals (green), and the Autonomous Line (orange).

General Definitions

Adult - Anyone who is not a *Student*.

Alliance - A pre-assigned grouping of two (2) *Teams* that are paired together during a given *Match*.

Alliance Station - The designated regions where the *Drive Team Members* must remain for the duration of the *Match*.

Autonomous Bonus - A point bonus awarded to the *Alliance* that has earned the most points at the end of the *Autonomous Period*. See <SC6> for more information.

Autonomous Win Point - A bonus awarded to any *Alliance* that has completed a defined set of tasks at the end of the *Autonomous Period* of a *Qualification Match*. See <SC6> for more information.

Disablement - A penalty applied to a *Team* for a rule *Violation*. A *Team* that is Disabled is not allowed to operate their *Robot* for the remainder of the *Match*, and the *Drive Team Member(s)* will be asked to place their controller(s) on the ground.

Disqualification - A penalty applied to a *Team* for a rule *Violation*. A *Team* that receives a *Disqualification* in a *Qualification Match* receives zero (0) *Win Points*, *Autonomous Win Points*, *Autonomous Points*, and *Strength of Schedule Points*. When a *Team* is Disqualified in an *Elimination Match*, the entire *Alliance* is Disqualified and they receive a loss for the *Match*. At the *Head Referee's* discretion, repeated *Violations* and / or *Disqualifications* for a single *Team* may lead to its *Disqualification* for the entire tournament. (See <T13>). A *Team* that receives a *Disqualification* in a *Driving Skills Match* or *Programming Skills Match* receives a score of zero (0) for that *Robot Skills Match*.

Drive Team Member - A *Student* who stands in the *Alliance Station* during a *Match*. *Adults* are not allowed to be *Drive Team Members*. See rules <G7>, <G8>, and <G9>.

Entanglement - A *Robot* status. A *Robot* is Entangled if it has grabbed, hooked, or attached to an opposing *Robot* or a *Field Element*. See rules <G12> and <SG3>.

Field Element - All elements that make up the field, including the foam field tiles, field perimeter, white tape, *High Goals*, *Nets*, *Rollers*, *Barriers*, and all supporting structures and accessories (such as *Alliance Station* posts, field monitors, etc.).

Game Design Committee (GDC) - The creators of VRC Spin Up, and authors of this Game Manual.

Match - A set time period, consisting of Autonomous and / or *Driver Controlled Periods*, during which *Teams* play a defined version of Spin Up to earn points. See Section 4.

- **Autonomous Period** - A time period during which *Robots* operate and react only to sensor inputs and commands pre-programmed by the *Students* into the *Robot* control system.
- **Driver Controlled Period** - A time period during which *Drive Team Members* operate their *Robot* via remote control.

Match Type	Participants	Pertinent Rules	Autonomous Period (m:ss)	Driver Controlled Period (m:ss)
Head-to-Head	Two <i>Alliances</i> (red / blue), each composed of two <i>Teams</i> with one <i>Robot</i> each	Sections 2-4	0:15	1:45
Driver Skills Challenge	One <i>Team</i> , with one <i>Robot</i>	Appendix B	None	1:00
Programming Skills Challenge	One <i>Team</i> , with one <i>Robot</i>	Appendix B	1:00	None
VEX U	Two <i>Teams</i> (red / blue), with two <i>Robots</i> each	Appendix C	0:45	1:15

Robot - A machine that has passed inspection, designed to execute one or more tasks autonomously and / or by remote control from a *Drive Team Member*.

Student - A person is considered a *Student* if they meet both of the following criteria:

1. Anyone who is earning or has earned credit toward a high school diploma, certificate, or other equivalent during the six (6) months preceding the VEX Robotics World Championship. Courses earning credits leading up to high school would satisfy this requirement.
 2. Anyone born after May 1, 2003 (i.e., who will be 19 or younger at VEX Worlds 2023). Eligibility may also be granted based on a disability that has delayed education by at least one year.
- **Middle School Student** - A *Student* born after May 1, 2007 (i.e., who will be 15 or younger at VEX Worlds 2023). A *Middle School Student* may "play up" and compete as a *High School Student*.
 - **High School Student** - Any eligible *Student* who is not a *Middle School Student*.

Team - One or more *Students* make up a *Team*.

- A *Team* is classified as a Middle School *Team* if all members are *Middle School Students*.
- A *Team* is classified as a High School *Team* if any of its members are *High School Students*, or if the *Team* is made up of *Middle School Students* who declare themselves "playing up" as *High School Students* by registering their *Team* as a High School *Team*.
- Once declared and playing as a High School *Team*, that *Team* may not change back to a Middle School *Team* for the remainder of the season. *Teams* may be associated with schools, community / youth organizations, or groups of neighborhood *Students*.

In the context of this Game Manual, *Teams* include three *Student* roles related to *Robot* assembly, design, and programming. See <G2> and <G6> for more information. *Adults* may not fulfill any of these roles.

- **Builder** - The *Student(s)* on the *Team* who assemble(s) the *Robot*. *Adults* are permitted to teach the *Builder(s)* how to use concepts or tools associated with *Robot* construction, but may never work on the *Robot* without the *Builder(s)* present and actively participating.
- **Designer** - The *Student(s)* on the *Team* who design(s) the *Robot*. *Adults* are permitted to teach the *Designer(s)* how to use concepts or tools associated with design, but may never work on the design of the *Robot* without the *Designer(s)* present and actively participating.
- **Programmer** - The *Student(s)* on the *Team* who write(s) the computer code that is downloaded onto the *Robot*. *Adults* are permitted to teach the *Programmer(s)* how to use concepts or tools associated with programming, but may never work on the code that goes on the *Robot* without the *Programmer(s)* present and actively participating.

Trapping - A *Robot* status. A *Robot* is *Trapping* if it has restricted an opposing *Robot* into a small, confined area of the field, approximately the size of one foam field tile or less, and has not provided an avenue for escape. *Trapping* can be direct (e.g., pinning an opponent to a field perimeter wall) or indirect (e.g., preventing a *Robot* from escaping from a corner of the field). See rule <G15>.

Note: If a Robot is not attempting to escape, then that Robot has not been Trapped.

Violation - The act of breaking a rule in the Game Manual.

- **Minor Violation** - A Violation which does not result in a *Disqualification*.
 - Accidental, momentary, or otherwise non-*Match Affecting* Violations are usually *Minor Violations*.
 - *Minor Violations* usually result in a verbal warning from the *Head Referee* during the *Match*, which should serve to inform the *Team* that a rule is being Violated before it escalates to a *Major Violation*.

- **Major Violation** - A *Violation* which results in a *Disqualification*.
 - Unless otherwise noted in a rule, all *Match Affecting Violations* are *Major Violations*.
 - If noted in the rule, egregious or intentional *Violations* may also be *Major Violations*.
 - Multiple *Minor Violations* within a *Match* or tournament may escalate to a *Major Violation*, at the *Head Referee's* discretion.

- **Match Affecting** - A *Violation* which changes the winning and losing *Alliance* in the *Match*.
 - Multiple *Violations* within a *Match* can cumulatively become *Match Affecting*.
 - When evaluating if a *Violation* was *Match Affecting*, *Head Referees* will focus primarily on any *Robot* actions that were directly related to the *Violation*.
 - Determining whether a *Violation* was *Match Affecting* can only be done once the *Match* is complete and the scores have been calculated.

Some rules include *Violation* Notes in a *red italicized text* to denote special circumstances or provide additional clarifications. If no *Violation* Notes are found in a given rule, then it should be assumed that the above "default" definitions apply.

To determine whether a *Violation* may have been *Match Affecting*, check whether the *Team* who committed the *Violation* won or lost the *Match*. If they did not win the *Match*, then the *Violation* could not have been *Match Affecting*, and it was very likely a *Minor Violation*.

See the flowchart in Figure 4 for more information.

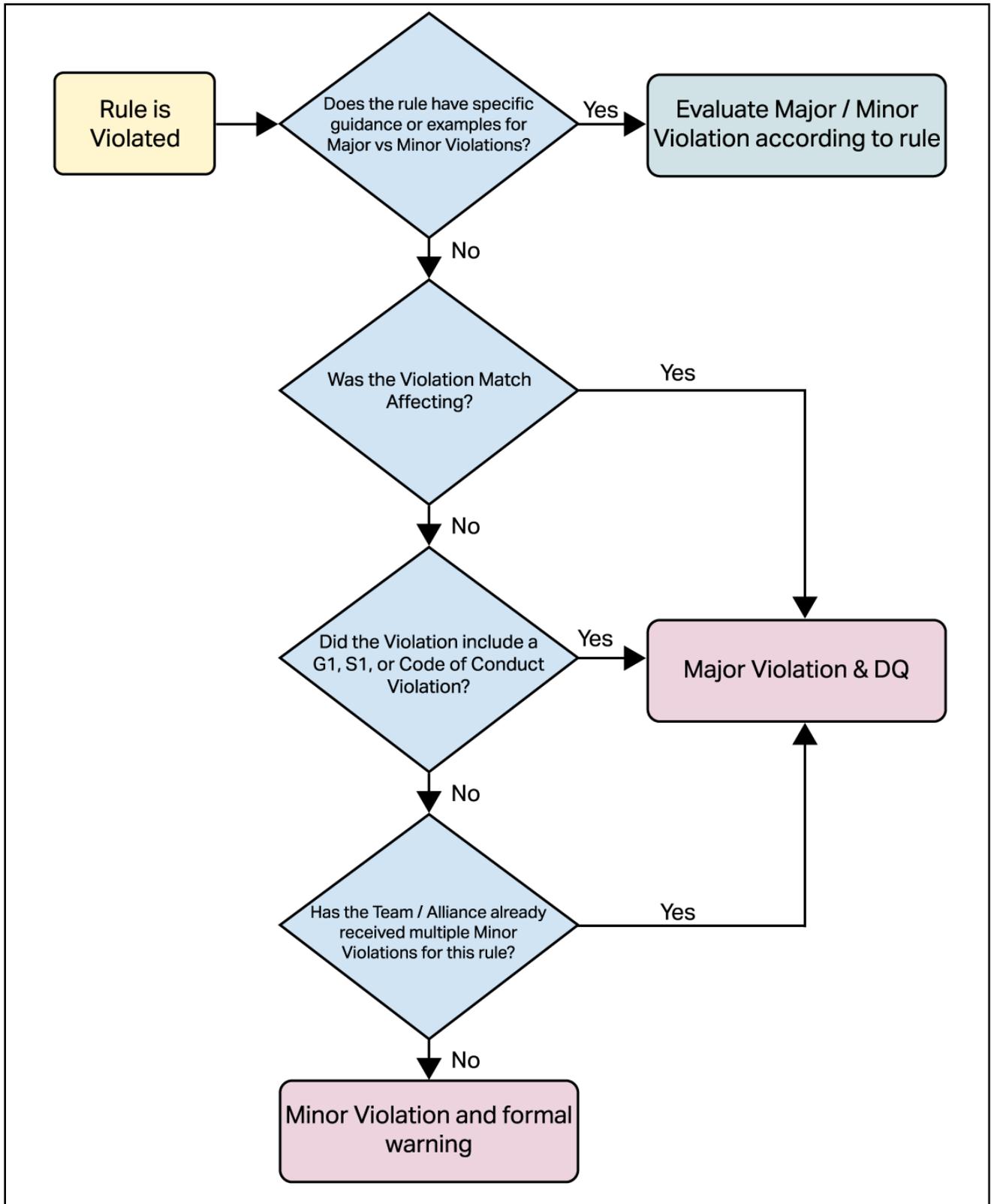


Figure 4: The process for determining whether or not an infraction should result in a Major Violation or Minor Violation

Game-Specific Definitions

Autonomous Line - The pair of white tape lines that runs diagonally across the field. See <SG8> for more information.

Barrier - A *Field Element* that marks an edge of each *Low Goal*. *Barriers* are made of red or blue plastic extrusions and black plastic connectors.

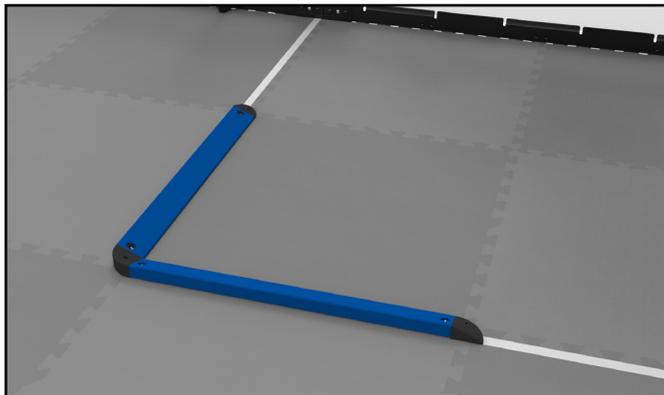


Figure 5: A Barrier

Covered - A field tile status. See <SC5> for more information.

Disc - A yellow foam object that can be manipulated by *Robots*. *Discs* have the following overall dimensions, with an expected tolerance of 0.02”:

- Diameter: 5.512” (140mm)”
- Thickness: 0.787” (20mm)”
- Weight: 65g ± 20g

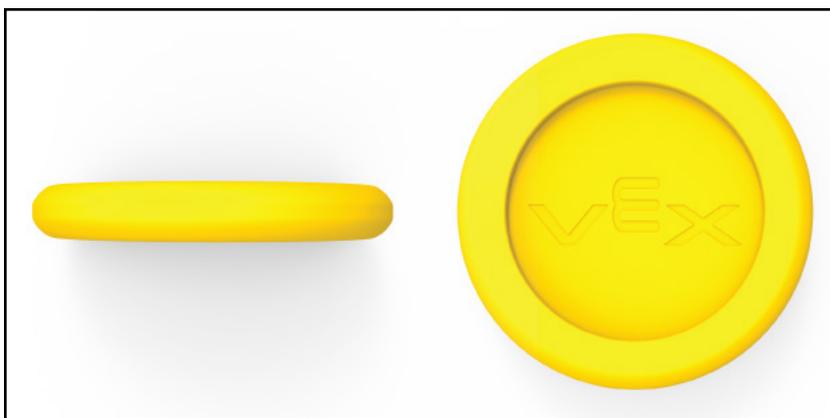


Figure 6: Two views of a Disc

Endgame - The final 10 seconds of the *Match*.

Goal - A place where *Robots* can Score *Discs*.

- **High Goal** - A basket-shaped *Field Element* where *Robots* can Score *Discs*. The *High Goal* is defined as the top & bottom colored plastic pieces, the chains, and the vertical pipe assembly connecting the top and bottom together. The horizontal supporting structures and brackets used to attach this basket assembly to the field are not considered part of the *High Goal*. The color of the *High Goal* indicates which *Alliance* receives points for *Discs Scored* in that *High Goal*.

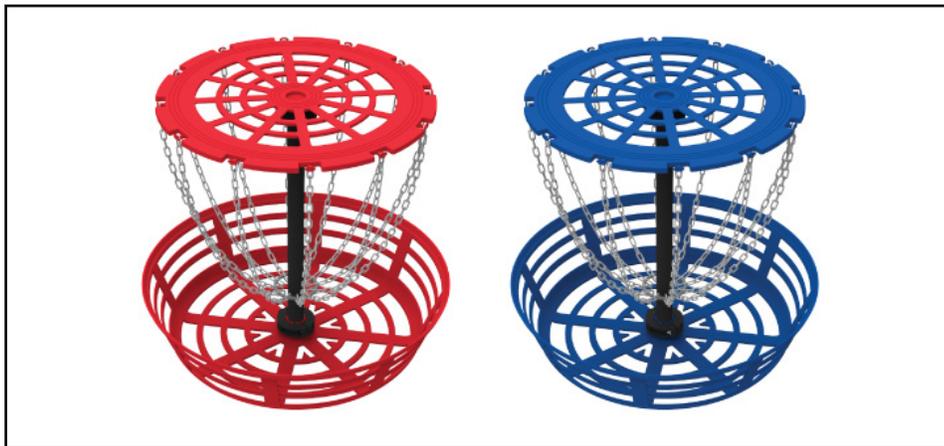


Figure 7: The red and blue High Goals

- **Low Goal** - A region of the field where *Robots* can Score *Discs*. The *Low Goal* is defined as the space in each corner of the field directly beneath each *High Goal*, bordered by white tape lines, the field perimeter, and the *Barrier*. The white tape lines and *Barrier* are considered part of the *Low Goal*, and the color of the *Barrier* indicates which *Alliance* receives points for *Discs Scored* in that *Low Goal*.

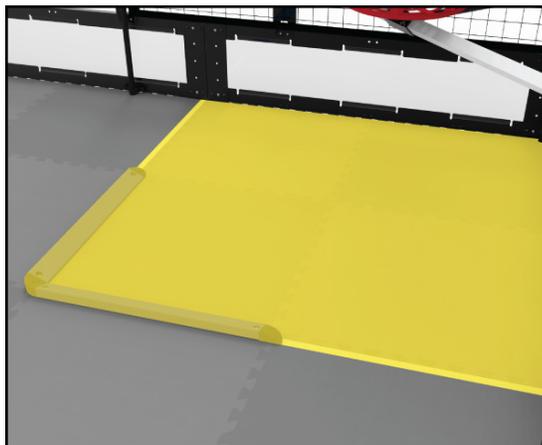


Figure 8: A highlighted representation of a Low Goal

Loader - A metal ramp, one per *Alliance*, that can be used to introduce *Match Load Discs*. See rule <SG6> for more information.



Figure 9: A Loader, with and without a Disc loaded into it

Match Load Discs - One of the fourteen (14) *Discs*, seven (7) per *Alliance*, that begin the *Match* in an *Alliance Station* and may be introduced during the *Match*. See <SG6> for more information.

Net - One of two woven, nylon, mesh structures located behind the *High Goals*.

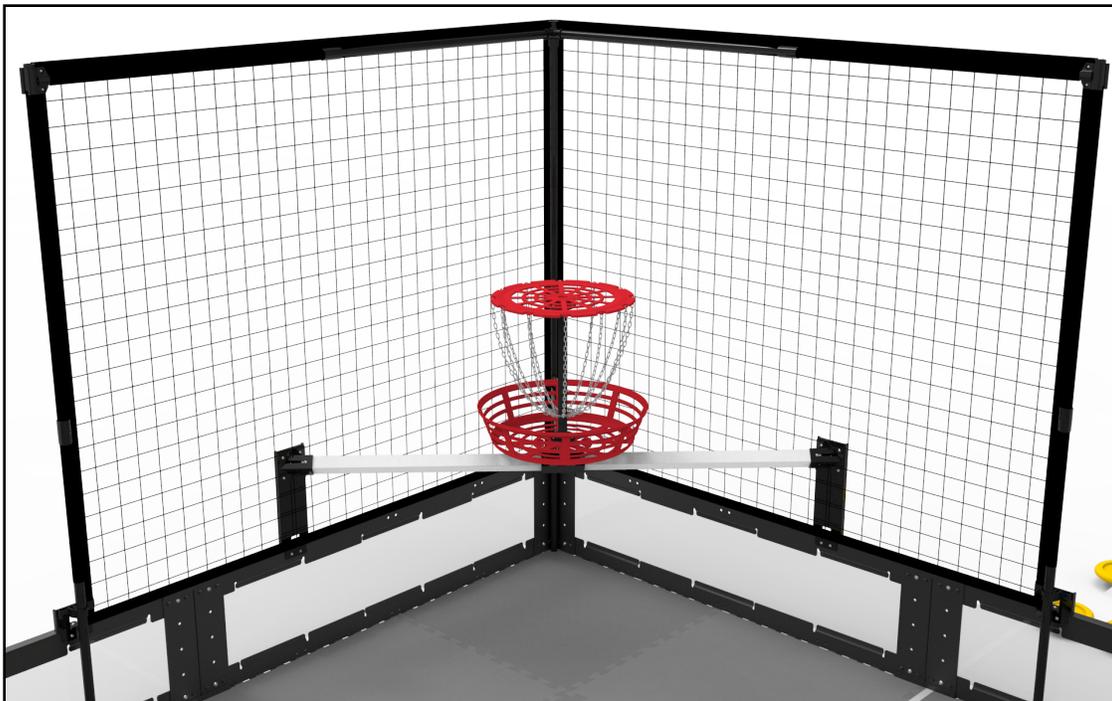


Figure 10: A Net and High Goal

Owned - A *Roller* status that can be used to score points. See <SC4> for more information.

Preload - The *Discs*, two (2) per *Robot*, placed prior to the start of each *Match*. If used, *Preloads* must be placed such that they satisfy the conditions in <SG1> and <SG2>. If they are not used, they may be used as additional *Match Load Discs*.

Possession - A *Robot / Disc* status. A *Robot* is considered to be in *Possession* of a *Disc* if the *Robot* is carrying, holding, or controlling the movement of a *Disc* such that if the *Robot* changes direction, the *Disc* will move with the *Robot*. Therefore, pushing / plowing *Discs* is not considered *Possession*; however, using concave portions of a *Robot* to control the movement of *Discs* is considered *Possession*.

Roller - One of four (4) *Field Elements* mounted to the field perimeter that can be *Owned* to score points. Each *Roller* has two pairs of pointers that, when viewed from above, indicate which *Alliance Owns* the *Roller*. In *Head-to-Head Matches*, *Rollers* begin in a neutral position. *Rollers* are made of 2" nominal Schedule 40 PVC pipe, and are 9.843" (250mm) long and 2.375" (60.3mm) in diameter. See <SC4> for more information.

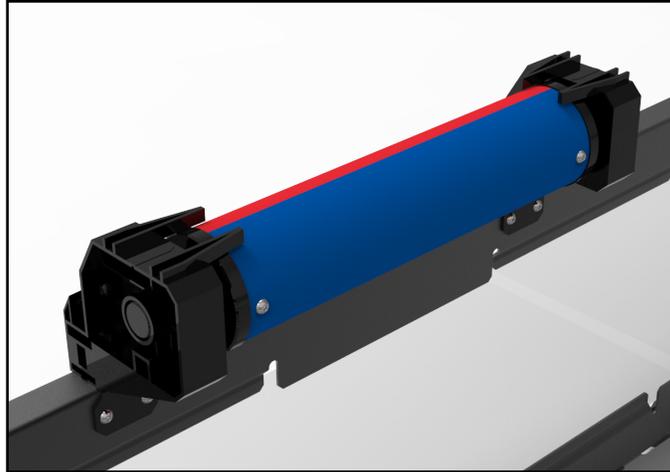


Figure 11: A Roller

Scored - A *Disc* status. See the Scoring section for more details.

Starting Line - One of four (4) white tape lines placed perpendicular to the field wall and used to determine *Robot* starting locations. See <SG1> for more information.

Scoring

Each <i>Disc</i> Scored in a <i>High Goal</i>	5 Points
Each <i>Disc</i> Scored in a <i>Low Goal</i>	1 Point
Each <i>Owned Roller</i>	10 Points
Each <i>Covered Field Tile</i>	3 Points
Winner of the <i>Autonomous Bonus</i>	10 Points

<SC1> All Scoring statuses are evaluated **immediately after the Match ends**. For determination of the *Autonomous Bonus* and *Autonomous Win Point*, all Scoring statuses are evaluated immediately after the *Autonomous Period* ends, unless otherwise noted.

- a. For the purposes of this rule, "immediately after" means when all *Discs*, *Field Elements*, and *Robots* on the field come to rest.

<SC2> A *Disc* is considered **Scored in the High Goal** for the corresponding *Alliance* color if it meets the following criteria:

- a. Not contacting a *Robot* of the same color *Alliance* as the *High Goal*.
- b. Not contacting the gray or black supporting structures underneath the *High Goal*.
- c. At least partially contained within the vertical projection of the widest portion of the bottom "basket" of the *High Goal*.

In most circumstances, this should be roughly equivalent to saying, "*Discs* must be fully supported by the *High Goal* and *I* or by other *Discs* which are fully supported by the *High Goal*". However, if one *Disc* at the bottom of a pile of *Scored Discs* does not meet this definition (e.g., it is being contacted by a *Robot*, and therefore not fully supported), then that non-*Scored Disc* should just be ignored. It does not have any bearing on other *Discs* in the *High Goal*.

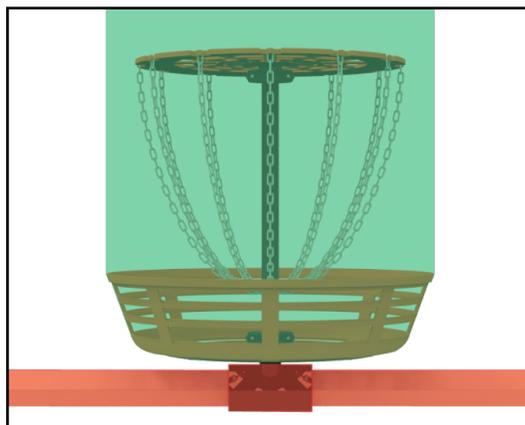


Figure 12: A visual representation of the 3-dimensional volume in which *Discs* are considered *Scored in the High Goal*

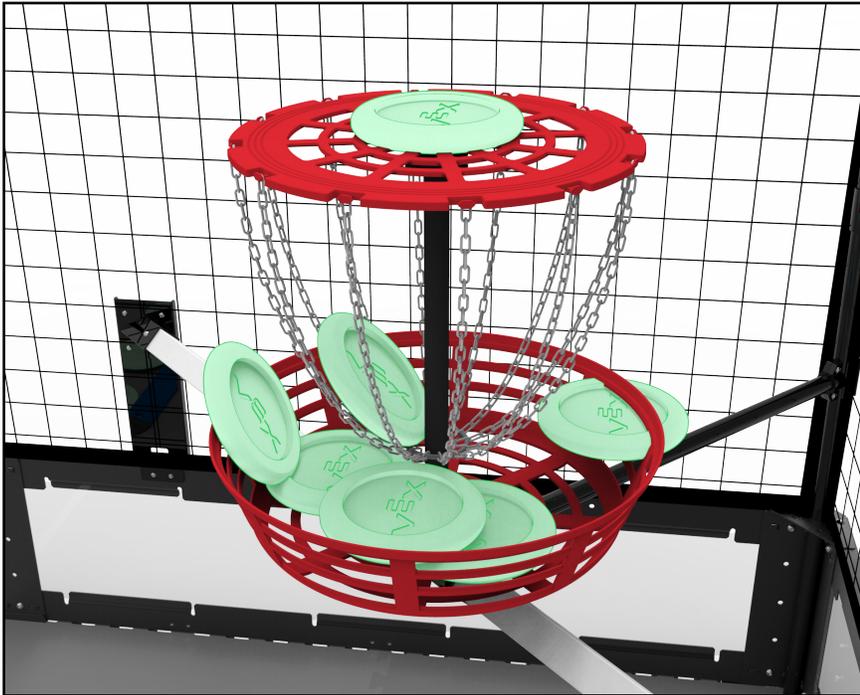


Figure 13: A High Goal with Discs

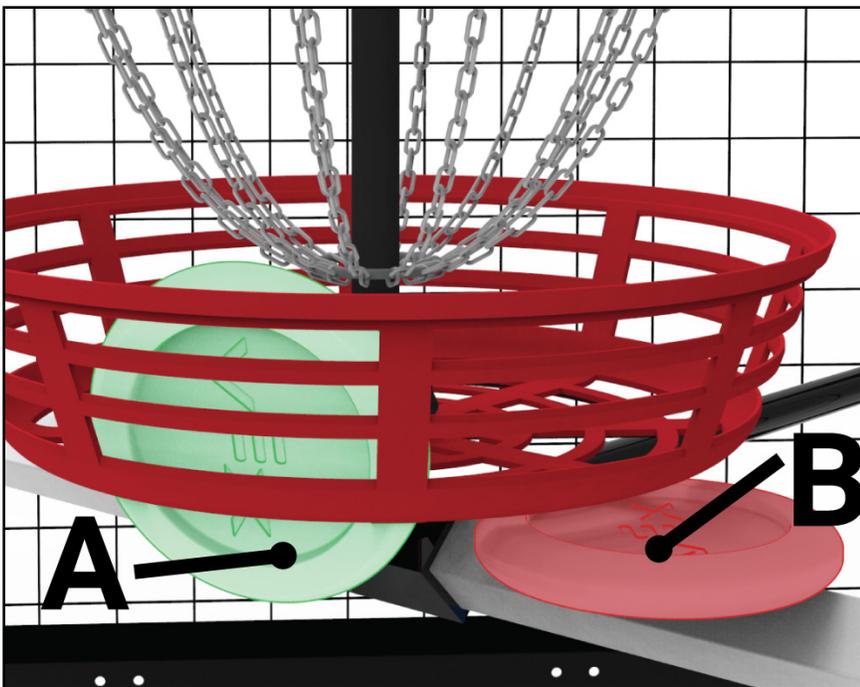


Figure 14: A High Goals with Discs

All of the *Discs* in Figure 13 would be considered *Scored* in the *High Goal* for the red *Alliance*.

In Figure 14, *Disc A* would be considered *Scored* in the *High Goal*. *Disc B* would NOT be considered *Scored*, because it is contacting one of the support structures underneath the *High Goal*.

<SC3> A Disc is considered **Scored in the Low Goal** for the *Alliance* corresponding to the color of the adjacent *Barrier* if it meets the following criteria:

- Not fully supported by a *Robot* of the same color *Alliance* as the *Low Goal*.
- At least partially contained within the vertical projection of the *Low Goal* (i.e., “breaking the plane” of the *Low Goal*).
- Not contacting any field tiles outside of the *Low Goal*.
- Not contacting the *Net*.
- Not contacting the *High Goal*, or any of the supporting structures underneath the *High Goal*.

Note: Discs which are Scored in a High Goal may not also count as being Scored in a Low Goal.

In Figure 15,

- Discs B, D, E, F, G, and I are all considered Scored in the Low Goal.*
- Disc H is not considered Scored, as it is being fully supported by a Robot of the same color Alliance as the Low Goal.*
- Discs A, C, J, and K are not considered Scored, as they are contacting the gray foam tiles outside of the Low Goal.*

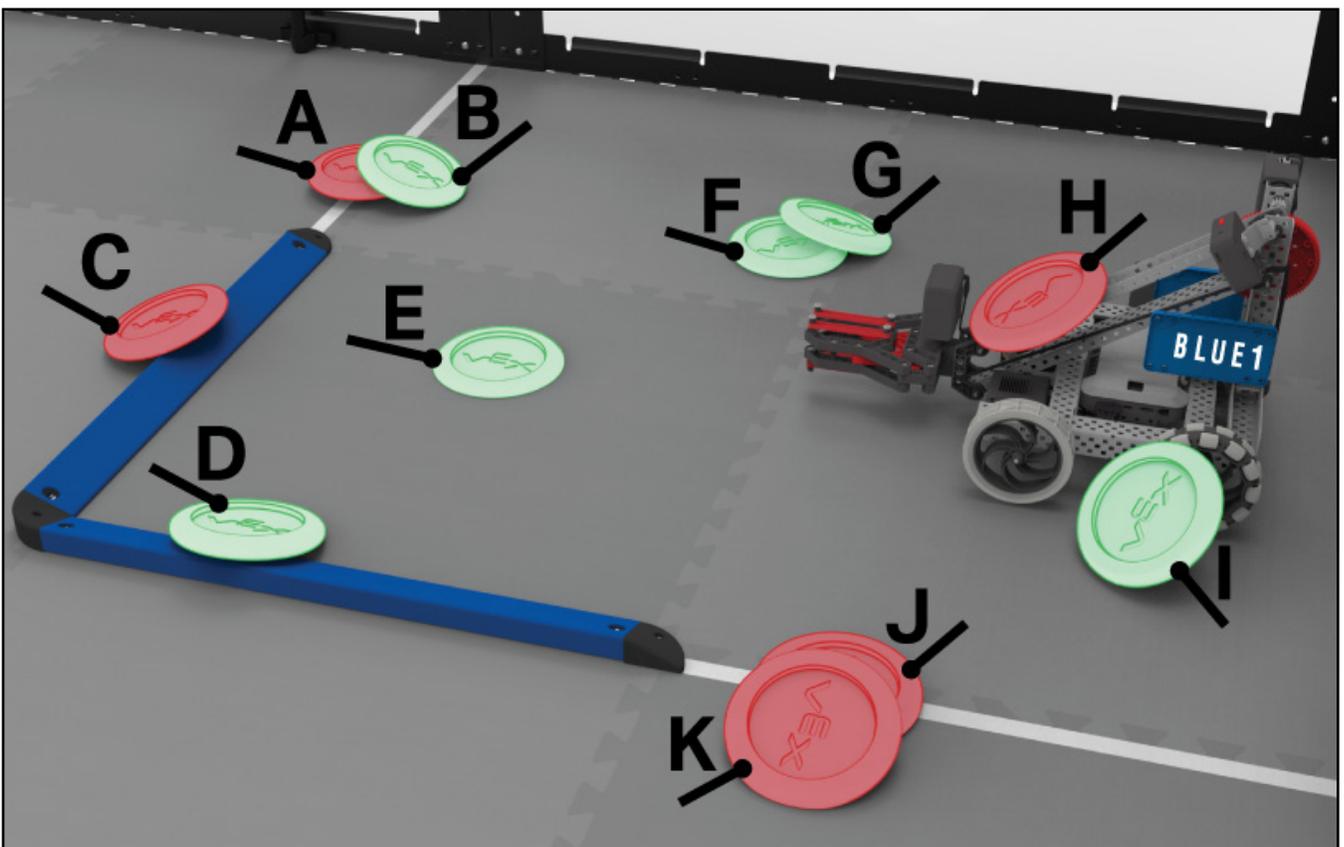


Figure 15: A Low Goal with Discs highlighted to indicate Scored statuses

<SC4> A **Roller is Owned** by an *Alliance* if the area between the *Roller's* pointers is entirely that *Alliance's* color, when viewed from above.

In Figure 16, *Roller A* is *Owned* by the blue *Alliance*, because blue is the only color that appears between the pointers. *Roller B* is not *Owned* by either *Alliance* because both red and blue clearly appear between the pointers.

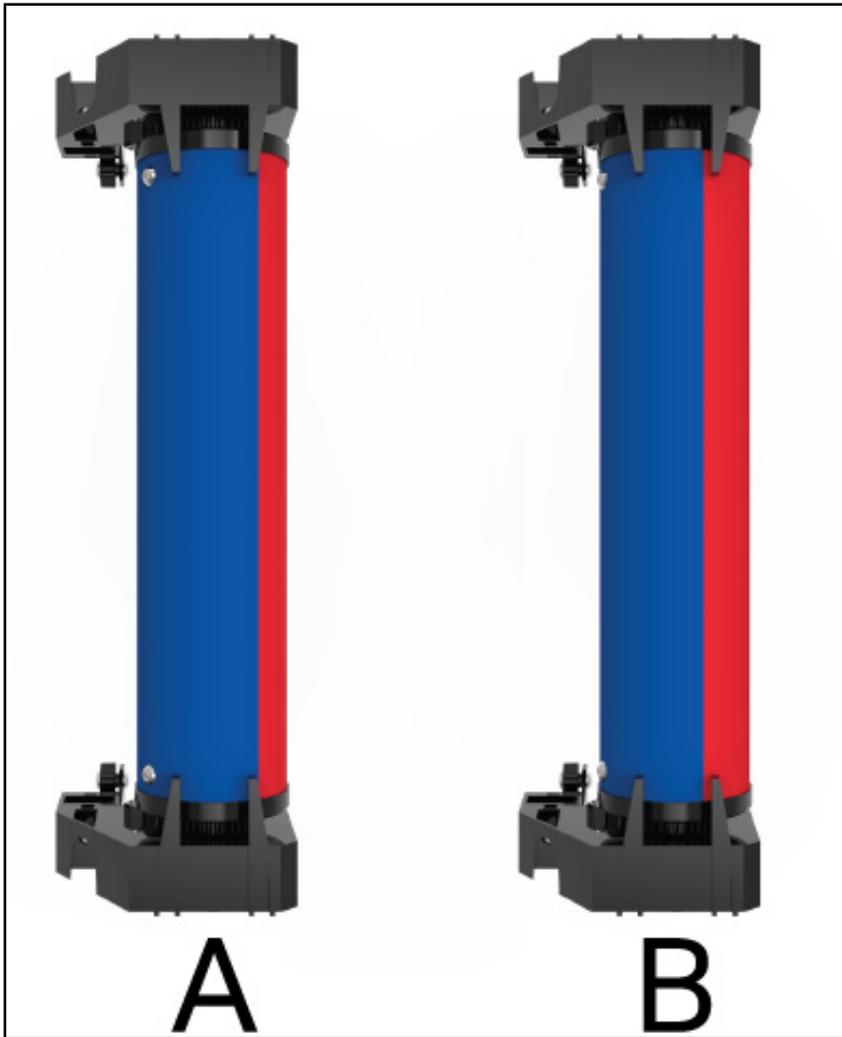


Figure 16: Examples of Roller states

The *Rollers* use a "ratchet and pawl"-style mechanism for rotating in predefined increments; they are not free-spinning. If assembled correctly, a *Roller's Owned* state should always be clearly visible to a *Head Referee*.

If a *Roller* is "too close to call" between two states, then referees are advised to give the "benefit of the doubt" to the color that is within the two pointers. For example, in Figure 16, if either *Roller* was positioned such that the color boundary was directly beneath the pointer and it was "too close to call," then it should be considered *Owned* by the blue *Alliance*.

<SC5> A **field tile is considered Covered** if it is being contacted by a *Robot* at the end of a *Match*.

- A field tile may be *Covered* by both *Alliances*.
- Each *Alliance* may only receive points for one *Cover* per field tile, regardless of how many of their *Robots* are contacting that field tile.
- The field tiles located in the *Low Goals* do not count towards *Cover* points (i.e., they will not be *Covered* by either *Alliance*).
- Covered* field tiles are only counted for points at the end of the *Driver Controlled Period*. They are not *Scored* at the end of the *Autonomous Period*.

For the sake of clarity, the following figures depict the same scenario. In this scenario, the blue *Alliance* would receive 15 points for *Covered* field tiles, and the red *Alliance* would receive 6 points.

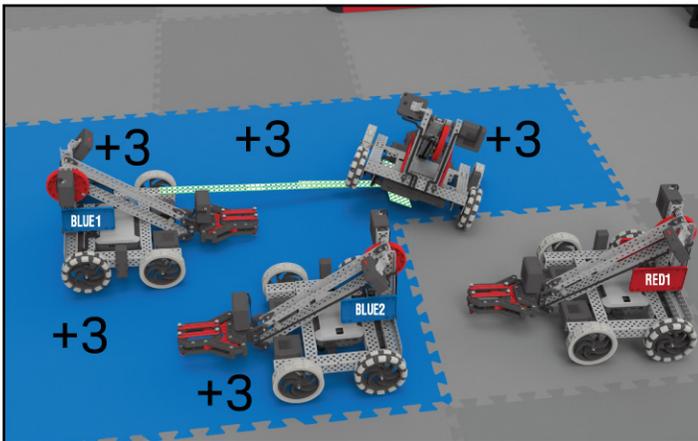


Figure 17:

- The wheels of Blue Robot 1 are contacting four different tiles, and its horizontal expansion (highlighted in green) is contacting one additional tile.
- Blue Robot 2 is entirely within one tile that is already being contacted by Blue Robot 1.

The blue *Alliance* would receive 15 points for *Covering* 5 tiles.

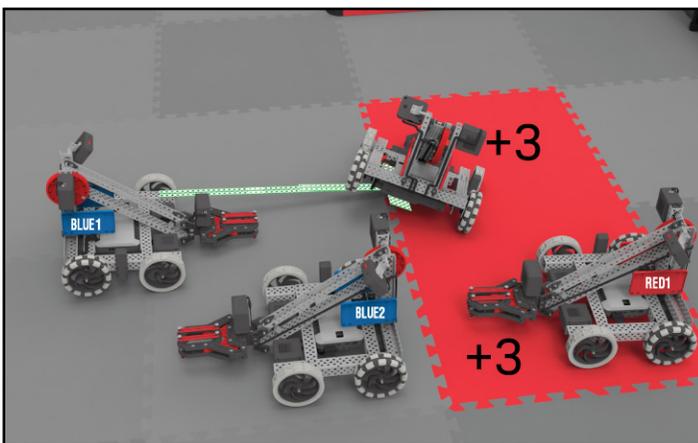


Figure 18:

- Red Robot 1 is entirely within a single tile.
- The left wheels of Red Robot 2 are being lifted off the ground by Blue Robot 1's horizontal extension (highlighted in green), and are not contacting any tiles.
- The rear right wheel of Red Robot 2 is contacting the same tile that Red Robot 1 is already *Covering*.

The red *Alliance* would receive 6 points for *Covering* 2 tiles.

<SC6> The **Autonomous Bonus** is awarded to the *Alliance* who has scored the most *Roller* and *Disc* points at the end of the *Autonomous Period*. An *Autonomous Win Point* is awarded to any *Alliance* that *Owens* two (2) *Rollers*, and has *Scored* at least two (2) *Discs* in their *Alliance-colored High Goal* at the end of the *Autonomous Period*.

- Covered* field tiles are not included in the determination of the *Autonomous Bonus*.
- If the *Autonomous Period* ends in a tie, including a zero-to-zero tie, each *Alliance* will receive an *Autonomous Bonus* of five (5) points.

Safety Rules

<S1> Be safe out there. If at any time the *Robot* operation or *Team* actions are deemed unsafe or have damaged a *Field Element* or *Disc*, the offending *Team* may receive a *Disablement* and *I* or *Disqualification* at the discretion of the *Head Referee*. The *Robot* will require re-inspection as described in rule <R3e> before it may take the field again.

Note: Teams should exercise caution when interacting with the Net, per <SG3>.

<S2> Stay inside the field. If a *Robot* is completely out-of-bounds (outside the playing field), it will be Disabled for the remainder of the *Match*.

If a *Robot* comes in contact with anything outside of the field during the *Endgame* period or due to an early expansion, including the floor or the outside face of the Field Perimeter, it will automatically receive a *Disqualification* for that *Match*.

Teams are responsible for the actions of their *Robots* at all times, including during the *Endgame* or an early expansion. Interactions that cause expansions to leave the playing field and which result in a *Disqualification* are not protected by rule <G14>; <G1> will still apply.

Note: The intent of this rule is not to penalize Robots for having mechanisms that inadvertently cross the field perimeter during normal game play. However, mechanisms which cross the field perimeter intentionally and / or repeatedly while interacting with the Loader and / or during the Endgame may be considered a Violation of <S1> at the Head Referee's discretion.

<S3> Wear safety glasses. All *Drive Team Members* must wear safety glasses or glasses with side shields while in the *Alliance Stations* during *Matches*. While in the pit area, it is highly recommended that all *Team* members wear safety glasses.

General Game Rules

<G1> Treat everyone with respect. All *Teams* are expected to conduct themselves in a respectful and professional manner while competing in VEX Robotics Competition events. If a *Team* or any of its members (*Students* or any *Adults* associated with the *Team*) are disrespectful or uncivil to event staff, volunteers, or fellow competitors, they may be Disqualified from a current or upcoming *Match*. *Team* conduct pertaining to <G1> may also impact a *Team's* eligibility for judged awards. Repeated or extreme *Violations* of <G1> could result in a *Team* being Disqualified from an entire event, depending on the severity of the situation.

This rule exists alongside the REC Foundation Code of Conduct. As such, *Violations* of the Code of Conduct can also be considered a *Violation* of <G1>. The Code of Conduct can be found at <https://kb.roboticseducation.org/hc/en-us/articles/4587951023639-Code-of-Conduct-for-VRC>.

Violation Notes: Violations of this rule will be reviewed on a case-by-case basis. Teams at risk of a <G1> Major Violation due to multiple disrespectful or uncivil behaviors will usually receive a "final warning", although the Head Referee is not required to provide one. Major Violations of <G1> and / or the Code of Conduct can result in Disqualification from a current Match, an upcoming Match, an entire event, or (in extreme cases) an entire competition season.

<G2> VRC is a student-centered program. *Adults* may assist *Students* in urgent situations, but *Adults* may never work on or program a *Robot* without *Students* on that *Team* being present and actively participating. *Students* must be prepared to demonstrate an active understanding of their *Robot's* construction and programming to judges or event staff.

Some amount of *Adult* mentorship, teaching, and / or guidance is an expected and encouraged facet of VEX competitions. No one is born an expert in robotics! However, obstacles should always be viewed as teaching opportunities, not tasks for an *Adult* to solve without *Students* present and actively participating.

When a mechanism falls off, it is...

- ...Okay for an *Adult* to help a *Student* investigate why it failed, so it can be improved.
- ...Not okay for an *Adult* to put the *Robot* back together.

When a *Team* encounters a complex programming concept, it is...

- ...Okay for an *Adult* to guide a *Student* through a flowchart to understand its logic.
- ...Not okay for an *Adult* to write a pre-made command for that *Student* to copy / paste.

During *Match* play, it is...

- ...Okay for an *Adult* to provide cheerful, positive encouragement as a spectator.
- ...Not okay for an *Adult* to explicitly shout step-by-step commands from the audience.

This rule operates in tandem with the REC Foundation Student Centered Policy, which is available on the REC Foundation website for *Teams* to reference throughout the season: <https://kb.roboticseducation.org/hc/en-us/articles/4588261517719-Student-Centered-Policy-for-VRC>.

Violation Notes: Potential Violations of this rule will be reviewed on a case-by-case basis. By definition, all Violations of this rule become Match Affecting as soon as it is determined that a Robot which was built by an Adult has won a Match.

<G3> Use common sense. When reading and applying the rules in this document, please remember that common sense always applies in the VEX Robotics Competition.

For example...

- If there is an obvious typographical error (such as “per <T5>” instead of “per <G5>”), this does not mean that the error should be taken literally until corrected in a future update.
- Understand the realities of the VEX V5 *Robot* construction system. For example, if a *Robot* could hover above the Field for a whole *Match*, that would create loopholes in many of the rules. But... they can't. So don't worry about it.
- When in doubt, if there is no rule prohibiting an action, it is generally legal. However, if you have to ask whether a given action would violate <S1>, <G1>, or <T1>, then that's probably a good indication that it is outside the spirit of the competition.
- In general, *Teams* will be given the “benefit of the doubt” in the case of accidental or edge-case rules infractions. However, there is a limit to this allowance, and repeated or strategic infractions will still be penalized.
- This rule also applies to *Robot* rules. If a component's legality cannot be easily / intuitively discerned by the *Robot* rules as written, then *Teams* should expect additional scrutiny during inspection. This especially applies to those rules which govern non-VEX components (e.g. <R9>, <R10>, <R11>, etc). There is a difference between “creativity” and “lawyering”.

<G4> Robots begin the Match in the starting volume. At the beginning of a *Match*, each *Robot* must be smaller than a volume of 18” (457.2 mm) long by 18” (457.2 mm) wide by 18” (457.2 mm) tall. Using *Field Elements*, such as the field perimeter wall, to maintain starting size is only acceptable if the *Robot* would still satisfy the constraints of <R5> and pass inspection without the *Field Elements*.

Violation Notes: Any Violation of this rule will result in the Robot being removed from the field prior to the start of the Match, and rules <R3d> and <T5> will apply until the situation is corrected.

<G5> Keep your Robots together. Robots may not intentionally detach parts during the *Match* or leave mechanisms on the field.

Note: Parts which become detached unintentionally and therefore a Minor Violation are no longer considered "part of a Robot," and should be ignored for the purposes of any rules which involve Robot contact (e.g., Covering field tiles, contacting a Low Goal, horizontal expansion, etc.) or Robot size.

Violation Notes: Major Violations of this rule should be rare, as Robots should never be designed to intentionally violate it. Minor Violations are usually due to Robots being damaged during gameplay, such as a wheel falling off.

<G6> The Robot must represent the skill level of the Team. Each *Team* must include *Drive Team Members, Programmer(s), Designer(s), and Builder(s)*. No *Student* may fulfill any of these roles for more than one VEX Robotics Competition *Team* in a given competition season. *Students* may have more than one role on the *Team*, (e.g., a *Designer* may also be a *Builder, a Programmer, and a Drive Team Member*).

- a. *Team* members may move from one *Team* to another for non-strategic reasons that are outside of the *Team's* control.
 - i. Examples of permissible moves may include, but are not limited to, illness, changing schools, conflicts within a *Team*, or combining / splitting *Teams*.
 - ii. Examples of strategic moves in *Violation* of this rule may include, but are not limited to, one *Programmer* "switching" *Teams* in order to write the same program for multiple *Robots*, or one *Student* writing the Engineering Notebook for multiple *Teams*.
 - iii. If a *Student* leaves a *Team* to join another *Team*, <G6> still applies to the *Students* remaining on the previous *Team*. For example, if a *Programmer* leaves a *Team*, then that *Team's* *Robot* must still represent the skill level of the *Team* without that *Programmer*. One way to accomplish this would be to ensure that the *Programmer* teaches or trains a "replacement" *Programmer* in their absence.
- b. When a *Team* qualifies for a Championship event (e.g., States, Nationals, Worlds, etc.) the *Students* on the *Team* attending the Championship event are expected to be the same *Students* on the *Team* who were awarded the spot. *Students* can be added as support to the *Team*, but may not be added as *Drive Team Members* or *Programmers* for the *Team*.
 - i. An exception is allowed if one (1) *Drive Team Member* and / or one (1) *Programmer* on the *Team* cannot attend the event. The *Team* can make a single substitution of a *Drive Team Member* or *Programmer* for the Championship event with another *Student*, even if that *Student* has competed on a different *Team*. This *Student* will now be on this new *Team* and may not return to the original *Team*.

Violation Notes: Violations of this rule will be evaluated on a case-by-case basis, in tandem with the REC Foundation Student Centered Policy as noted in <G2>, and the REC Foundation Code of Conduct as noted in <G1>.

Event Partners should bear in mind <G3>, and use common sense when enforcing this rule. It is not the intent to punish a *Team* who may change *Team* members over the course of a season due to illness, changing schools, conflicts within a *Team*, etc.

Event Partners and referees are not expected to keep a roster of any *Student* who has ever been a *Drive Team Member* for one day. This rule is intended to block any instance of loaning or sharing *Team* members for the sole purpose of gaining a competitive advantage.

<G7> Only Drivers, and only in the Alliance Station. During a *Match*, each *Team* may have up to three (3) *Drive Team Members* in their *Alliance Station* and all *Drive Team Members* must remain in their *Alliance Station* for the duration of the *Match*.

Drive Team Members are prohibited from any of the following actions during a *Match*:

- a. Bringing / using any sort of communication devices into / in the *Alliance Station*. Devices with communication features turned off (e.g., phones in airplane mode) are allowed.
- b. Standing on any sort of object during a *Match*, regardless of whether the field is on the floor or elevated.
- c. Bringing / using additional materials to simplify the game challenge during a *Match*.

<G7c> is intended to refer to non-*Robot*-related items that directly influence gameplay, such as using a fan to influence opponent *Discs* traveling through the air. Provided no other rules are violated, examples such as the following are not considered violations of <G7>:

- Materials used before or after a *Match*, such as a pre-*Match* alignment aid, or a carrying case for Robots / Controllers
- Strategic aids, such as a whiteboard or clipboard
- Earplugs, gloves, or other personal accessories

Note: Drive Team Members are the only Team members that are allowed to be in the Alliance Station during a Match.

Note 2: During a Match, Robots may be operated only by the Drive Team Members and / or by software running on the Robot's control system, in accordance with <R25> and <G8>.

Violation Notes: Major Violations of this rule are not required to be Match Affecting, and could invoke Violations of other rules, such as <G1>, <G2>, or <G6>.

<G8> Controllers must stay connected to the field. Prior to the beginning of each *Match*, *Drive Team Members* must plug their primary V5 Controller into the field's control system. This cable must remain plugged in for the duration of the *Match*, and may not be removed until the "all-clear" has been given for *Drive Team Members* to retrieve their *Robots*. See <T22> for more information regarding field control system options.

Violation Notes: The intent of this rule is to ensure that Robots abide by commands sent by the tournament software. Temporarily removing the cable to assist with mid-Match troubleshooting, with an Event Partner or other event technical staff present and assisting, would not be considered a Violation.

<G9> Hands out of the field. *Drive Team Members* are prohibited from making intentional contact with any *Discs*, *Field Elements*, or *Robots* during a *Match*, apart from the contact specified in <G9a>.

- a. During the *Driver Controlled Period*, *Drive Team Members* may only touch their own *Robot* if the *Robot* has not moved at all during the *Match*. Touching the *Robot* in this case is permitted only for the following reasons:
 - i. Turning the *Robot* on or off
 - ii. Plugging in a battery
 - iii. Plugging in a V5 Robot Radio
 - iv. Touching the V5 Robot Brain screen, such as to start a program
- b. *Drive Team Members* are not permitted to break the plane of the field perimeter at any time during the *Match*, apart from the actions described in <G9a>.
 - i. This rule includes the act of introducing *Match Load Discs* through the *Loaders*
- c. Transitive contact, such as contact with the field perimeter that causes the field perimeter to contact *Field Elements* or *Discs* inside of the field, could be considered a *Violation* of this rule.

Note: Any concerns regarding Field Element or Disc starting positions should be raised with the Head Referee prior to the Match. Team members may never adjust the Discs or Field Elements themselves.

<G10> Autonomous means "no humans." During the *Autonomous Period*, *Drive Team Members* are not permitted to interact with the *Robots* in any way, directly or indirectly. This could include, but is not limited to:

- Activating any controls on their V5 Controller(s)
- Unplugging or otherwise manually interfering with the field connection in any way
- Triggering sensors (including the Vision Sensor) in any way, even without touching them

Violation Notes: See <G11>.

<G11> All rules still apply in the Autonomous Period. *Teams* are responsible for the actions of their *Robots* at all times, including during the *Autonomous Period*. Any *Violations* committed during the *Autonomous Period* that affect the outcome of the *Autonomous Bonus* - whether they are *Match Affecting* or not - will result in the *Autonomous Bonus* being automatically awarded to the opposing *Alliance*. If both *Alliances* commit *Violations* during the *Autonomous Period* that would have affected the outcome of the *Autonomous Bonus*, then no *Autonomous Bonus* will be awarded.

Violation Notes: The intent of this rule is to provide retribution for Violations committed during the Autonomous Period that are not Match Affecting, and therefore not Major Violations, but do affect the outcome of the Autonomous Bonus.

<G12> Don't destroy other Robots. But, be prepared to encounter defense. Strategies aimed solely at the destruction, damage, tipping over, or *Entanglement* of opposing *Robots* are not part of the ethos of the VEX Robotics Competition and are not allowed.

- a. VRC Spin Up is intended to be an offensive game (i.e., *Teams* should be focused on ways to actively score points). *Teams* that partake in solely defensive or destructive strategies will not have the protections implied by <G12> (see <G13>). However, defensive play which does not involve destructive or illegal strategies is still within the spirit of this rule.
- b. VRC Spin Up is also intended to be an interactive game. Some incidental tipping, *Entanglement*, and damage may occur as a part of normal gameplay without *Violation*. It will be up to the *Head Referee's* discretion whether the interaction was incidental or intentional.
- c. A *Team* is responsible for the actions of its *Robot* at all times, including the *Autonomous Period*. This applies both to *Teams* that are driving recklessly or potentially causing damage, and to *Teams* that drive around with a small wheel base. A *Team* should design its *Robot* such that it is not easily tipped over or damaged by minor contact.
- d. During the *Endgame*, *Robots* should expect the possibility of vigorous interactions with opponent *Robots*. Incidental damage that is caused by pushing, tipping, or *Entangling* during the *Endgame* will not be considered a *Violation* of <G12>. Intentional damage or dangerous mechanisms may still be considered a *Violation* of <R4>, <S1>, or <G1> at the *Head Referee's* discretion.

Violation Notes:

- *Major Violations of this rule are not required to be Match Affecting. Intentional and / or egregious tipping, Entanglement, or damage may be considered a Major Violation at the Head Referee's discretion.*
- *Repeated Violations within a Match or tournament could be considered a Violation of <G1> and / or <S1> at the Head Referee's discretion.*

<G13> Offensive Robots get the "benefit of the doubt." In a case where *Head Referees* are forced to make a judgment call regarding a destructive interaction between a defensive and an offensive *Robot*, or an interaction which results in a questionable *Violation*, referees will err on the side of the offensive *Robot* (i.e., the *Robot* that is actively attempting to score points).

<G14> You can't force an opponent into a penalty. Intentional strategies that cause an opponent to break a rule are not permitted, and will not result in a *Violation* for the opposing *Alliance*.

Violation Notes: In most cases, if a Team causes their opponent to break a rule, the Head Referee will simply not enforce the penalty on that opponent, and it will be considered a Minor Violation for the guilty Team. However, if the forced situation becomes Match Affecting in favor of the guilty Team, it will be considered a Major Violation.

<G15> No Trapping for more than 5 seconds. A *Robot* may not Trap an opposing *Robot* for more than five seconds (0:05) during the *Driver Controlled Period*.

- a. A Trap ends once the *Trapping Robot* has moved away and the *Robots* are separated by at least two (2) feet (approximately one [1] foam tile).
- b. After ending a Trap, a *Robot* may not Trap the same *Robot* again for a duration of five seconds (0:05). If a *Team* does Trap the same *Robot* again within five seconds (0:05), the count will resume from where it ended when the *Trapping Robot* initially backed away.

Note: There is no penalty for Traps which begin during the Endgame, but <G15a> and <G15b> apply to all Traps that begin before the final ten (10) seconds of the Match. If a Robot initiates a Trap before the Endgame and does not separate for at least two (2) feet and five (5) seconds before resuming the Trap, the count will resume as described in <G15b>.

<G16> Don't clamp your Robot to the field. *Robots* may not intentionally grasp, grapple or attach to any *Field Elements*. Strategies with mechanisms that react against multiple sides of a *Field Element* in an effort to latch or clamp onto said *Field Element* are prohibited. The intent of this rule is to prevent *Teams* from damaging the field and / or from anchoring themselves to the field.

Violation Notes: Major Violations of this rule should be rare, as Robots should never be designed to intentionally violate it.

<G17> Use Discs to play the game. *Discs* may not be used to accomplish actions that would be otherwise illegal if they were attempted by *Robot* mechanisms (e.g., interfering with an opponent's *Autonomous* routine per <SG8>).

The intent of this rule is to prohibit *Teams* from using game objects as "gloves" to loophole any rule that states "a *Robot* may not [do some action]." This rule is not intended to be taken in its most extreme literal interpretation, where any interaction between a *Disc* and a *Robot* needs to be scrutinized with the same intensity as if it were a *Robot*.

Violation Notes: If a rule is Violated through the use of Discs instead of a Robot mechanism, it should be evaluated as though the rule in question had been Violated by a Robot mechanism.

Specific Game Rules

<SG1> Starting a Match. Prior to the start of each *Match*, the *Robot* must be placed such that it is:

- a. Contacting at least one (1) of the gray foam field tiles adjacent to the field perimeter that are between a pair of *Starting Lines* on their *Alliance's* side of the *Autonomous Line*. See Figure 19.
- b. Not contacting any other gray foam field tiles.
- c. Not contacting any *Discs* other than the *Preloads*.
- d. Not contacting another *Robot*.
- e. Not contacting any *Field Elements*, such as the *Barrier* or the *Net*.
 - i. Contact with the field perimeter is permitted, but not required.
- f. Contacting no more than two (2) *Preloads*. See rule <SG2>.
- g. Not contacting any gray foam tiles inside the *Low Goal*.
- h. Within the required starting volume. See rule <G4>.

Violation Notes: The Match will not begin until the conditions in this rule are met for all Robots on the field. If a Robot cannot meet these conditions in a timely manner, the Robot will be removed from the field and rules <R3d> and <T5> will apply until the situation is corrected.

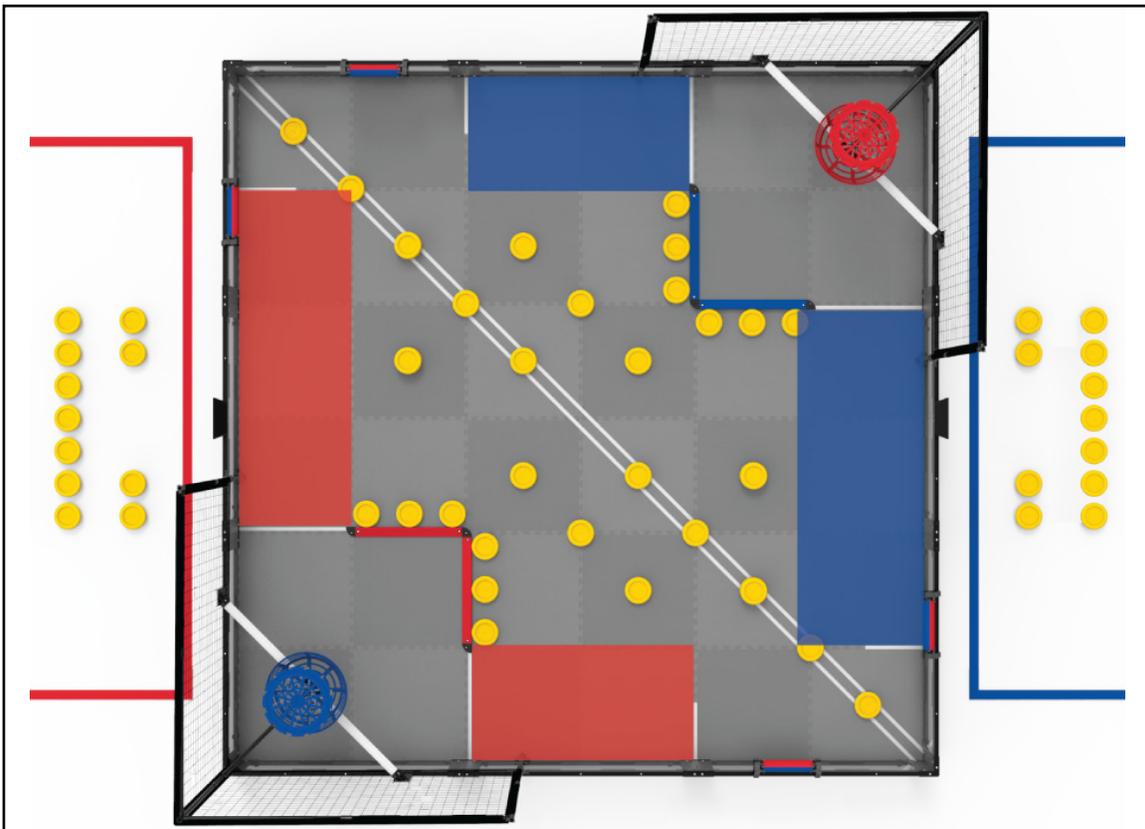


Figure 19: Overhead view of the field, highlighting legal starting tiles for each Alliance

<SG2> Robots get two Preloads. Prior to the start of each *Match*, each *Preload* must be placed such that it is:

- a. Contacting no more than one *Robot*.
- b. Fully within the field perimeter.
- c. Not in any position that would be considered *Scored* (such as *Disc I* in Figure 15).
- d. In the vertical projection of at least one (1) of the gray foam tiles adjacent to the field perimeter that are between a pair of *Starting Lines* on their *Alliance's* side of the *Autonomous Line*. See Figure 19.
- e. Not contacting any other gray foam field tiles.
- f. Not contacting any *Discs* other than the *Preloads*.

If a *Team* does not wish to use one or more of their *Preloads*, or if a *Robot* is not present for their *Match*, then the *Preloads* may be used as *Match Load Discs* in accordance with <SG6>.

Violation Notes: See <SG1>.

<SG3> Stay away from the Net. Becoming Entangled with the *Net* is considered a *Violation* of <S1> and / or <G16>, and will result in a *Disablement*. Causing an opponent to become Entangled with the *Net* is considered a *Violation* of <G14> and, at a minimum, will result in a *Disablement* for both *Teams*.

This rule is a specific exception to <G14>. Normally, under <G14>, a *Robot* which is forced into breaking a rule (such as being pushed into the *Net*) is not penalized. However, because *Entanglement* with the *Net* is a potential safety concern, a *Robot* which becomes Entangled must be Disabled, regardless of who was at fault. Of course, strategic or intentional *Violations* could be considered a *Violation* of <G1> and result in a *Disqualification*.

Violation Notes:

- *Momentary or incidental contact that does not result in Entanglement, such as while aligning with a Loader, is expected and is not considered a Violation.*
- *The Disablement associated with this rule is not considered a Major Violation. It is intended to be an avenue for the Head Referee to prevent any potential safety concerns and / or damage to the Net.*
- *Intentional, strategic, or repeated Minor Violations and / or Disablements may escalate to a Major Violation at the Head Referee's discretion.*

<SG4> Horizontal expansion is limited until the Endgame. *Robots* may not expand beyond a horizontal area of 18" x 18" at any point during the *Match* prior to the *Endgame*. A *Robot* that expands early in a head-to-head *Match* and cannot rectify the *Violation* cannot participate in further gameplay and will not receive points for tiles *Covered* in the *Endgame*.

There are no horizontal expansion limits during the *Endgame*. However, any *Robot* that comes in contact with anything outside of the field during the *Endgame* period or due to an early expansion, including the floor or the outside face of the Field Perimeter, will automatically receive a *Disqualification* for that *Match* under rule <S2>.

Violation Notes:

- *Teams can prevent an accidental or momentary expansion that does not result in an <S2> Violation from becoming a Major Violation by immediately moving to rectify the Violation, and / or removing themselves from gameplay (e.g., parking in a corner of the field without impacting gameplay for other Robots).*
- *Even if an expansion was accidental, it can still be considered a Major Violation if the Head Referee judges that the expansion was intentional, strategic, and / or Match Affecting.*

Examples of Major Violations could include, but are not limited to:

- *A Robot utilizing an expanded mechanism to manipulate Discs*
- *A tipped or expanded Robot blocking access to an opponent's Low Goal*
- *A Robot forfeiting Driver Controlled gameplay (i.e., "accidentally" expanding early) in order to get a head-start on the Endgame*

<SG5> **Vertical expansion is limited.** *Robots may expand vertically within the following conditions:*

- a. *The Robot must not be contacting the gray field tiles in either Low Goal.*
- b. *No part of the Robot may exceed an overall height of 24". This height limit is a "virtual ceiling," meaning that no part of any Robot may ever exceed 24" above the foam tiles, regardless of Robot orientation.*
- c. *Any extensions or combinations of extensions above 18" must fit within a vertical cylinder 2" in diameter.*
- d. *There are no vertical expansion limits during the Endgame.*
- e. *Robots may not contact the High Goal, Discs which are Scored in the High Goal, or the horizontal supporting structures directly underneath the High Goal. This rule applies at all times, regardless of Alliance / High Goal color.*

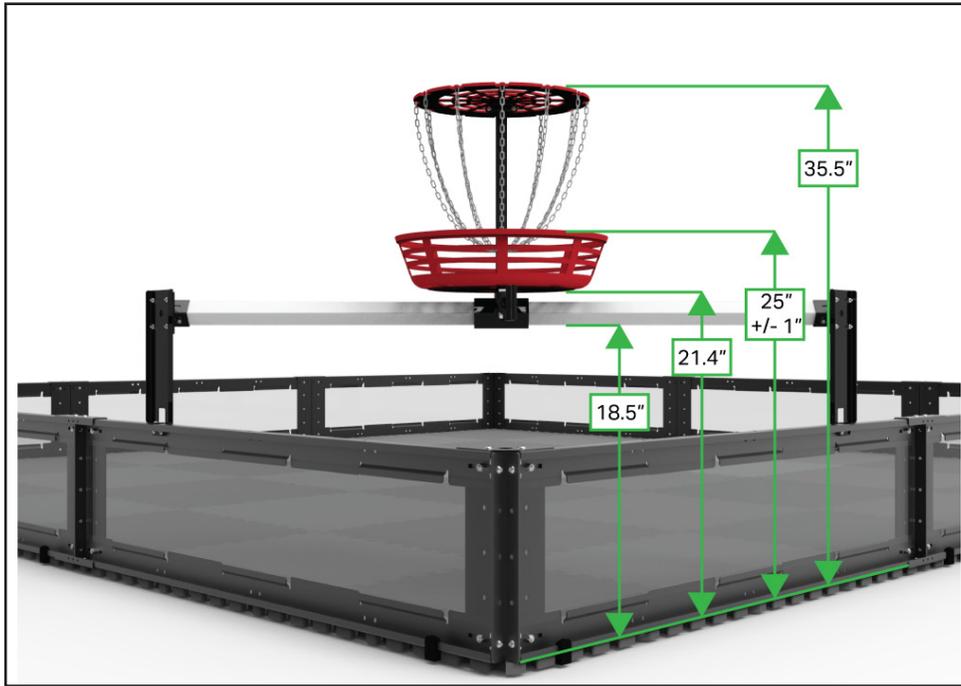


Figure 20: Vertical dimensions of the High Goal

The *Rollers* are made from 2" nominal Schedule 40 PVC pipe, with an average inner diameter of 2.067" (52mm). A *Roller*, or any other piece of 2" Schedule 40 PVC pipe, can be used to check *Robot* compliance with part "c" of this rule. If a vertically extending mechanism touches the inner walls of the PVC pipe, then it is too wide.

See Figure 20. The intent of this height limit is to prevent mechanisms from extending above the bottom half of the *High Goal*, which is roughly 25" from the foam tiles. If a mechanism extends above the top of this *Field Element*, then it is too tall.

A *Robot* that has not extended vertically should be able to drive under the supporting structure of the *High Goal* without contacting it.

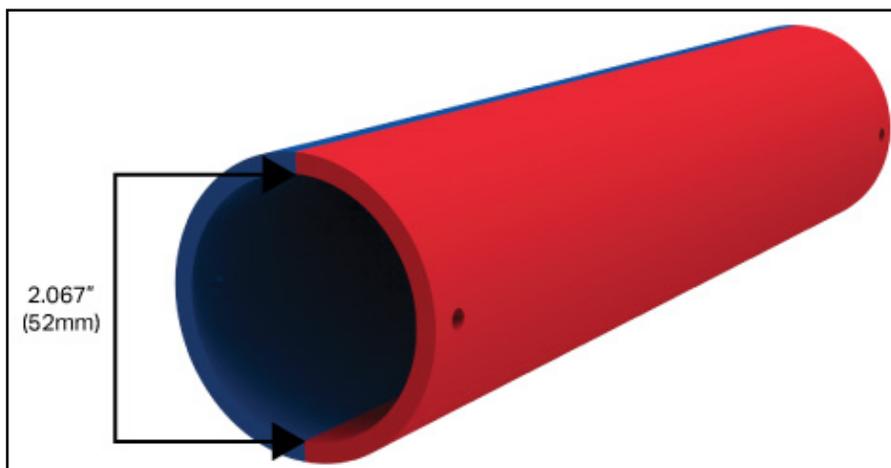


Figure 21: Any vertically expanding parts should be able to fit within a Roller

Violation Notes:

- *Repeated Minor Violations that involve interference with gameplay, such as blocking an opponent's launched Disc while contacting a Low Goal, may escalate to a Major Violations at the Head Referee's discretion.*
- *It is expected that momentary Minor Violations may occur, such as a mechanism retracting while a Robot enters a Low Goal, or while driving over a Disc. These will likely only result in a warning, if no gameplay interference occurs.*
- *Even if an expansion was accidental, it can still be considered a Major Violation if the Head Referee judges that the expansion was intentional, strategic, and / or Match Affecting. This especially applies to part "e" of this rule.*

<SG6> Match Load Discs may be safely introduced during the Match under certain conditions.

For the purpose of this rule, "introduce" refers to the moment when *Match Load Discs* are no longer in contact with a human, have crossed the plane of the field perimeter, and are no longer in contact with the Loader.

- a. *Match Load Discs* may only be introduced once the *Driver Controlled Period* has begun.
 - i. During the *Autonomous Period*, and during the time between the *Autonomous* and *Driver Controlled Period*, *Match Load Discs* may not cross the plane of the field perimeter.
- b. *Match Load Discs* must be introduced by a *Drive Team Member* placing them gently onto a *Loader*. They may then be retrieved from the *Loader* by a *Robot*, or gently pushed into the field by a *Drive Team Member*. See Figure 22 for examples of how *Match Load Discs* should be introduced.
 - i. The intent of this rule is to permit *Teams* to impart enough energy on *Match Load Discs* such that they slide onto the tile (or a *Robot*) directly in front of the *Loader*. "Throwing," "rolling," or otherwise imparting enough energy onto the *Discs* such that they leave the intended tile, or violate one of the other points in this rule, is not permitted.
- c. *Match Load Discs* may never be contacted by a *Robot* while still being contacted by a *Drive Team Member*.
- d. When utilizing the *Loader* correctly, a *Drive Team Member's* hands should never break the plane of the field perimeter. Therefore, rule <G9> still applies to this interaction.
- e. When utilizing the *Loader* correctly, a *Robot* should never break the plane of the field perimeter. Therefore, rules <S1> and <S2> still apply to this interaction.

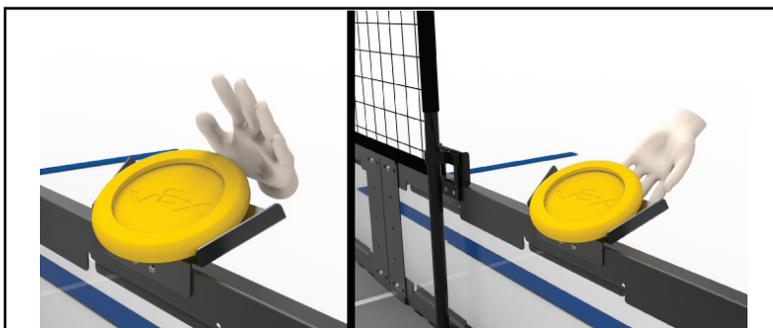


Figure 22: Recommended safe methods for introducing Discs through the Loader

<SG7> Possession is limited to three (3) Discs. Robots may not have greater-than-momentary Possession of more than three (3) Discs at once. Robots in Violation of this rule must immediately stop all Robot actions except for attempting to remove the excess Disc(s). A Robot that is in Violation of rule <SG7> and cannot rectify the Violation cannot participate in further gameplay and will not receive points for tiles Covered in the Endgame.

Note: This rule applies to both intentional and accidental Possession.

Violation Notes:

- Any intentional Violation by an Alliance who wins the Match will be considered Match Affecting.
- Egregious Violations, such as continuing to play other portions of the Game (e.g., Rollers or Endgame) without attempting to remove excess Discs for the majority of the Match, or "accidentally" Possessing an egregious amount of Discs, may also be considered Major Violations at the Head Referee's discretion.

Other than a situation involving a blatantly intentional Violation of <G14>, any Robot which is in Possession of more than three Discs is in Violation of this rule, regardless of intent, circumstance, or context. It is extremely difficult to extrapolate how limiting an opponent's access to game objects, even temporarily, may impact a Match. Therefore, in general, it is a Team's responsibility to ensure that:

- a. Their Robots are designed to mitigate the possibility of controversial rulings (e.g., they cannot physically Possess more than the permitted Disc limit).
- b. Their strategies during a Match mitigate the possibility of controversial rulings (e.g., they do not attempt to score any points while Possessing four or more Discs).

<SG8> Don't cross the Autonomous Line. During the Autonomous Period, Robots may not contact foam tiles, Discs, or Rollers which are on the opposing Alliance's side of the Autonomous Line.

- a. <G17> does not apply to this rule, unless egregiously exploited for strategic gain. It is expected that Discs which are launched as part of normal Autonomous gameplay will contact foam tiles on the opponent's side of the field, and this is not a Violation. However, holding a Disc over the Autonomous Line to manipulate an opponent's Roller would still be considered a Violation.
- b. The fourteen (14) Discs which begin the Match on the Autonomous Line are not considered to be on either side, and may be utilized by either Alliance during the Autonomous Period. If attempting to utilize these Discs, Teams should be cognizant of the possibility that opponent Robots may attempt to do the same. <G11>, <G12>, <G14>, and <G17> will be taken into account when these types of Robot interactions occur. Teams should also be prepared for additional scrutiny from Head Referees to ensure that any mechanisms which interact with these Discs do not contact the foam tiles on the other side of the Autonomous Line.

Violation Notes:

- *All Violations of this rule (Major or Minor) will result in the Autonomous Bonus being awarded to the opposing Alliance.*
- *Intentional, strategic, or egregious Violations, such as intentional contact with an opposing Robot while completely across the Autonomous Line, will be considered Major Violations.*

<SG9> Keep Discs in the field. Teams may not intentionally remove Discs from the field.

- Although Discs may accidentally leave the field, doing so intentionally or repeatedly would be a *Violation* of this rule.
- Discs that leave the field during *Match* play, whether intentionally or unintentionally, will be returned to the field at a location nearest the point at which they exited. Referees will return the Discs to the field when it is deemed safe to do so, at the leisure of the referee.

Violation Notes: Major Violations of this rule should be rare; a single Disc exiting the field will almost always be considered accidental / incidental.

Occasionally, a Disc launched at a *High Goal* may exit the field by slipping through the bottom of the *Net*. When this happens, it should be returned to the *Low Goal*, since this would be considered the "location nearest the point at which it exited". [See this Q&A for more information.](#)

Section 3

The Robot

Overview

This section provides rules and requirements for the design and construction of your *Robot*. A VEX Robotics Competition *Robot* is a remotely operated and / or autonomous vehicle designed and built by a registered VEX Robotics Competition *Team* to perform specific tasks.

There are specific rules and limitations that apply to the design and construction of your *Robot*. Please ensure that you are familiar with these *Robot* rules before beginning your *Robot* design. These “inspection rules” are verified prior to the beginning of each event, in a formal *Robot* Inspection.

Inspection Rules are “pass / fail”; there are no Major or Minor Violations, only *Violations*. The penalty for all *Violations* is the same, as outlined in <R3d> and <R26>.

Most of these rules are “hard limits,” such as the maximum number of motors permitted. However, some are “at inspector discretion,” such as determining a mechanism’s potential safety risk. At many events, the lead inspector and the *Head Referee* are the same person; if they are not, then the volunteer inspector should confirm any questionable judgment calls with the *Head Referee*. The *Head Referee* has final authority regarding all *Robot* rules, since it is ultimately their decision whether a *Robot* takes the field for a *Match* after inspection has concluded (per <R3d> and <R3e>).

Inspection Rules

<R1> One Robot per Team. Only one (1) *Robot* will be allowed to compete per *Team* at a given event in the VEX Robotics Competition. Though it is expected that *Teams* will make changes to their *Robot* at the competition, a *Team* is limited to only one (1) *Robot* at a given event. A VEX *Robot*, for the purposes of the VEX Robotics Competition, has the following subsystems:

- Subsystem 1: Mobile robotic base including wheels, tracks, legs, or any other mechanism that allows the *Robot* to navigate the majority of the flat playing field surface. For a stationary *Robot*, the robotic base without wheels would be considered Subsystem 1.
- Subsystem 2: Power and control system that includes a legal VEX battery, a legal VEX control system, and associated motors for the mobile robotic base.
- Subsystem 3: Additional mechanisms (and associated motors) that allow manipulation of *Discs*, *Field Elements*, or navigation of field obstacles.

Given the above definitions, a minimum *Robot* for use in any VEX Robotics Competition event (including Skills Challenges) must consist of subsystems 1 and 2 above. Thus, if you are swapping out an entire subsystem of either item 1 or 2, you have now created a second *Robot* and have Violated this rule.

- a. *Teams* may not compete with one *Robot* while a second is being modified or assembled
- b. *Teams* may not have an assembled second *Robot* on-hand that is used to repair or swap parts with the first *Robot*.
- c. *Teams* may not switch back and forth between multiple *Robots* during a competition. This includes using different *Robots* for Skills Challenges, *Qualification Matches* and / or *Elimination Matches*.

- d. Multiple *Teams* may not use the same *Robot*. Once a *Robot* has competed under a given *Team* number at an event, it is “their” *Robot* - no other *Teams* may compete with it for the duration of the competition season.

The intent of <R1a>, <R1b>, and <R1c> is to ensure an unambiguous level playing field for all *Teams*. *Teams* are welcome (and encouraged) to improve or modify their *Robots* between events, or to collaborate with other *Teams* to develop the best possible game solution.

However, a *Team* who brings and / or competes with two separate *Robots* at the same tournament has diminished the efforts of a *Team* who spent extra design time making sure that their one *Robot* can accomplish all of the game’s tasks. A multi-*Team* organization that shares a single *Robot* has diminished the efforts of a multi-*Team* organization who puts in the time, effort, and resources to undergo separate individual design processes and develop their own *Robots*.

To help determine if a *Robot* is a “separate *Robot*” or not, use the subsystem definitions found in <R1>. Above that, use common sense as referenced in <G3>. If you can place two *Robots* on a table next to each other, and they look like two separate legal / complete *Robots* (i.e., each have the 3 subsystems defined by <R1>), then they are two *Robots*. Trying to decide if changing a screw, a wheel, or a microcontroller constitutes a separate *Robot* is missing the intent and spirit of this rule.

<R2> Robots must represent the Team’s skill level. The *Robot* must be designed, built, and programmed by members of the *Team*. *Adults* are expected to mentor and teach design, building and programming skills to the *Students* on the *Team*, but may not design, build, or program that *Team*’s *Robot*. See rules <G2> and <G6>.

In VRC, we expect *Adults* to teach fundamental *Robot* principles like linkages, drive-trains, and manipulators, then allow the *Students* to determine which designs to implement and build on their *Robot*.

Similarly, *Adults* are encouraged to teach the *Students* how to code various functions involving applicable sensors, then have the *Students* program the *Robot* from what they have learned.

<R3> Robots must pass inspection. Every *Robot* will be required to pass a full inspection before being cleared to compete. This inspection will ensure that all *Robot* rules and regulations are met. Initial inspections will take place during team registration / practice time.

- a. Significant changes to a *Robot*, such as a partial or full swap of Subsystem 3, must be re-inspected before the *Robot* may compete again.
- b. All possible functional *Robot* configurations must be inspected before being used in competition. This especially pertains to modular or swappable mechanisms (per <R1>) and *Match* starting configurations / sizes (per <R5>).

- c. Teams may be requested to submit to random spot inspections by *Head Referees*. Refusal to submit will result in *Disqualification*.
 - i. If a *Robot* is determined to be in *Violation* of a *Robot* rule before a *Match* begins, the *Robot* will be removed from the field. A *Drive Team Member* may remain at the field so that the *Team* does not get assessed a "no-show" (per <T5>).
- d. *Robots* which have not passed inspection (i.e., that may be in *Violation* of one or more *Robot* rules) will not be permitted to play in any *Matches* until they have done so. <T5> will apply to any *Matches* that occur until the *Robot* has passed inspection.
- e. If a *Robot* has passed inspection, but is later confirmed to be in *Violation* of a *Robot* rule during a *Match* by a *Head Referee*, they will be *Disqualified* from that *Match*. This is the only *Match* that will be affected; any prior *Matches* that have already been completed will not be revisited. <R3d> will apply until the *Violation* is remedied and the *Team* is re-inspected.
- f. All Inspection Rules are to be enforced within the discretion of the *Head Referee* within a given event. *Robot* legality at one event does not automatically imply legality at future events. *Robots* which rely on "edge-case" interpretations of subjective rules, such as whether a decoration is "non-functional" or not, should expect additional scrutiny during inspection.

<R4> **Robots must be safe.** The following types of mechanisms and components are NOT allowed:

- a. Those that could potentially damage *Field Elements* or *Discs*.
- b. Those that could potentially damage other competing *Robots*.
- c. Those that pose an unnecessary risk of *Entanglement* with other *Robots* or the *Net*.
- d. Those that could pose a potential safety hazard to *Drive Team Members*, event staff, or other humans.

Per <G12d>, it is expected that some *Entanglement* or incidental damage may occur during the *Endgame*. Therefore, it will be at the inspector's discretion whether any mechanisms designed solely for use during the *Endgame* violate any portion of <R4>.

In general, if the mechanism in question does not pose a risk of *Entanglement* or damage during the rest of the *Match* (e.g., it is demonstrably confined to an intentional expansion during the *Endgame*), then it will not be considered a violation of <R4a>, <R4b>, or <R4c>. This can be considered a "necessary" risk, in the context of <R4> / <G12>.

However, this interpretation does not extend to rule <R4d>. Any mechanism or component which is deemed to pose an unnecessary / egregious safety risk may still be considered in violation of <R4>, <S1>, and / or <G1> at the *Head Referee's* discretion.

<R5> **Robots must fit in a sizing box.** *Robots* must be able to satisfy <G4>, and begin each *Match* in a volume smaller than 18" (457.2 mm) long by 18" (457.2 mm) wide by 18" (457.2 mm) tall.

- a. Compliance with this rule must be checked using the official VEX Robotics On-Field Robot Expansion Sizing Tool: <https://www.vexrobotics.com/276-5942.html>.

- b. Any restraints used to maintain starting size (i.e., zip ties, rubber bands, etc.) must remain attached to the *Robot* for the duration of the *Match*, per <G5>.
- c. For the purposes of this rule, it can be assumed that *Robots* will be inspected and begin each *Match* on a flat standard foam field tile.

The official sizing tool is intentionally manufactured with a slightly oversized tolerance. Therefore, any contact with the sizing tool (i.e., a "paper test") while being measured should be considered a clear indication that a *Robot* is outside of the permitted size. This tolerance also provides a slight "leeway" for minor protrusions, such as screw heads or zip ties.

Other tools, such as custom sizing boxes or the legacy non-expanding VEX Sizing Tool (276-2086), may be used for informal checks. However, in the event of a conflict or "close call," a check with the official On-Field Robot Expansion Sizing Tool takes precedence.

Although it is not required by <R5>, events may also choose to check that any possible *Robot* expansion satisfies the requirements of <SG4> and <SG5> during inspection. The intent of this check is to help *Teams* identify any potential *Violation* risks before their *Matches*.

<R6> Robots are built from the VEX V5 system. *Robots* may be built ONLY using official VEX V5 components, unless otherwise specifically noted within these rules. *Teams* are responsible for providing documentation proving a part's legality in the event of a question. Examples of documentation include receipts, part numbers, official VEX websites, or other printed evidence.

- a. Products from the VEXpro, VEX EXP, VEX IQ, VEX GO, VEX 123, or VEX Robotics by HEXBUG product lines cannot be used for *Robot* construction, unless specifically allowed by a clause of <R7> or "cross-listed" as part of the VEX V5 Product lines. For example, the Shaft Base Pack (228-3506) is a VEX IQ component that can be found on the VEX "Drive Shafts" page, and is thus legal: <https://www.vexrobotics.com/drive-shafts.html>.
- b. The following electronics from the VEX Cortex control system are not permitted:

SKU	Description
276-2192	VEXnet Joystick
276-1891	VEXnet Partner Joystick
276-2194	VEX ARM® Cortex-based Microcontroller
276-2245 / 276-3245	VEXnet Key 1.0 / 2.0
276-2177	2-Wire Motor 393
276-2162	3-Wire Servo
276-2210	VEX Flashlight
276-2193	Motor Controller 29

- c. The following electronics from the VEX Cortex control system are permitted:

SKU	Description
276-2174 / 276-4859	Limit Switch V1 / V2
276-2159	Bumper Switch
276-2156	Optical Shaft Encoder
276-2216	Potentiometer
276-2155	Ultrasonic Range Finder
276-2176	LED Indicator
276-2333	Yaw Rate Gyroscope
276-2332	Analog Accelerometer V1.0
276-2154	Line Tracker
276-1380	Jumper
276-2158	Light Sensor

- d. Components that are unique to the V5 Workcell product line are not permitted. This includes the following:

SKU	Description
276-7151	Robot Arm Metal
276-7152	Robot Brain Mount
276-7153	Input Output Conveyor
276-7720	Disc Feeder
276-7047	V5 Electromagnet
276-4842	V5 Smart Motor (5.5W)

- e. VEX IQ pins are permitted, if used solely for the purpose of attaching *Robot* License Plates.
- f. Components obtained from the V5 beta program, including V5 beta firmware, are not legal for competition use.
- i. All V5 beta hardware can be identified by its lighter gray pre-production color. Robot Brains, Robot Batteries, Controllers, and Vision Sensors from the V5 beta have a "BETA TEST" stamp on them. Smart Motors and Radios do not have this stamp, but can still be identified by color.
- g. Components from the VEXplorer kit that are not found in modern VEX V5 kits are not permitted. These include (but may not be limited to) electronics, wheels, non-standard gears, and plastic connectors.
- h. Official VEX products are ONLY available from VEX Robotics. All official products are listed on www.vexrobotics.com.

Using VEX apparel, competition support materials, packaging, or other non-*Robot* products on a VEX Robotics Competition *Robot* goes against the spirit of this rule and is not permitted.

<R7> Certain non-VEX components are allowed. Robots are allowed the following additional “non-VEX” components:

- a. Any material strictly used as a color filter or a color marker for a legal sensor, such as the VEX Light Sensor or the VEX V5 Vision Sensor.
- b. Any non-aerosol-based grease or lubricating compound, when used in extreme moderation on surfaces and locations that do NOT contact the playing field walls, foam field surface, *Discs*, or other *Robots*.
- c. Anti-static compound, when used in extreme moderation (i.e., such that it does not leave residue on *Field Elements*, *Discs*, or other *Robots*).
- d. Hot glue when used to secure cable connections.
- e. An unlimited amount of non-elastic rope / string, with a thickness / diameter between 1/8" (imperial standard) / 3mm (metric standard) and 1/4" (6.35mm). String must measure at least 1/8" / 3mm in diameter at its narrowest point while on the Robot under no load.
- f. Commercially available items used solely for bundling or wrapping of 2-wire, 3-wire, 4-wire, or V5 Smart Cables, and / or pneumatic tubing are allowed. These items must solely be used for the purposes of cable / tubing protection, organization, or management. This includes but is not limited to electrical tape, cable carrier, cable track, etc. It is up to inspectors to determine whether a component is serving a function beyond protecting and managing cables and tubing.
- g. Non-functional 3D printed license plates, per <R12> and <R24>, are permitted. This includes any supporting structures whose sole purpose is to hold, mount, or display an official license plate.
- h. Rubber bands that are identical in length and thickness to those included in the VEX V5 product line (#32, #64 and 117B).
- i. Pneumatic components with identical SMC manufacturer part numbers to those listed on the VEX website. For more detail regarding legal pneumatic components, see the Legal VEX Pneumatics Summary document: <https://link.vex.com/docs/2022-2023/vrc-spin-up/LegalPneumatics>.
- j. Zip ties that are identical in length and thickness to those included in the VEX V5 product line (4" or 11" long).

If string is used as part of an *Endgame* expansion mechanism, we strongly recommend *Teams* use a string color that matches their *Alliance* for the current *Match*, or a highly visible string that is periodically marked with their current *Alliance* color. *Teams* that choose not to do this make *Match* scoring difficult for referees and scorekeepers, and open the possibility that *Covered* tiles may be missed or incorrectly scored.

<R8> Give the radio some space. The V5 Radio must be mounted such that no metal surrounds the radio symbol on the V5 Radio.

It is fine to loosely encapsulate the V5 Radio within *Robot* structure. The intent of this rule is to minimize radio connection issues by minimizing obstructions between VEXnet devices. Burying a radio deep within a *Robot* may result in *Robot* communication issues.

<R9> A limited amount of custom plastic is allowed. Robots may use custom-made parts cut from certain types of non-shattering plastic. It must be possible to have cut all of the plastic parts on the Robot from a single 12" x 24" sheet, up to 0.070" thick.

- a. The intent of the area / thickness constraints is to limit the number of custom plastic parts used in Robot construction, not to define an absolute volume. For example, using a sheet which is 0.035" thick does not permit two 12" x 24" sheets' worth of parts.
- b. Plastic parts do not have to be literally cut from the same original 12" x 24" sheet. However, all individual parts must be able to "nest" or rearrange into a 12" x 24" area.
 - i. A collection of parts which theoretically have a total surface area of 288 in², but cannot be nested onto a single 12" x 24" sheet, would not be legal. See Figure 23.
- c. Plastic may be mechanically altered by cutting, drilling, bending, etc. It cannot be chemically treated, melted, or cast. Heating polycarbonate to aid in bending is acceptable.
- d. Legal plastic types include polycarbonate (Lexan), acetal monopolymer (Delrin), acetal copolymer (Acetron GP), POM (acetal), ABS, PEEK, PET, HDPE, LDPE, Nylon (all grades), Polypropylene, and FEP.
- e. Shattering plastic, such as PMMA (also called Plexiglass, Acrylic, or Perspex), is prohibited.
- f. The PET Sheet Variety Pack (276-8340), sold by VEX, is considered "plastic" in the context of this rule, and is subject to the same limitations as "off-the-shelf" plastic sheets.
- g. This rule does not apply to 3D printed plastic parts. 3D printed parts are not permitted in the VEX Robotics Competition, except as non-functional decorations (per <R12>) or as custom License Plates (per <R24>).

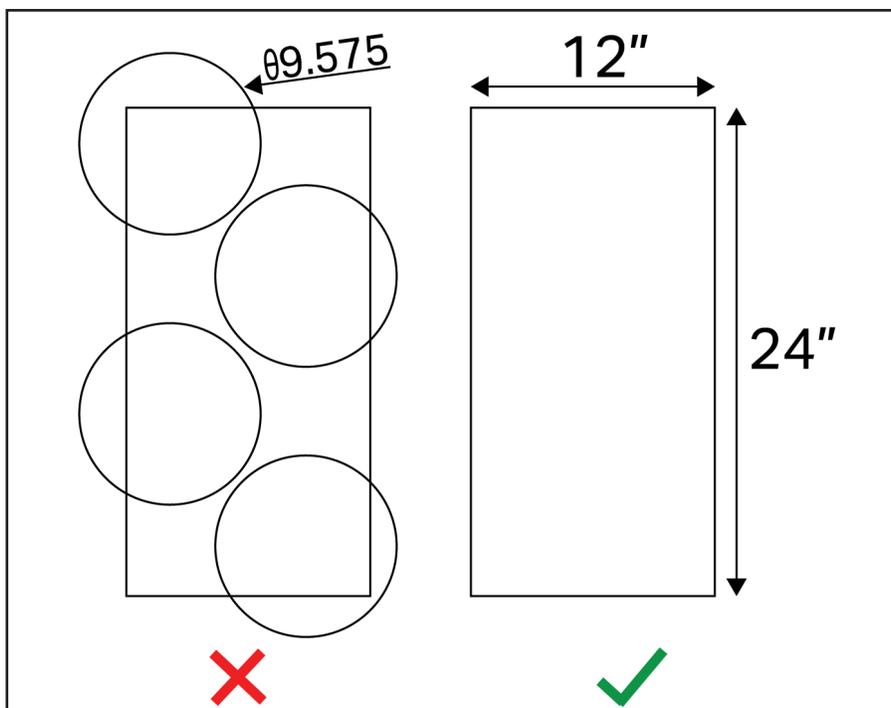


Figure 23: Custom plastic parts must fit within a single 12" x 24" sheet of plastic.

<R10> A limited amount of tape is allowed. *Robots* may use a small amount of tape for the following purposes:

- a. To secure any connection between the ends of two (2) VEX cables.
- b. To label wires and motors.
- c. To cover the backs of license plates (i.e., hiding the “wrong color”).
- d. To prevent leaks on the threaded portions of pneumatic fittings. This is the only acceptable use of Teflon tape.
- e. In any other application that would be considered a “non-functional decoration” per <R12>.

<R11> Certain non-VEX fasteners are allowed. *Robots* may use the following commercially available hardware:

- a. #4, #6, #8, M3, M3.5, or M4 screws up to 2.5” (63.5mm) long made of steel or stainless steel (i.e. similar to those found in the VEX V5 product line).
- b. Shoulder screws cannot have a shoulder length over 0.20” and a diameter over 0.176”
- c. Any commercially available nut, washer, standoff, and / or non-threaded spacer up to 2.5” (63.5mm) long which fits these screws.

The intent of the rule is to allow *Teams* to purchase their own commodity hardware without introducing additional functionality not found in standard VEX equipment. It is up to inspectors to determine whether the non-VEX hardware has introduced additional functionality or not.

If a key component of a *Robot’s* design relies upon convincing an inspector that a specialized component is “technically a screw,” it is probably outside of the spirit and intent of this rule.

All specific dimensions listed in this rule are intended to be ‘nominal’ references to hardware sizes found within the VEX V5 product line and / or their metric equivalents.

<R12> Decorations are allowed. *Teams* may add non-functional decorations, provided that they do not affect *Robot* performance in any significant way or affect the outcome of the *Match*. These decorations must be in the spirit of the competition. Inspectors will have final say in what is considered “non-functional.” Unless otherwise specified below, non-functional decorations are governed by all standard *Robot* rules.

To be considered “non-functional,” any guards, decals, or other decorations must be backed by legal materials that provide the same functionality. For example, if a *Robot* has a giant decal that prevents *Discs* from falling out of the *Robot*, the decal must be backed by VEX material that would also prevent the *Discs* from falling out. A simple way to check this is to determine if removing the decoration would impact the performance of the *Robot* in any way.

- a. Anodizing and painting of parts is considered a legal nonfunctional decoration.

- b. Small cameras are permitted as non-functional decorations, provided that any transmitting functions or wireless communications are disabled. Unusually large cameras being used as ballast are not permitted.
- c. VEX electronics may not be used as non-functional decorations.
- d. Decorations that visually mimic *Field Elements*, or could otherwise interfere with an opponent's Vision Sensor, are considered functional and are not permitted. The Inspector and *Head Referee* will make the final decision on whether a given decoration or mechanism violates this rule.
- e. Internal power sources (e.g., for a small blinking light) are permitted, provided that no other rules are violated and this source only provides power to the non-functional decoration (i.e. does not directly or indirectly influence any functional portions of the *Robot*).
- f. Decorations which provide feedback to the *Robot* (e.g., by influencing legal sensors) would be considered "functional," and are not permitted.
- g. Decorations which provide visual feedback to Drive Team Members (e.g., decorative lighting) are permitted, provided that they do not violate any other rules and serve no other function (e.g., structural support).

<R13> New VEX parts are legal. Additional VEX components released during the competition season on www.vexrobotics.com are considered legal for use unless otherwise noted.

Some "new" components may have certain restrictions placed on them upon their release. These restrictions will be documented in the official Q&A, in a Game Manual Update, or on their respective product web pages.

<R14> Robots have one microcontroller. *Robots* must ONLY use one (1) VEX V5 Robot Brain (276-4810). Any other microcontrollers or processing devices are not allowed, even as non-functional decorations.

This includes microcontrollers that are part of other VEX product lines, such as VEX Cortex, VEX EXP, VEXpro, VEX RCR, VEX IQ, VEX GO, or VEX Robotics by HEXBUG. This also includes devices that are unrelated to VEX, such as Raspberry Pi or Arduino devices.

<R15> Robots use VEXnet. *Robots* must ONLY utilize the VEXnet system for all wireless *Robot* communication.

- a. Electronics from the Cortex, VEX EXP, VEXpro, VEX RCR, VEXplorer, VEX IQ, VEX GO, or VEX Robotics by HEXBUG product line are prohibited unless otherwise noted in <R6c>.
- b. V5 Controllers may only be used in conjunction with a V5 Robot Brain.
- c. *Teams* are permitted to use the Bluetooth® capabilities of the V5 Robot Brain and / or V5 Controller in *Team* pits or outside of *Matches*. However, VEXnet must be used for wireless communication during *Matches*.
- d. *Teams* are permitted to use the Wi-Fi capabilities of the Vision Sensor in *Team* pits or outside of *Matches*. However, the Vision Sensor must have its wireless transmitting functionality disabled during *Matches*.

<R16> Motors are limited. *Robots* may use up to eight (8) V5 Smart Motors.

- a. V5 Smart Motors, connected to V5 Smart Ports, are the only motors that may be used with a V5 Robot Brain. The 3-wire ports may not be used to control motors of any kind.
- b. The 5.5W V5 Smart Motor, found in the V5 Workcell system, is not legal for use.

<R17> Pneumatics are limited. A *Robot's* pneumatic sub-system must satisfy the following criteria:

- a. *Teams* may use a maximum of two (2) legal VEX pneumatic air reservoirs on a *Robot*.
- b. Pneumatic devices may be charged to a maximum of 100 psi.
- c. The compressed air contained inside a pneumatic sub-system can only be used to actuate legal pneumatic devices (e.g., cylinders).

The intent of <R17a> and <R17b> is to limit *Robots* to the air pressure stored in two reservoir tanks, as well as the normal working air pressure contained in their pneumatic cylinders and tubing on the *Robot*. *Teams* may not use other elements for the purposes of storing or generating air pressure. Using cylinders or additional pneumatic tubing solely for additional storage is in *Violation* of the spirit of this rule.

The intent of <R17c> is to ensure that pneumatics are being used safely. Pressurized systems, such as a *Robot's* pneumatic sub-system, have the potential to be dangerous if used incorrectly. This rule ensures the safety of participants, and prevents potentially unsafe uses in the future.

Another way of thinking of <R17c> is that pneumatics should only be used with pneumatics. *Teams* should not use compressed air as a means of actuating non-pneumatic devices such as screws, nuts, etc. For example, pulling a pin with a pneumatic cylinder is okay, but using air to actuate the pin itself is not.

<R18> Electrical power comes from VEX batteries only. *Robots* may use one (1) V5 Robot Battery (276-4811) to power the V5 Robot Brain.

- a. No other sources of electrical power are permitted, unless used as part of a non-functional decoration per <R12e>.
- b. There are no legal power expanders for the V5 Robot Battery.
- c. V5 Robot Batteries may only be charged by a V5 Robot Battery Charger (276-4812 or 276-4841).
- d. V5 Wireless Controllers may only be powered by their internal rechargeable battery.
 - i. *Teams* are permitted to have an external power source (such as a rechargeable battery pack) plugged into their V5 Controller during a *Match*, provided that this power source is connected safely and does not violate any other rules, such as <G8> or <R22>.
 - ii. Some events may choose to provide field power for V5 Wireless Controllers. If this is provided for all *Teams* at the event, then this is a legal power source for the wireless remotes.

<R19> One or two Controllers per Robot. No more than two (2) VEX V5 Controllers may control a single *Robot*.

- a. No physical or electrical modification of these Controllers is allowed under any circumstances.
 - i. Attachments which assist the *Drive Team Member* in holding or manipulating buttons / joysticks on the V5 Controller are permitted, provided that they do not involve direct physical or electrical modification of the Controller itself.
- b. No other methods of controlling the *Robot* (light, sound, etc.) are permissible.
 - i. Using sensor feedback to augment Driver control (such as motor encoders or the Vision Sensor) is permitted.

<R20> No modifications to electronic or pneumatic components are allowed. Motors (including the internal PTC or V5 Smart Motor firmware), microcontrollers (including V5 Robot Brain firmware), cables, sensors, controllers, battery packs, reservoirs, solenoids, pneumatic cylinders, and any other electrical or pneumatics component of the VEX platform may NOT be altered from their original state in ANY way.

- a. External wires on VEX 2-wire or 3-wire electrical components may be repaired by soldering or using twist / crimp connectors, electrical tape, or shrink tubing such that the original functionality and length are not modified in any way.
 - i. Wire used in repairs must be identical to VEX wire.
 - ii. *Teams* make these repairs at their own risk; incorrect wiring may have undesired results.
- b. *Teams* must use the latest official VEXos firmware updates, found at <https://link.vex.com/firmware>. Custom firmware modifications are not permitted.
- c. *Teams* may make the following modifications to the V5 Smart Motor's user-serviceable features. This list is all-inclusive; no other modifications are permitted. Where applicable, the components listed below (in the specific applications listed below) are permissible exceptions to <R11>.
 - i. Removing the gear cartridge, or replacing the gear cartridge with other official cartridges.
 - ii. Removing or replacing the screws from the V5 Smart Motor Cap (276-6780).
 - iii. Removing or replacing the threaded mounting inserts (276-6781).
 - iv. Aesthetic / non-functional labeling (e.g. markers, stickers, etc).
- d. For the purposes of this rule, the gear cartridges found within the V5 Smart Motor are considered "part of the motor". Therefore, any physical or functional modifications to official gear cartridges is not permitted.
- e. For the purposes of this rule, the V5 Smart Motor Cap is not considered "part of the motor". Therefore, <R22> applies.

<R21> Custom V5 Smart Cables are allowed. *Teams* who create custom cables acknowledge that incorrect wiring may have undesired results.

- a. Official V5 Smart Cable Stock must be used.
- b. Use of non-VEX 4P4C connectors and 4P4C crimping tools is permissible.

<R22> Most modifications to non-electrical components are allowed. Physical modifications, such as bending or cutting, of legal metal structure or plastic components are permitted.

- a. Internal or external mechanical repairs of VEX Limit and Bumper switches are permitted.
 - i. Modifying the metal arm on the Limit Switch is permitted.
 - ii. Using components from these devices in other applications is prohibited.
- b. Metallurgical modifications that change fundamental material properties, such as heat treating or melting, are not permitted.
- c. Pneumatic tubing may be cut to desired lengths.
- d. Fusing / melting the end of legal nylon rope / string (see <R7e>) to prevent fraying is permitted.
- e. Welding, soldering, brazing, gluing, or attaching parts to each other in any way that is not provided within the VEX platform is not permitted.
- f. Mechanical fasteners may be secured using Loctite or a similar thread-locking product. This may ONLY be used for securing hardware, such as screws and nuts.

<R23> Keep the power button accessible. The on / off button on the V5 Robot Brain must be accessible without moving or lifting the *Robot*. All screens and / or lights must also be easily visible by competition personnel to assist in diagnosing *Robot* problems.

<R24> Officially registered Team numbers must be displayed on Robot license plates. To participate in an official VEX Robotics Competition event, a *Team* must first register on robotevents.com and receive a VRC *Team* number.

This *Team* number must be displayed on a minimum of two (2) sides of the *Robot* using license plates. *Teams* may choose to use the official VRC License Plate Kit, or may create their own.

- a. *Robots* must use plates that match their *Alliance* color for each *Match* (i.e., red *Alliance Robots* must display red plates for the *Match*). It must be abundantly clear which color *Alliance* the *Robot* belongs to.
 - i. If both colors of license plates are mounted on a *Robot*, then the incorrect color must be covered, taped over, or otherwise obscured. Because license plates are considered non-functional decorations, this is a legal non-functional use of tape.
- b. License plates are considered non-functional decorations (per <R12>), and must abide by all relevant *Robot* rules (i.e., they must fit within the 18" cube, cannot functionally change the stability or rigidity of the *Robot*, cause *Entanglement*, etc.).
- c. Team numbers must be in white font.
- d. License plates must be at least 2.48 inches (63.2mm) tall and 4.48 inches (114mm) wide (i.e., at least the height/width dimensions of the plates in the VRC License Plate Kit).



Figure 24: An example of a license plate made from the VRC License Plate Kit



Figure 25: An example of a legal custom license plate

The intent of this rule is to make it immediately apparent to *Head Referees* which *Alliance* and which *Team* each *Robot* belongs to, at all times. Being able to "see through" a *Robot* arm to the wrong color license plate on the opposite side of the *Robot* could cause confusion, and would be considered a *Violation* of <R24a>.

It will be at the full discretion of the *Head Referee* and inspector at a given event to determine whether a given custom license plate satisfies the criteria listed in <R24>. *Teams* wishing to utilize custom plates should be prepared for the possibility of this judgment, and ensure that they are prepared to replace any custom parts with official VEX license plates if requested. Not bringing official replacement plates to an event will not be an acceptable reason for overlooking a *Violation* of one or more points in <R24>.

<R25> **Use a "Competition Template" for programming.** The *Robot* must be programmed to follow control directions provided by the VEXnet Field Controllers.

During the *Autonomous Period*, *Drive Team Members* will not be allowed to use their V5 Controllers. As such, *Teams* are responsible for programming their *Robot* with custom software if they want to perform in the *Autonomous Period*. *Robots* must be programmed to follow control directions provided by the VEXnet Field Controllers (i.e., ignore wireless input during the *Autonomous Period*, disable at the end of the *Driver Controlled Period*, etc.).

Teams must use a provided "competition template" or functional equivalent to accomplish this. For more information on this, *Teams* should consult the help guides produced by the developers of their chosen programming software.

<R26> **There is a difference between accidentally and willfully violating a Robot rule.** Any *Violation* of *Robot* rules, whether accidental or intentional, will result in a *Team* being unable to play until they pass inspection (per <R3d>).

However, *Teams* who intentionally and / or knowingly circumvent or violate rules to gain an advantage over their fellow competitors are in *Violation* of the spirit and ethos of the competition. Any *Violation* of this sort may be considered a *Violation* of <G1> and / or the REC Foundation Code of Conduct.

<R27> **Let go of Discs after the Match.** *Robots* must be designed to permit easy removal of *Discs* from any mechanism without requiring the *Robot* to have power after a *Match*.

Section 4

The Tournament

Overview

VEX Robotics Competition Qualification and Elimination *Matches* are played in a Head-to-Head tournament format. *Qualification Matches* are used to rank *Teams* based on *Win Points* (WP), *Autonomous Points* (AP), and *Strength of Schedule Points* (SP). The top-ranked *Teams* then form *Alliances* to participate in *Elimination Matches* and determine the tournament champions.

This section applies primarily to VRC Head-to-Head *Matches*. For rules specific to other types of *Matches*, see Appendices B, C, D, and E

Tournament Definitions

Alliance Captain - One of the *Teams* with the privilege of inviting another available *Team* to form an *Alliance* for the *Elimination Matches*. See <T15>.

Alliance Selection - The process of choosing the permanent *Alliances* for the *Elimination Matches*. *Alliance Selection* proceeds as follows:

1. The highest ranked *Team* at the end of *Qualification Matches* becomes the first *Alliance Captain*.
2. The *Alliance Captain* invites another *Team* to join their *Alliance*.
3. The invited *Team's* representative either accepts or declines as outlined in <T15>.
4. The next-highest-ranked *Team* becomes the next *Alliance Captain*.
5. *Alliance Captains* continue to select their *Alliances* in this order until all *Alliances* are formed for the *Elimination Matches*

Autonomous Points (AP) - The second basis of ranking *Teams*. An *Alliance* who wins the *Autonomous Bonus* during a *Qualification Match* earns ten (10) *Autonomous Points*. In the event of a tie, both *Alliances* will receive five (5) *Autonomous Points*.

Autonomous Win Point - One (1) *Win Point* (WP) given to an *Alliance* that *Owens* two (2) *Rollers* and has *Scored* at least two (2) *Discs* in their *Alliance-colored High Goal* at the end of the *Autonomous Period*. Both *Alliances* can earn this *Win Point* if both *Alliances* accomplish this task.

Elimination Bracket - A schedule of *Elimination Matches* for eight (8) to sixteen (16) *Alliances*. See <T16>.

Elimination Match - A *Match* used in the process of determining the champion *Alliance*. *Alliances* of two (2) *Teams* face off according to the *Elimination Bracket*; the winning *Alliance* moves on to the next round.

Event Partner - The volunteer VEX Robotics Competition tournament coordinator who serves as an overall manager for the volunteers, venue, event materials, and all other event considerations. *Event Partners* serve as the official liaison between the REC Foundation, other event volunteers, and event attendees.

Head Referee - An impartial volunteer responsible for enforcing the rules in this manual as written. *Head Referees* must have completed the REC Foundation Head Referee certification course (expected to be released in Summer 2022). *Head Referees* are the only individuals who may discuss ruling interpretations or scoring questions with *Teams* at an event.

Match Schedule - A list of *Matches* that is generated at the start of an event. The *Match Schedule* includes the predetermined, randomly-paired *Alliances* that will be competing in each *Qualification Match*, and the expected start times for these *Matches*. The *Match Schedule* is subject to change at the *Event Partner's* discretion.

- **Practice Match** - A *Match* used to provide time for *Teams* and volunteers to get acquainted with the official playing field and procedures. *Practice Matches* earn *Teams* zero (0) *Win Points*, *Autonomous Points*, and *Strength of Schedule Points*.
- **Qualification Match** - A *Match* used to determine *Team* rankings for *Alliance Selection*. Each *Qualification Match* consists of two *Alliances* competing to earn *Win Points*, *Autonomous Points*, and *Strength of Schedule Points*.

Qualification Match List 						
KALAHARI CLASSIC INDOOR WATERPARK VEX VRC High School Signature Event - Zambezi						
Match	Field	Time	Red 1	Red 2	Blue 1	Blue 2
Q1	Field 1	Fri 9:00 AM	3547Y	7316G	248E	99999V
Q2	Field 1	Fri 9:06 AM	3145M	26681B	8823G	23017A
Q3	Field 1	Fri 9:12 AM	59759A	45224A	6008B	2011G
Q4	Field 1	Fri 9:18 AM	75476Z	7882F	11124E	169A
Q5	Field 1	Fri 9:24 AM	7882B	9364C	40938A	1375A
Q6	Field 1	Fri 9:30 AM	7316A	98575A	6210Y	6741A
Q7	Field 1	Fri 9:36 AM	97031A	6008Z	6741E	7316X
Q8	Field 1	Fri 9:42 AM	2894B	5430A	1274A	3547A
Q9	Field 1	Fri 9:48 AM	11254X	60883D	23017C	2719J
Q10	Field 1	Fri 9:54 AM	323V	9364E	2011A	81P
Q11	Field 1	Fri 10:00 AM	6842C	2719A	6302U	248C
Q12	Field 1	Fri 10:06 AM	11124W	6403W	9364A	9257C
Q13	Field 1	Fri 10:12 AM	2011C	6008N	244D	44691X
Q14	Field 1	Fri 10:18 AM	60470S	8823C	8823E	11124P
Q15	Field 1	Fri 10:24 AM	7316E	2011E	38141A	40938C

Figure 26: An example of a Qualification Match Schedule

Scorekeeper Referee - An impartial volunteer responsible for tallying scores at the end of a *Match*. *Scorekeeper Referees* do not make ruling interpretations, and should redirect any *Team* questions regarding rules or scores to the *Head Referee*.

Strength of Schedule Points (SP) - The third basis of ranking *Teams*. *Strength of Schedule Points* are equivalent to the score of the losing *Alliance* in a *Qualification Match*. In the event of a tie, both *Alliances* receive SPs equal to the tied score. If both *Teams* on an *Alliance* are Disqualified, the *Teams* on the not-Disqualified *Alliance* will receive their own score as SPs for that *Match*.

Time Out - A single break period no greater than three minutes (3:00) allotted for each *Alliance* during *Elimination Matches*. See <T17>.

Win Points (WP) - The first basis of ranking *Teams*. *Teams* will receive zero (0), one (1), two (2), or three (3) *Win Points* for each *Qualification Match*. Unless a *Team* is Disqualified, both *Teams* on an *Alliance* always earn the same number of WPs.

- One (1) WP is awarded for completing the *Autonomous Win Point* task(s).
- Two (2) WPs are awarded for winning a *Qualification Match*.
- One (1) WP is awarded for tying a *Qualification Match*.
- Zero (0) WPs are awarded for losing a *Qualification Match*.

Win Percentage (WP) - Replaces *Win Points* in a league event. *Win Percentage* is calculated by the number of wins divided by the number of *Qualification Matches* the *Team* plays. In cases of a tie, the *Team* is given a 0.5 number of "wins" for that *Match*. Each *Autonomous Win Point* is also considered 0.5 "wins," and is added to the total number of wins.

Tournament Rules

<T1> The Head Referee has ultimate and final authority on all gameplay ruling decisions during the competition.

- a. *Scorekeeper Referees* score the *Match*, and may serve as observers or advisers for the *Head Referees*, but may not determine any rules or infractions directly.
- b. When issuing a *Major Violation* or *Minor Violation* to a *Team*, The *Head Referee* must provide the rule number of the specific rule that has been Violated.
- c. *Violations* of the REC Foundation Code of Conduct may involve additional escalation beyond the *Head Referee's* initial ruling, including (but not limited to) investigation by an REC Foundation representative. Rules <S1>, <G1>, and <G2> are the only rules for which this escalation may be required.
- d. *Event Partners* may not overrule a *Head Referee's* decision.

Note from the VEX GDC: The rules contained in this Game Manual are written to be enforced by human *Head Referees*. Many rules have "black-and-white" criteria that can be easily checked. However, some rulings will rely on a judgment call from this human *Head Referee*. In these cases, *Head Referees* will make their calls based on what they and the *Scorekeeper Referees* saw, what guidance is provided by their official support materials (the Game Manual and the Q&A), and most crucially, the context of the *Match* in question.

The VEX Robotics Competition does not have video replay, our fields do not have absolute sensors to count scores, and most events do not have the resources for an extensive review conference between each *Match*.

When an ambiguous rule results in a controversial call, there is a natural instinct to wonder what the "right" ruling "should have been," or what the GDC "would have ruled." This is ultimately an irrelevant question; our answer is that when a rule specifies "*Head Referee's* discretion" (or similar), then the "right" call is the one made by the *Head Referee* in the moment. The VEX GDC designs games, and writes rules, with this expectation (constraint) in mind.

<T2> Head Referees must be qualified. *Head Referees* must have the following qualifications:

- a. Be at least 20 years of age.
- b. Be approved by the *Event Partner*.
- c. Be an REC Foundation Certified VRC *Head Referee* for the current season (Certifications are expected to be released in Summer 2022).

Note: Scorekeeper Referees must be at least 15 years of age, and must be approved by the Event Partner.

Head Referees should demonstrate the following attributes:

- Thorough knowledge of the current game and rules of play
- Effective decision-making skills
- Attention to detail
- Ability to work effectively as a member of a team
- Ability to be confident and assertive when necessary
- Strong communication and diplomacy skills

<T3> The Drive Team is permitted to immediately appeal the Head Referee's ruling. If *Drive Team Members* wish to dispute a score or ruling, they must stay in the *Alliance Station* until the *Head Referee* talks with them. The *Head Referee* may choose to meet with the *Drive Team Members* at another location and / or at a later time so that the *Head Referee* has time to reference materials or resources to help with the decision. Once the *Head Referee* announces that their decision has been made final, the issue is over and no more appeals may be made (See rule <T1>).

- a. *Head Referees* may not review any photo or video *Match* recordings when determining a score or ruling.
- b. *Head Referees* are the only individuals permitted to explain a rule, *Disqualification*, *Violation*, warning or other penalty to the *Teams*. *Teams* should never consult other field personnel, including *Scorekeeper Referees*, regarding a ruling clarification.

Communication and conflict resolution skills are an important life skill for *Students* to practice and learn. In VEX Robotics Competitions, we expect *Students* to practice proper conflict resolution using the proper chain of command. *Violations* of this rule may be considered a *Violation* of <G1> and / or the Code of Conduct.

Some events may choose to utilize a "question box" or other designated location for discussions with *Head Referees*. Offering a "question box" is within the discretion of the *Event Partner* and / or *Head Referee*, and may act as an alternate option for asking *Drive Team Members* to remain in the *Alliance Station* (although all other aspects of this rule apply).

However, by using this alternate location, *Drive Team Members* acknowledge that they are forfeiting the opportunity to use any contextual information involving the specific state of the field at the end of the *Match*. For example, it is impossible to appeal whether a game element was *Scored* or not if the field has already been reset. If this information is pertinent to the appeal, *Drive Team Members* should still remain in the *Alliance Station*, and relocate to the "question box" once the *Head Referee* has been made aware of the concern and/or any relevant context.

<T4> The Event Partner has ultimate authority regarding all non-gameplay decisions during an event. The Game Manual is intended to provide a set of rules for successfully playing VRC Spin Up; it is not intended to be an exhaustive compilation of guidelines for running a VEX Robotics Competition event. Rules pertaining to an event venue, pit spaces, health and safety, or other unique circumstances are at the discretion of the *Event Partner* and should be treated with the same respect as the Game Manual.

This rule exists alongside <G1>, <S1>, and <G3>. Even though there isn't a rule that says "don't steal from the concession stand," it would still be within an *Event Partner's* authority to remove a thief from the competition.

<T5> A Team's Robot and / or Drive Team Member should attend every Match. A *Robot* or a *Student* member of the *Team* must report to the field for the *Team's* assigned *Match*, even if the *Robot* is not functional. If no *Student Drive Team Members* report to the field, the *Team* will be considered a "no-show" and receive zero (0) WPs, APs, and SPs, even if the *Robot* is not functional and / or has not passed inspection.

<T6> Robots at the field must be ready to play. If a *Team* brings their *Robot* to the field, it must be prepared to play (i.e., batteries charged, sized within the starting size constraint, etc.).

- a. *Teams* who use pneumatics must have their systems charged before they place the *Robot* on the field.
- b. *Robots* must be placed on the field promptly. Repeated failure to do so could result in a *Violation* of <G1>. The exact definition of the term "promptly" is at the discretion of the *Head Referee* and *Event Partner*, who will consider event schedule, previous warnings or delays, etc.

<T7> Match replays are allowed, but rare. A *Match* replay, where a *Match* is played over again from its start, must be agreed upon by both the *Event Partner* and *Head Referee*, and will only be issued in the most extreme circumstances. Some examples that may warrant a *Match* replay are as follows:

- a. *Match Affecting* "field fault" issues.
 - i. *Discs* or *Field Elements* not starting in the correct positions
 - ii. Tape lines lifting
 - iii. *Field Elements* detaching or moving beyond normal tolerances (not as a result of *Robot* interactions)
 - iv. The *Autonomous Period* or *Driver Controlled Period* ending early
 - v. Field control disconnecting or disabling *Robots*. Note that this is sometimes confused with a *Robot* whose motors have overheated, or bent pins on a controller's competition port causing intermittent drop-outs. In general, any true field fault will impact both *Alliances* simultaneously, not one *Robot* at a time.

- b. A V5 Robot Brain lockup that is outside of the *Team's* control and results in a complete shutdown of the *Robot*. To qualify for a *Match* replay, all of the following criteria must be met:
 - i. The screen on the V5 Brain is completely white, including the status bar at the top of the screen
 - ii. The Brain is unresponsive to any inputs from Controllers or sensors
 - iii. The Brain is unresponsive to the "power" button on the Brain (i.e., the only way to reboot the Brain is to remove the battery)
 - iv. All connected devices do not show a solid red light at their Smart Port connections (i.e., lights are blinking or off)
- c. *Match Affecting* game rule issues.
 - i. *Head Referee* disables a *Robot* for a misinterpretation of a rule *Violation*.
 - ii. *Head Referee* starts the *Driver Controlled Period* of the *Match* without determining the outcome of the *Autonomous Period* winner.
 - iii. The field is reset before a score is determined.

<T8> The red Alliance places last. The red *Alliance* has the right to place its *Robots* on the field last in both *Qualification Matches* and *Elimination Matches*. Once a *Team* has placed its *Robot* on the field, its position cannot be readjusted prior to the *Match*. If a *Team* chooses to reposition their *Robot* after it has already been placed, the opposing *Alliance* will also be given the opportunity to reposition their *Robots* promptly if appropriate.

In most cases, this rule does not come into play. However, *Head Referees* are encouraged during *Elimination Matches* to ask the red *Alliance* if they intend / expect to invoke this rule. If so, it is highly recommended that the *Head Referee* asks the blue *Alliance* to "confirm" their final placement before the red *Alliance* places their *Robots* on the field. This will help to mitigate excessive back-and-forth repositioning.

<T9> Qualification Matches follow the Match schedule. A *Qualification Match Schedule* will be available on the day of competition. The *Match Schedule* will indicate *Alliance* partners, *Match* pairings, and *Alliance* colors for each *Match*. For tournaments with multiple fields, the schedule will indicate which field each *Match* will take place on. The *Match Schedule* is subject to change at the *Event Partner's* discretion.

<T10> Qualification Matches will be scheduled as follows:

- a. When in a tournament, the tournament must have a minimum of four (4) *Qualification Matches* per *Team*. The suggested number of *Qualification Matches* per *Team* for a standard tournament is six (6), and is up to ten (10) for a championship event.

- b. When in a league, there must be at least three (3) league ranking sessions and each session must include a minimum of two (2) *Qualification Matches* per *Team*. The suggested number of *Qualification Matches* per *Team* for a standard league ranking session is four (4). Leagues will have a championship session where elimination rounds will be played. *Event Partners* may also choose to have *Qualification Matches* as part of their championship session.

<T11> Qualification Matches contribute to a Team's ranking as follows:

- a. When in a tournament, every *Team* will be ranked based on the same number of *Qualification Matches*.
- b. When in a league, every *Team* will be ranked based on the number of *Matches* played. *Students* that participate at least 60% of the total *Matches* available will be ranked above *Teams* that participate in less than 60% of the total *Matches* available (e.g., if the league offers 3 ranking sessions with 4 *Qualification Matches* per *Team*, teams that participate in 8 or more *Matches* will be ranked higher than *Teams* who participate in 7 or fewer *Matches*). Being a no-show to a *Match* that a *Team* is scheduled in still constitutes participation for these calculations.
- c. In some cases, a *Team* will be asked to play an additional *Qualification Match*. The extra *Match* will be identified on the *Match Schedule* with an asterisk; WPs, APs, or SPs for that *Qualification Match* will not impact a *Team's* ranking, and will not affect participation percentage for leagues.
 - i. *Teams* are reminded that <G1> is always in effect and *Teams* are expected to behave as if the additional *Qualification Match* impacts their rankings.
 - ii. In Leagues, *Teams* may have a different number of *Qualification Matches*. Rankings are determined by the *Win Percentage*, which is the number of wins divided by the number of *Qualification Matches* that *Team* has played.

<T12> Qualification Match rankings and tiebreakers. *Team* rankings are determined throughout *Qualification Matches* as follows:

- a. Average *Win Points* (WP / Number of *Matches* played)
- b. Average *Autonomous Points* (AP / Number of *Matches* played)
- c. Average *Strength of Schedule Points* (SP / Number of *Matches* played)
- d. Highest *Match* score
- e. Second highest *Match* score
- f. Random electronic draw

<T13> Disqualifications. When a *Team* receives a *Disqualification* in a *Qualification Match*, they receive zero (0) *Win Points*, *Autonomous Win Points*, *Autonomous Points*, and *Strength of Schedule Points*.

In a *Qualification Match*, *Disqualifications* are applied only to the *Team* who committed the *Major Violation*, not to the whole *Alliance*.

- a. If the *Team* receiving the *Disqualification* is on the winning *Alliance*, then *Teams* on the opposing *Alliance* who are not also *Disqualified* will receive the win for the *Match* and two (2) *WP*.
- b. If the *Match* was a tie, then each *Team* on the opposing *Alliance* (the *Alliance* that did not receive the *Disqualification*) will receive the win for the *Match* and two (2) *WP*.
- c. If both *Alliances* have a *Team* receiving a *Disqualification*, then all non-*Disqualified Teams* will receive a tie for the *Match* and one (1) *WP*.
- d. *Autonomous Win Points* are not given to *Teams* that receive a *Disqualification*, and are not automatically awarded to the opposing *Alliance*.

When a *Team* is *Disqualified* in an *Elimination Match*, the entire *Alliance* is *Disqualified*, they receive a loss for the *Match*, and the opposing *Alliance* is awarded the win. If both *Alliances* receive a *Disqualification* in an *Elimination Match*, both *Alliances* receive a loss and will play another *Match* to determine a winner.

<T14> Send a Student representative to Alliance Selection. Each *Team* must send one (1) *Student representative* to the playing field (or other designated area) to participate in *Alliance Selection*. If the *Team representative* fails to report for *Alliance Selection*, their *Team* will be ineligible for participation in the *Alliance Selection* process.

<T15> Each Team may only be invited once to join an Alliance. If a *Team representative* declines an *Alliance Captain's* invitation during *Alliance Selection*, that *Team* is no longer eligible to be selected by another *Alliance Captain*. However, they are still eligible to play *Elimination Matches* as an *Alliance Captain*.

For example:

- *Alliance Captain 1* invites *Team ABC* to join their *Alliance*.
- *Team ABC* declines the invitation.
- No other *Alliance Captains* may invite *Team ABC* to join their *Alliance*.
- However, *Team ABC* may still form their own *Alliance*, if *Team ABC* ranked high enough after *Qualification Matches* to become an *Alliance Captain*.

<T16> Elimination Matches follow the Elimination Bracket.

A sixteen (16) *Alliance* bracket plays as shown in Figure 27:

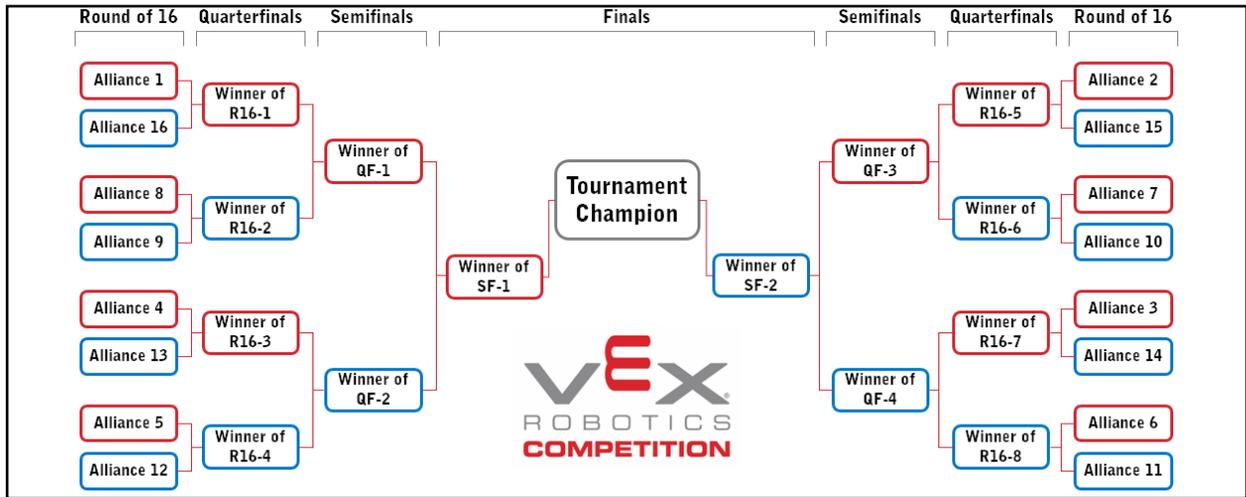


Figure 27: A 16-alliance bracket

If an event is run with fewer than sixteen (16) *Alliances*, then they will use the bracket shown above, with byes (automatic advancements to the next round of tournament play without competing) awarded when there is no applicable *Alliance*. For example, in a tournament with fourteen (14) *Alliances*, *Alliances* 1 and 2 would automatically advance to the Quarterfinal round.

Thus, an eight (8) *Alliance* bracket would run as shown in Figure 28, bypassing the Round of 16:

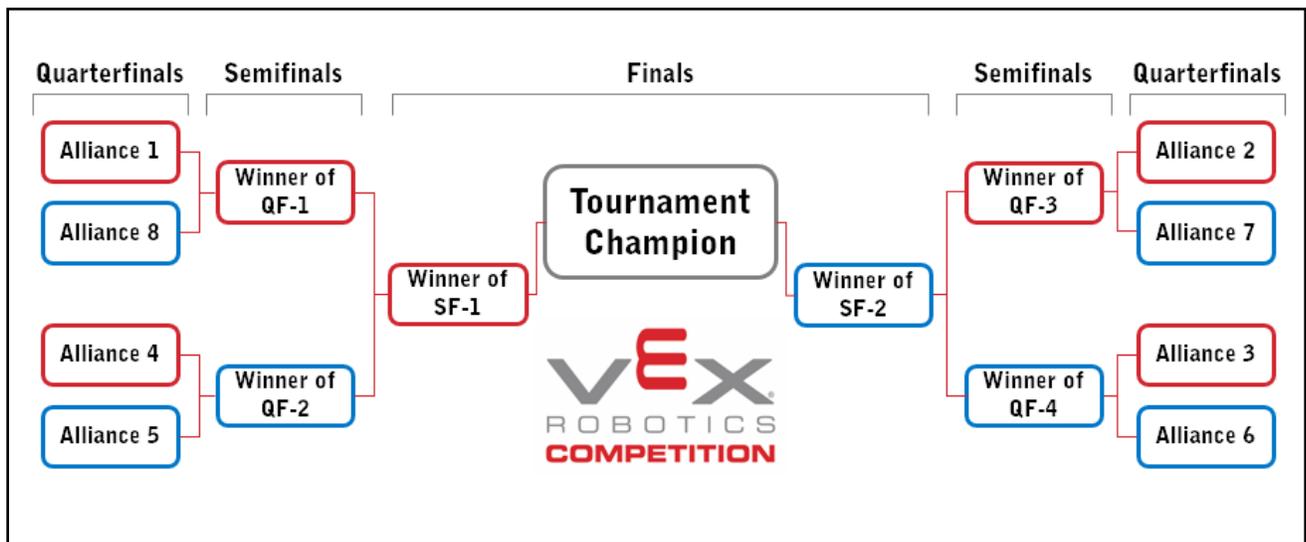


Figure 28: An 8-alliance bracket

<T17> Each Elimination Alliance gets one Time Out. Each *Alliance* may request one (1) *Time Out* during the *Elimination Bracket*. This *Time Out* must be requested between *Elimination Matches* by contacting the *Head Referee* and / or *Event Partner*. *Alliances* may not use their *Time Out* during a *Match*.

<T18> Elimination Matches are a blend of "Best of 1" and "Best of 3." "Best of 1" means that the winning *Alliance* in each *Match* advances to the next round of the *Elimination Bracket*. "Best of 3" means that the first *Alliance* to reach two wins will advance.

See the Flowchart in Figure 29 for more information.

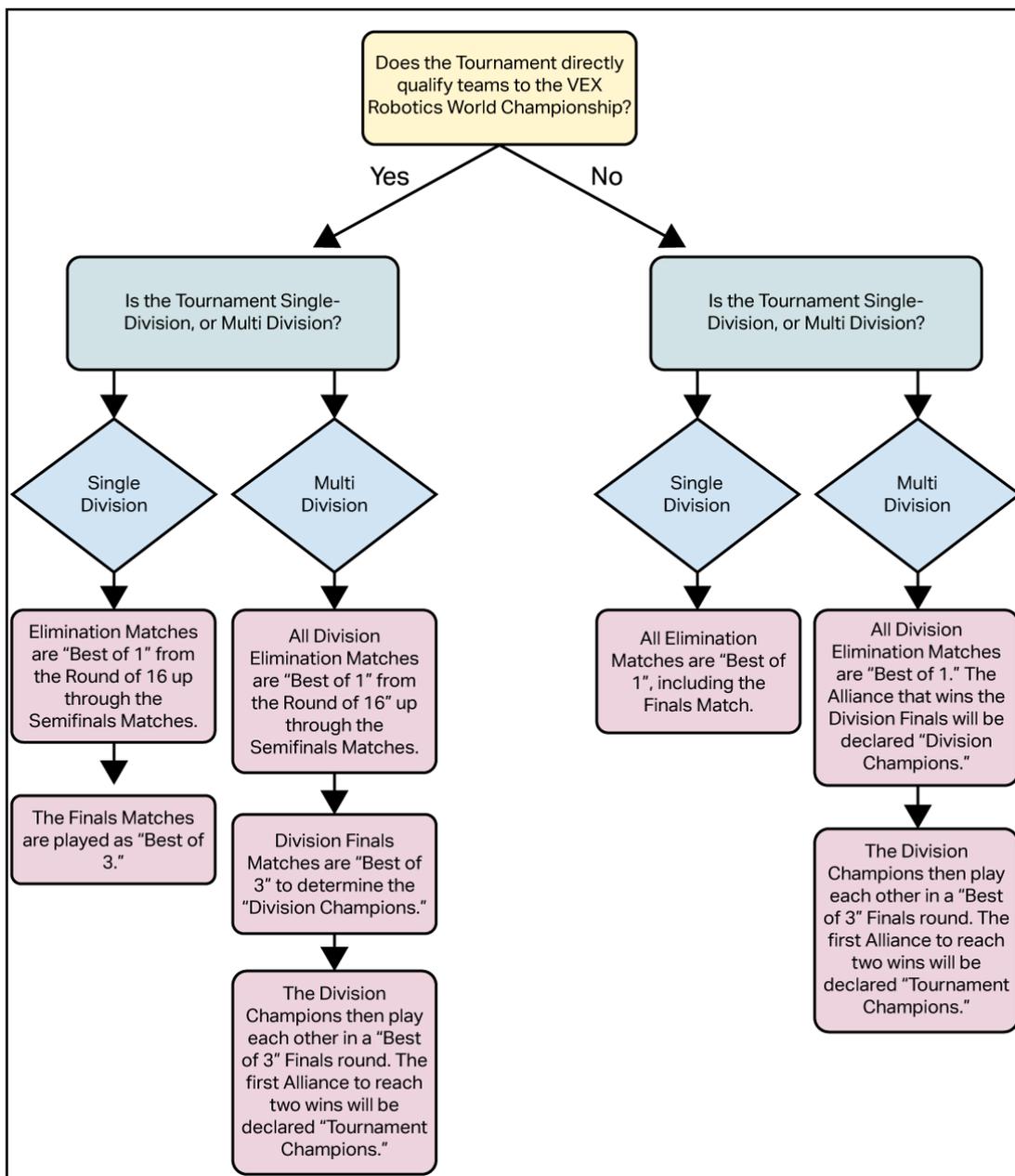


Figure 29: The process for determining how Elimination Matches should be played.

<T19> Small tournaments may have fewer Alliances. Events (or divisions within an event) with 32 or more *Teams* must use 16 two-*Team Alliances* for *Elimination Matches* as shown in Figure 28. Events with fewer than 32 *Teams* (i.e., the requisite amount for 16 full *Alliances*) must limit the number of *Alliances* by dividing the number of *Teams* by two, less any remainder.

<T20> Students must be accompanied by an Adult. No *Student* may attend a VRC event without a responsible *Adult* supervising them. The *Adult* must obey all rules and be careful to not violate Student-centered policies, but must be present at the event in the case of an emergency. *Violations* of this rule may result in removal from the event.

<T21> Fields at an event must be consistent with each other. There are many types of permissible aesthetic and / or logistical modifications that may be made to competition fields at the *Event Partner's* discretion. If an event has multiple Head-to-Head competition fields, they must all incorporate the same permissible / applicable modifications. For example, if one Head-to-Head field is elevated, then all Head-to-Head competition fields must be elevated to the same height.

Examples of these modifications may include, but are not limited to:

- Elevating the playing field off of the floor (common heights are 12" to 24" [30.5cm to 61cm])
- Field control systems (see <T22>)
- Field display monitors
- Field perimeter decorations (e.g., LED lights, sponsor decals on polycarbonate panels)
- Field perimeter type (see <T23>)
- Utilizing the VEX GPS Field Code Strips

Note: If an event uses a set of dedicated fields for Robot Skills Matches, there is no requirement for them to have the same consistent modifications as the Head-to-Head fields. See <RSC6> for more details.

<T22> There are three types of field control that may be used:

1. A VEXnet Field Controller, which connects to a Controller's competition port via Cat-5 cable.
2. A V5 Event Brain, which connects to a Controller via Smart Cable.
3. A VEXnet Competition Switch, which connects to a Controller's competition port via Cat-5 cable.
 - a. Except in extreme circumstances, VEXnet Competition Switches are only permitted to be used in *Practice Matches* or *Robot Skills Matches*.

If an event has multiple fields, then all fields of the same game type must use the same control system, in accordance with <T21> and <RSC6>.

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For example, it would be permissible for Head-to-Head competition fields to use V5 Event Brains, and for Skills Challenge fields to use VEXnet Field Controllers. However, it would not be permissible for one Head-to-Head field to use a V5 Event Brain, while another Head-to-Head field uses a VEXnet Field Controller.

<T23> There are two types of Field Perimeter that may be used:

1. VEX Metal Competition Field Perimeter (SKU 278-1501)
2. VEX Portable Competition Field Perimeter (SKU 276-8242)

See Appendix A for more details.

If an event has multiple fields, then all fields of the same game type must use the same Field Perimeter type, in accordance with <T21> and <RSC6>. For example, it would be permissible for Head-to-Head competition fields to use metal Field Perimeters, and for Skills Challenge fields to use Portable Field Perimeters. However, it would not be permissible for one Head-to-Head field to use a metal Field Perimeter, while other Head-to-Head fields use Portable Field Perimeters.

<T24> **Fields and Field Elements may be repaired at the Event Partner's discretion.** All competition fields and other *Field Elements* at an event must be set up in accordance with the specifications in Appendix A and I or other applicable Appendices. Minor aesthetic customizations or repairs are permitted, provided that they do not impact gameplay (see <T4>).

Examples of permissible modifications include, but are not limited to:

- Threadlocker applied to *Field Element* mounting hardware
- Tape over a hole in a damaged *Net*

Examples of prohibited modifications include, but are not limited to:

- Unofficial field perimeter walls, additional structural elements inside of the field perimeter, or unofficial / replica *Field Elements*
- Additional VEX structural parts attached to a *Field Element*
- An unofficial replacement *Net*
- Replacing the opaque field walls on the VEX Portable Competition Field Perimeter with transparent ones

Any specific repairs and / or modifications which pertain to the current season's game will be documented in this rule and Appendix A, as needed.

<T25> **Be prepared for minor field variance.** *Field Element* tolerances may vary from nominal by ± 1.0 ", unless otherwise specified in this Game Manual, official Q&A, or Appendix. *Disc* weights may vary from nominal to ± 20 grams. *High Goal* heights may vary from nominal to ± 1.0 " (25.4mm). *Teams* are encouraged to design their *Robots* accordingly. Please make sure to check Appendix A for more specific nominal dimensions and tolerances.

Disc placement at the beginning of *Matches* may vary from nominal to ± 1 " (25.4mm).



VEX[®]
ROBOTICS
COMPETITION
SPIN UP

The logo features the word 'VEX' in a large, bold, sans-serif font. The 'V' and 'X' are grey, while the 'E' is red. Below 'VEX' is the word 'ROBOTICS' in a smaller, grey, all-caps sans-serif font. Underneath that is the word 'COMPETITION' in a bold, red, all-caps sans-serif font. At the bottom of the logo is a dark grey rounded rectangle containing the words 'SPIN UP' in a white, bold, all-caps sans-serif font.

2022 - 2023

Appendix A - Field Overview and Specifications

Appendix A

Game Field Introduction

This document will provide Bill of Materials (BOM) information and detailed specifications for the Official Competition Field.

Teams who do not need an "official" field should refer to the separate low-cost field guide for cost-reduction options. *Teams* assembling the full field should refer to the separate VEX Robotics Competition Spin Up Field Build Instructions.

Please note: this field can utilize both the [VEX Portable Competition Field Perimeter \(276-8242\)](#) and the [VEX Competition Field Perimeter \(278-1501\)](#) developed by VEX Robotics. Instructions and specifications for these field perimeters are available in separate documents and are important for the field assembly.

This document is divided up into three sections:

1. Field Overview
2. Field BOM
3. Field Specifications

There is also an accompanying STEP file which can be imported into most 3D modeling programs (e.g., Inventor, Sketchup, Solidworks, etc.). This 3D model shows the "official" setup of a VEX Robotics Competition - Spin Up competition field, as well as detailed models of individual *Field Elements*.

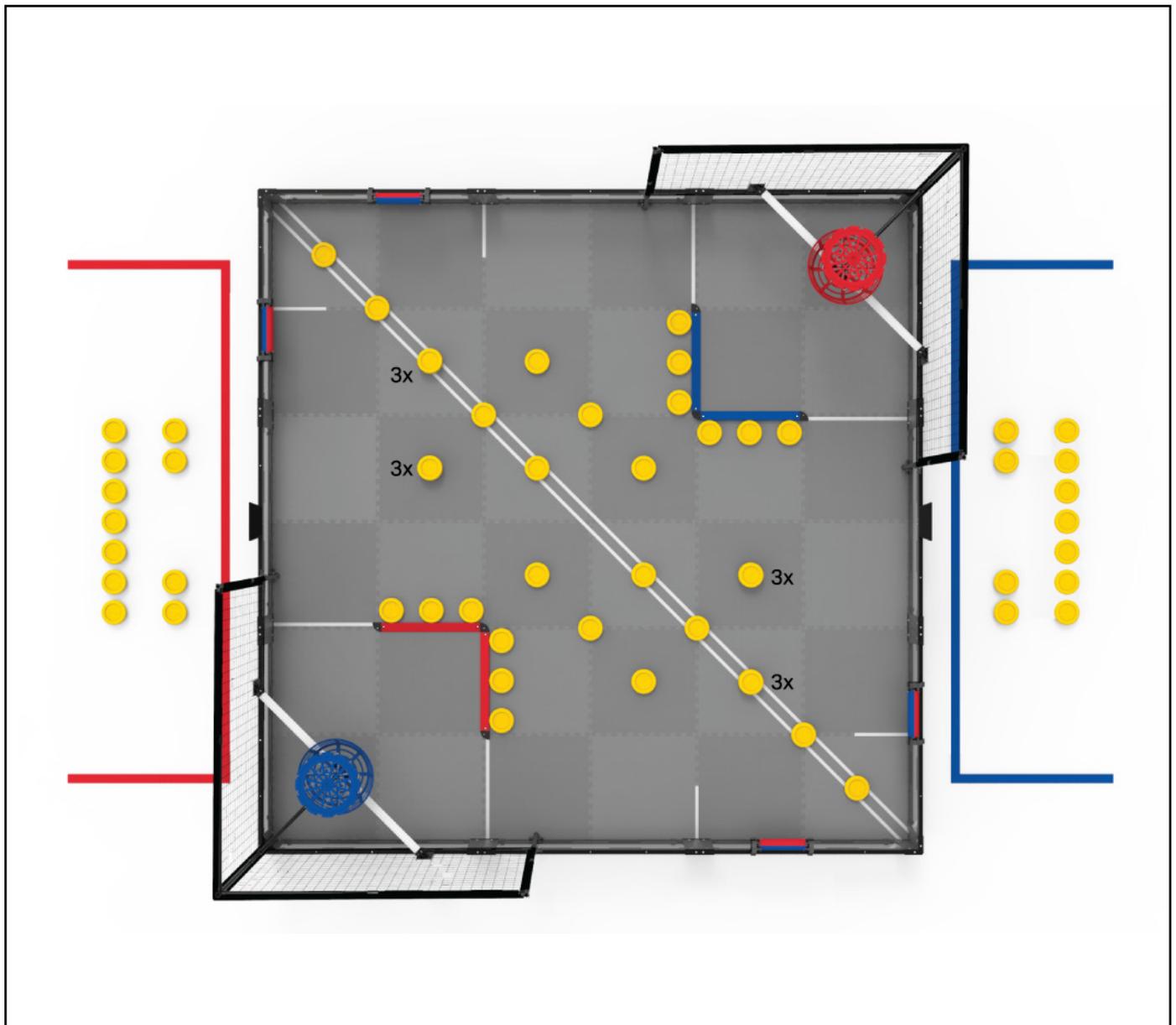
For additional game-play detail, please refer to the VEX Robotics Competition Spin Up Game Manual.

Field Overview

The game VEX Robotics Competition Spin Up is played on a 12ft x 12ft foam mat, surrounded by a perimeter, and divided diagonally into halves by tape lines.

The VRC Spin Up field consists of 60 *Discs*. Each *Alliance* has 2 *Rollers* and 1 *Loader*. Each half of the field includes a *Low Goal*, which is partially defined by a *Barrier*. A *High Goal* and supporting structure are located above each *Low Goal*, and surrounded by a *Net* and supporting structure.

For more details and specific gameplay rules, please refer to the VEX Robotics Competition Spin Up Game Manual.



Game Objects & Field Bill of Materials

All of these items are available for purchase from: www.vexrobotics.com

Generic Field Elements - Reuseable Each Year

Part Number	Description
278-1501	VRC Field Perimeter Frame & Hardware
276-8242	VEX Portable Competition Field Perimeter
276-6905	VRC Anti-Static Field Tiles (18-Pack)
275-1401	VRC VEXnet Field Controller

Official VEX Robotics Competition Spin Up Specific Elements

Part Number	Description	Quantity per Full Field
276-7500	VRC Spin Up Full Field & Game Element Kit	
276-7501	VRC Spin Up Game Element Kit	1
276-7502	VRC Spin Up Field Element Kit 1	1
276-7503	VRC Spin Up Field Element Kit 2	1

Practice Elements

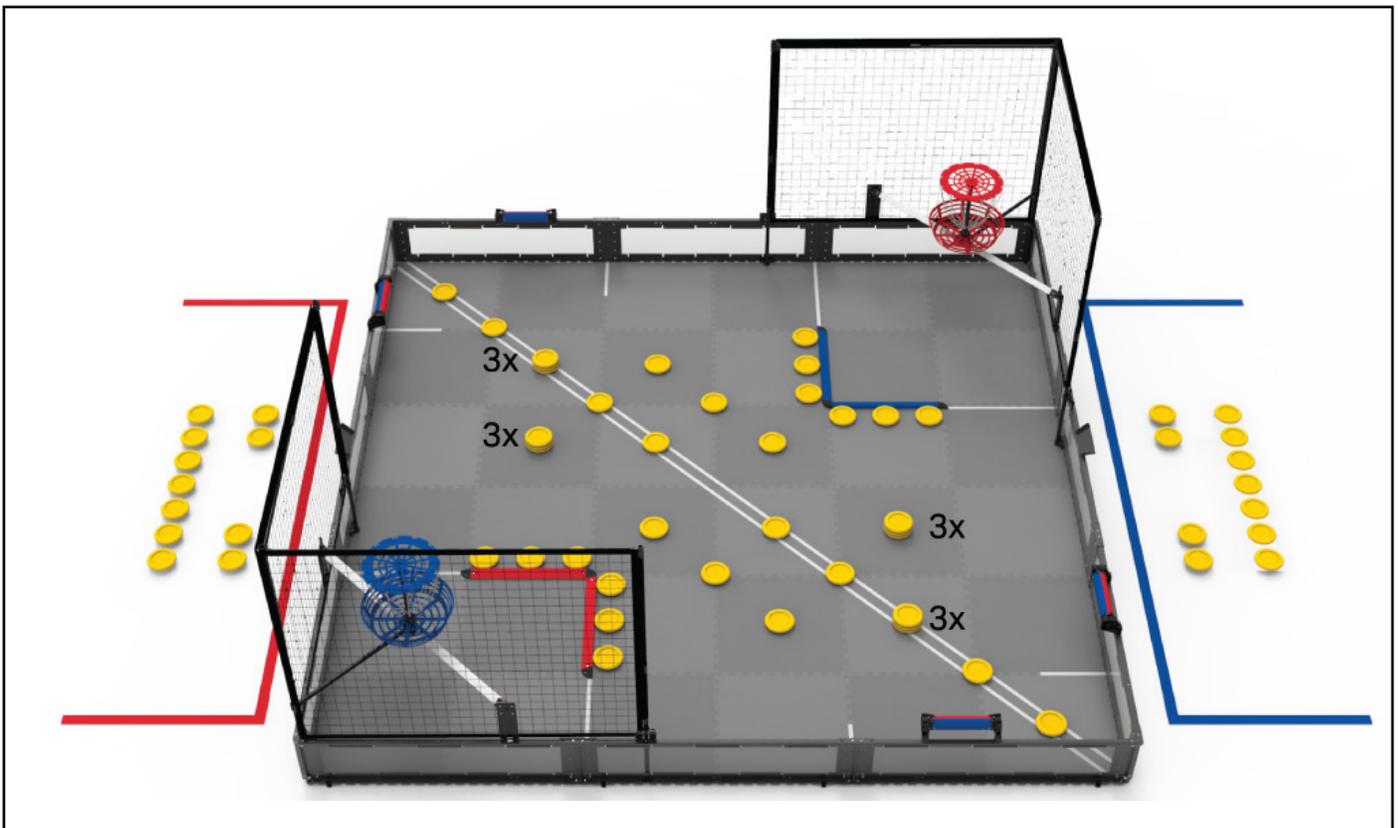
Part Number	Description
276-7501	VRC Spin Up Game Element Kit
276-7504	VRC Spin Up Scoring Element Kit

Field Specifications Introduction

This section will outline the specifications that are most important to teams designing a *Robot* to compete in the VEX Robotics Competition Spin Up. Though many of the critical dimensions are included in this section, it may be necessary to consult the separate assembly guide and 3D CAD models of the field for an additional level of detail. If you can't find a dimension in the specifications, we include a full model of the field to "virtually" measure whatever dimension is necessary.

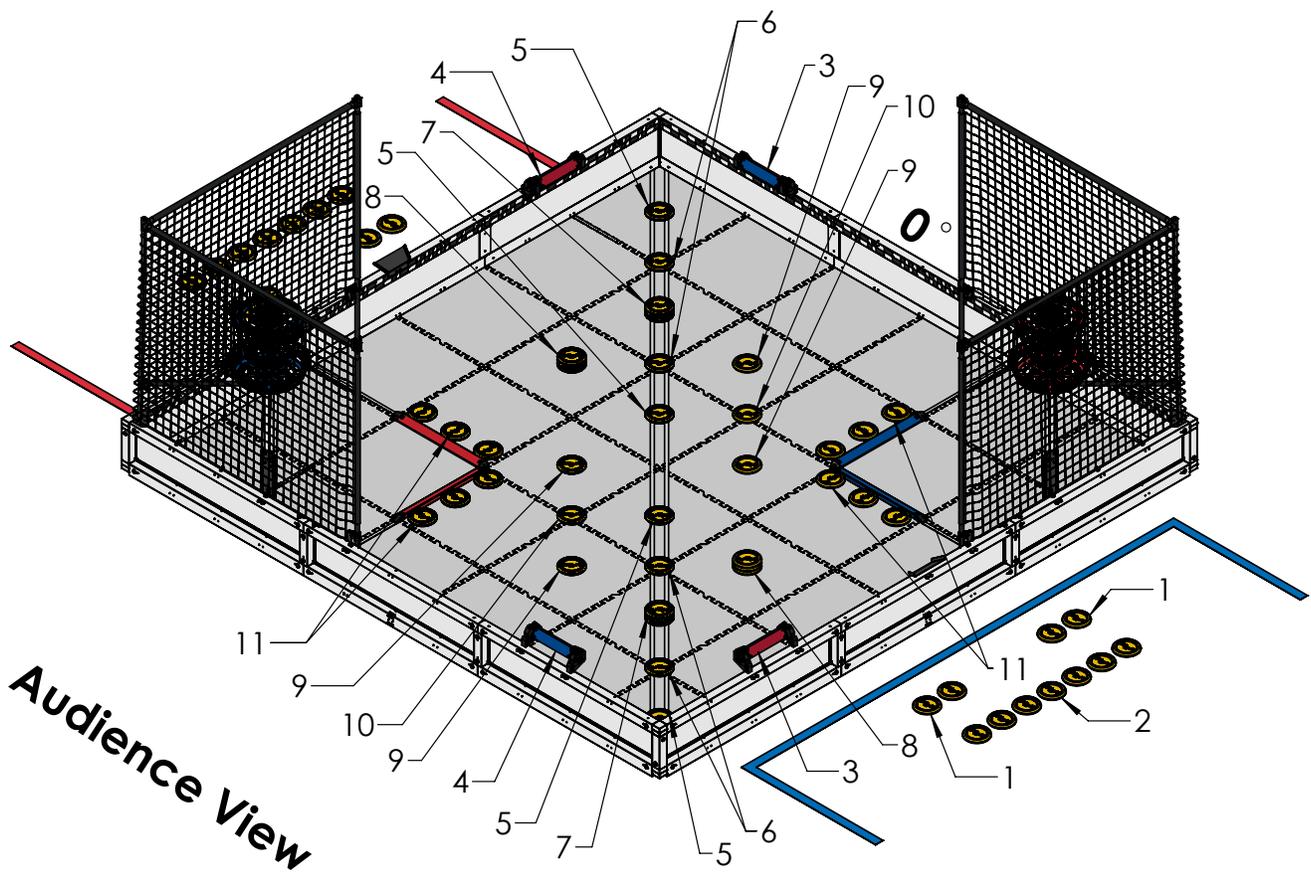
Field components may vary slightly from event to event. This is to be expected; *Teams* will need to adapt accordingly. It is good design practice to create mechanisms capable of accommodating variances in the field and game pieces.

Note: Minor field repairs are permissible, provided that the repairs do not affect gameplay. Examples of minor field repairs include (but are not limited to) threadlocker applied to Field Element mounting hardware or tape over a hole in a damaged Net. Be sure to check the Official Q&A for specific examples or to get an official clarification.



Scoring Objects are placed as follows before the start of each Match:

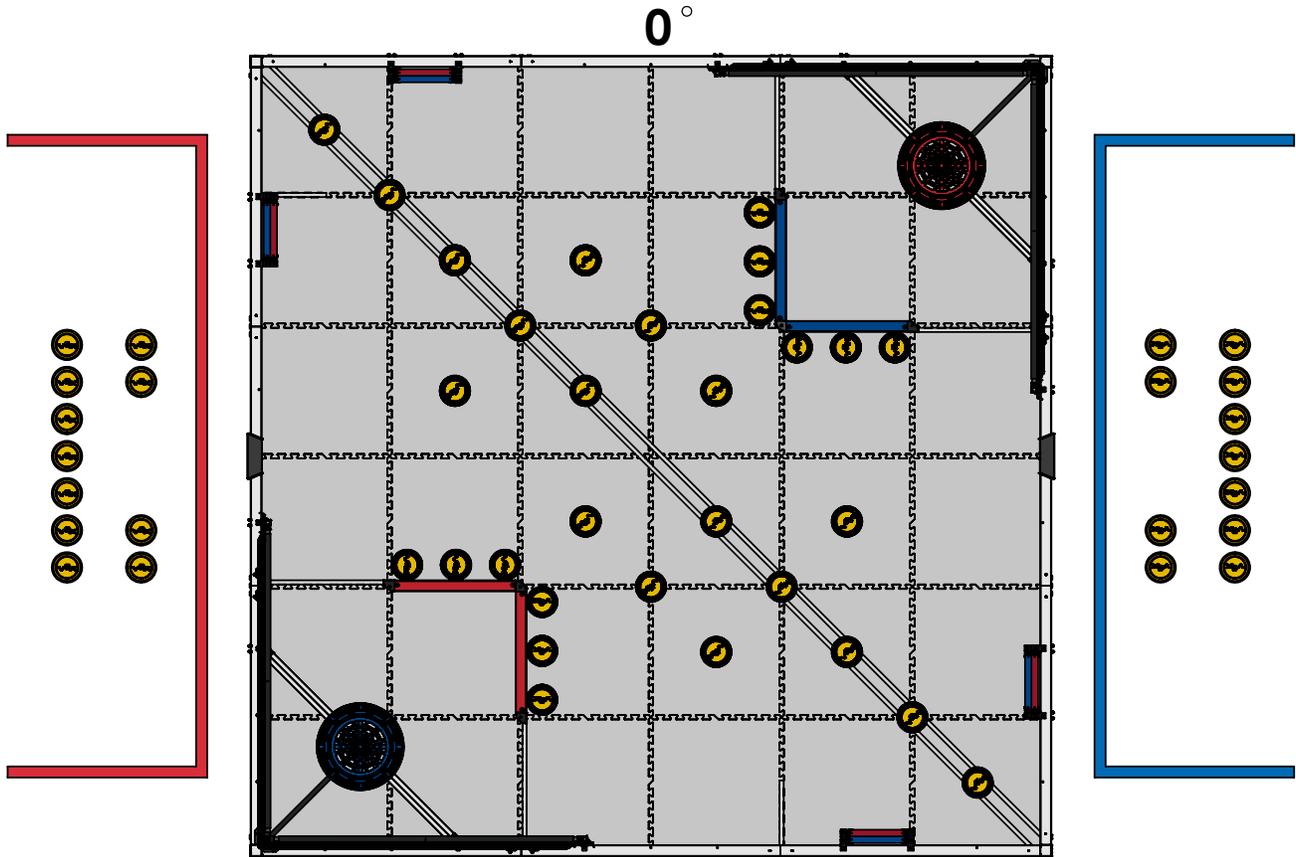
1. (2x) Disc for Preload into each Robot
2. (7x) Disc outside the field for Alliance Match Loads
3. (2x) Rollers closest to the Red High goal with Blue side facing into the field
4. (2x) Rollers closest to the Blue High goal with Red side facing into the field
5. (1x) Disc placed on Autonomus Line centered on field tile
6. (1x) Disc placed on Autonomus Line centered on the tile junction
7. (3x) Discs placed on the Autonomus Line in a stack centered on a field tile
8. (3x) Discs placed in a stack in the center of the field tile two tiles in front of the Loader
9. (1x) Disc centered on a field tile
10. (1x) Disc centered on a tile junction
11. (3x) Disc in a row on the edge of the low goal. Equal spaced touching the colored barrier



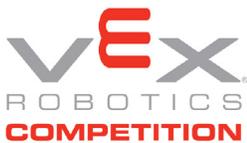
Audience View

	Description 2022-2023 Game Object Placement	
	Dwg No 276-7500-000 Field Specifications	
	Competition VRC 2022-2023	Sheet 1 of 14
	Release 11/21/2022	ALL DIMENSIONS ARE IN INCHES.
		www.VEXROBOTICS.COM

Reference Object Placement Image:



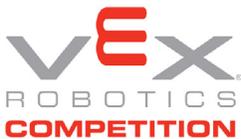
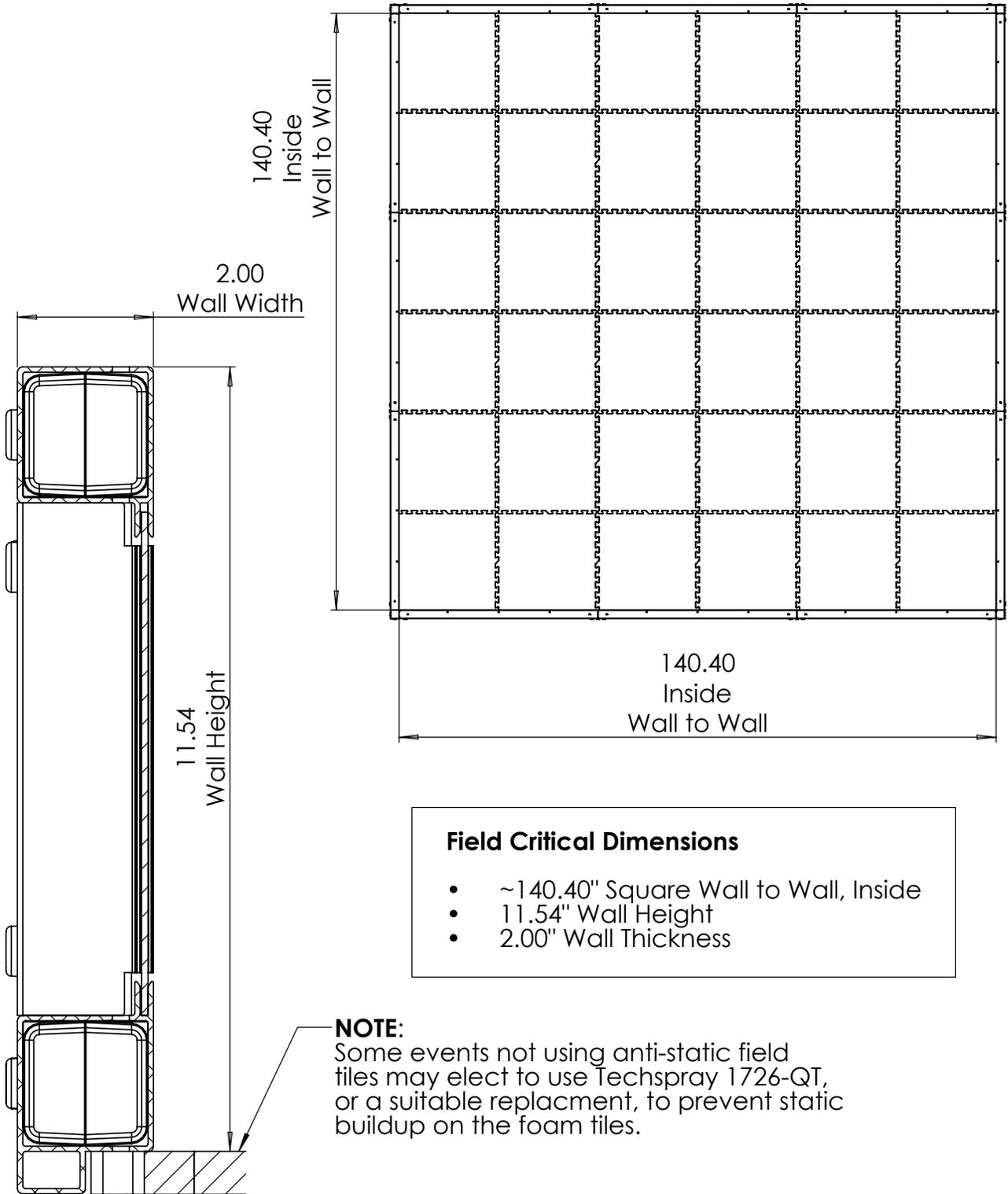
Audience View



Description	2022-2023 Game Object Placement (2)	
Dwg No	276-7500-000 Field Specifications	
Competition	VRC 2022-2023	Sheet 2 of 14
Release	11/21/2022	ALL DIMENSIONS ARE IN INCHES.

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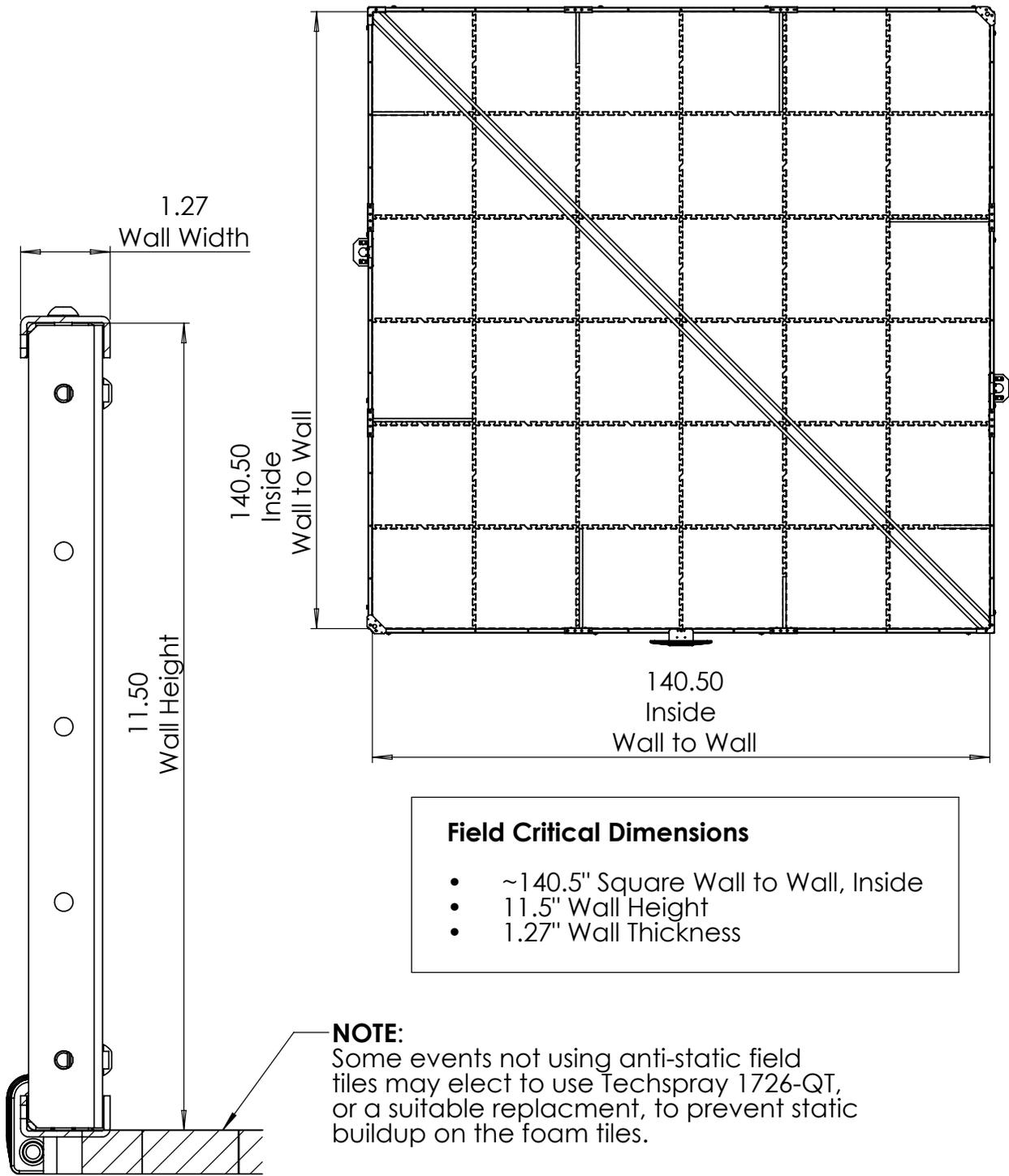
Field Critical Specs (276- 8242):



Description	Field Perimeter Specifications	
Dwg No	276-7500-000 Field Specifications	
Competition	VRC 2022-2023	Sheet 3 of 14
Release	11/21/2022	ALL DIMENSIONS ARE IN INCHES.

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Field Critical Specs (278- 1501):



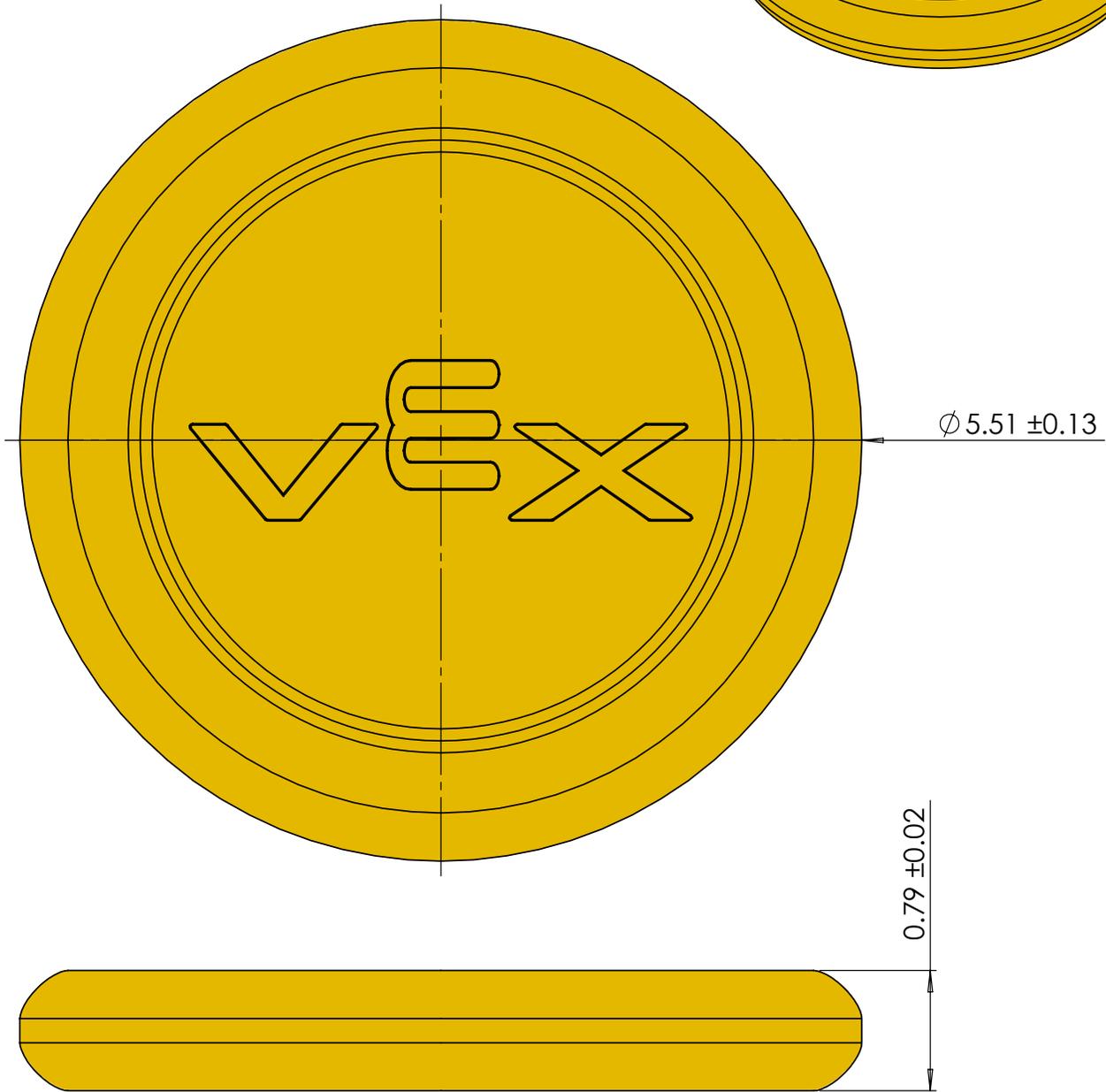
Field Critical Dimensions

- ~140.5" Square Wall to Wall, Inside
- 11.5" Wall Height
- 1.27" Wall Thickness

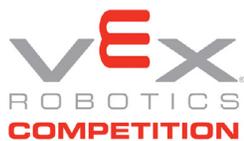
NOTE:
Some events not using anti-static field tiles may elect to use Techspray 1726-QT, or a suitable replacment, to prevent static buildup on the foam tiles.

	Description		Field Perimeter Specifications (2)
	Dwg No		276-7500-000 Field Specifications
	Competition	VRC 2022-2023	Sheet 4 of 14
	Release	11/21/2022	ALL DIMENSIONS ARE IN INCHES.
			www.VEXROBOTICS.COM

Disc Specs:



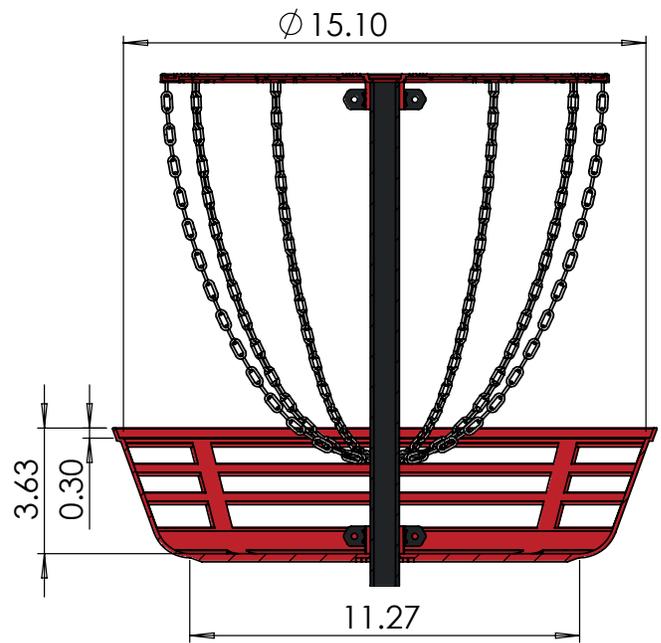
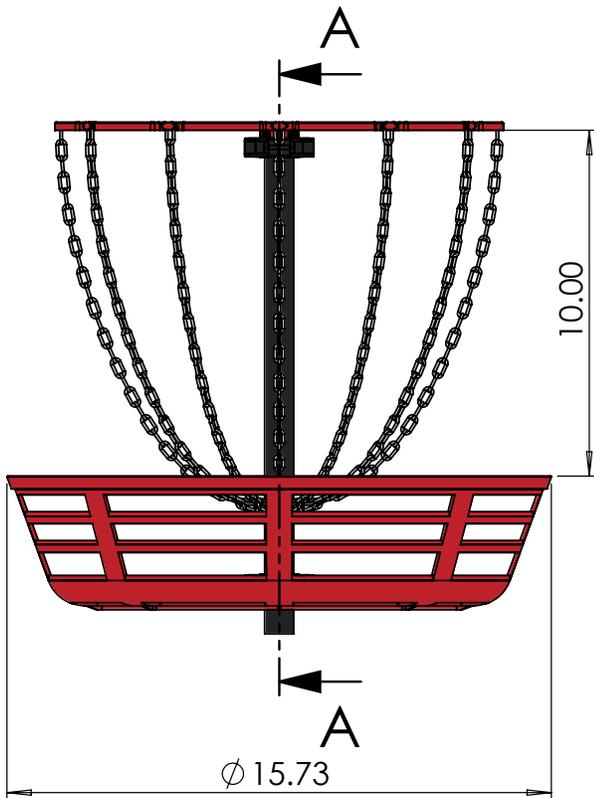
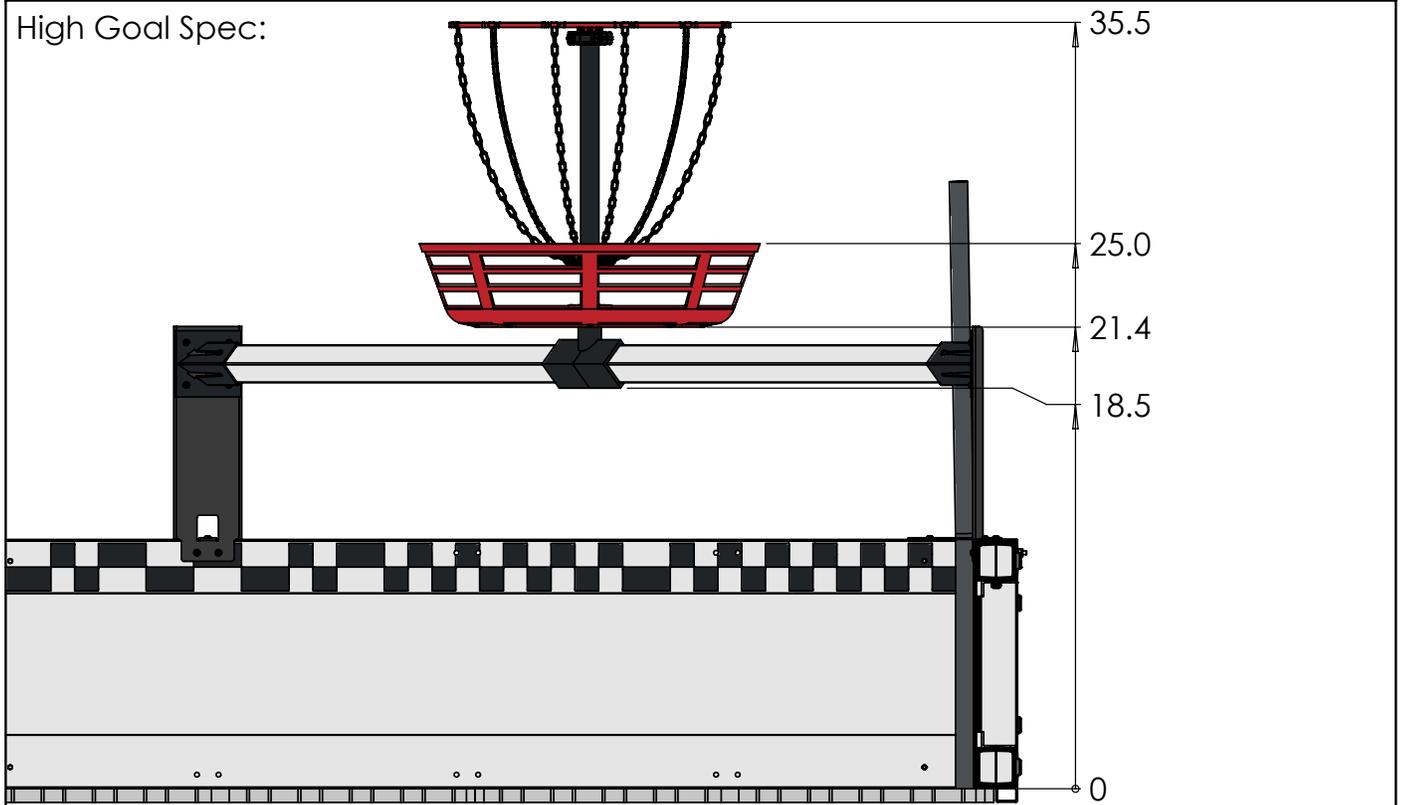
Mass: 65 ± 20 Grams



Description	2022-2023 Game Specs	
Dwg No	276-7500-000 Field Specifications	
Competition	VRC 2022-2023	Sheet 5 of 14
Release	11/21/2022	ALL DIMENSIONS ARE IN INCHES.

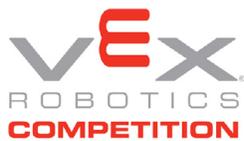
www.VEXROBOTICS.COM

High Goal Spec:



SECTION A-A

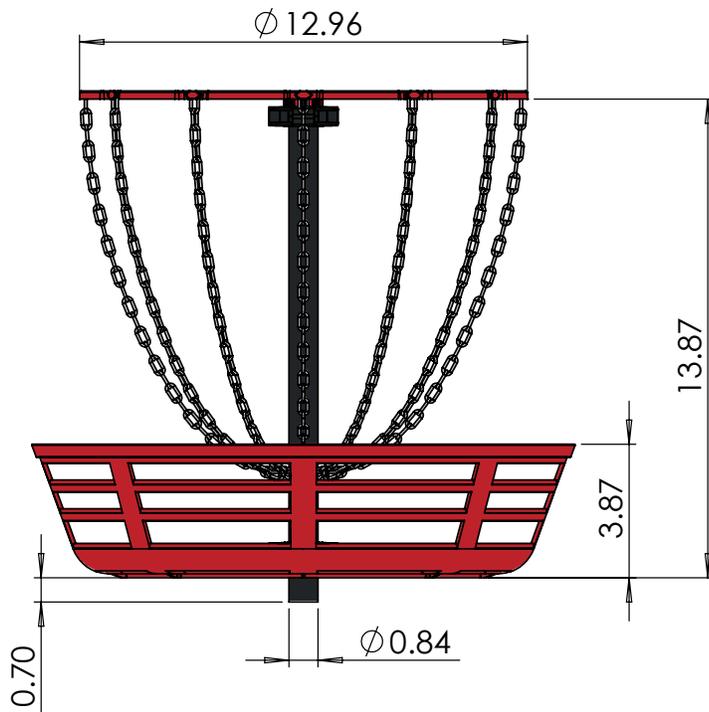
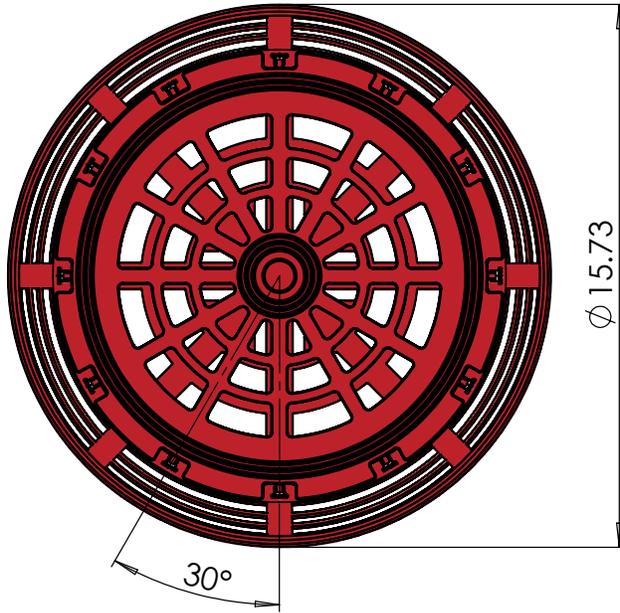
SCALE 1 : 5



Description	2022-2023 Game Specs (2)	
Dwg No	276-7500-000 Field Specifications	
Competition	VRC 2022-2023	Sheet 6 of 14
Release	11/21/2022	ALL DIMENSIONS ARE IN INCHES.

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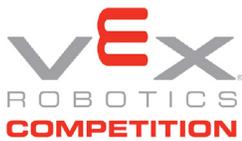
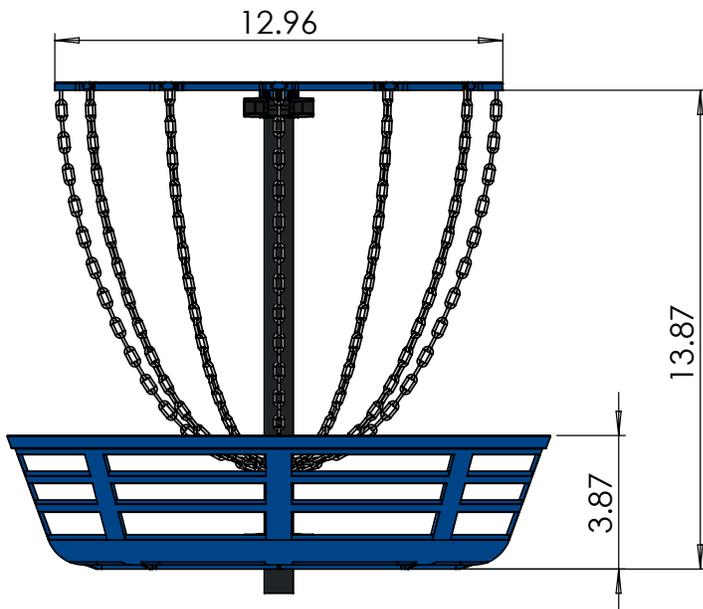
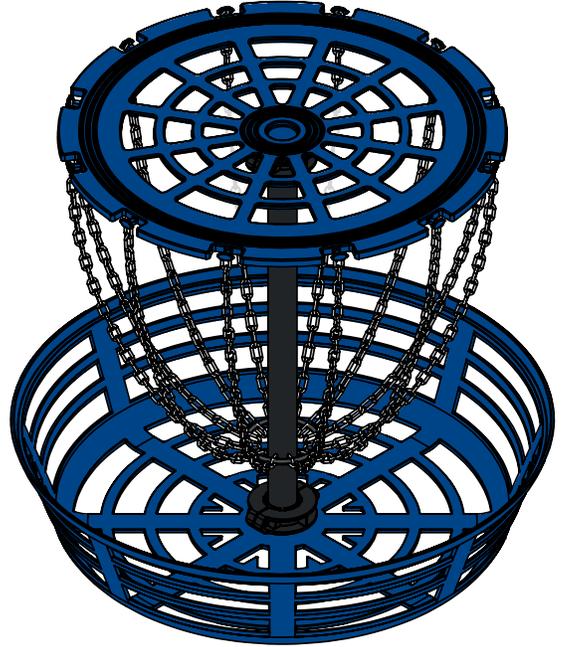
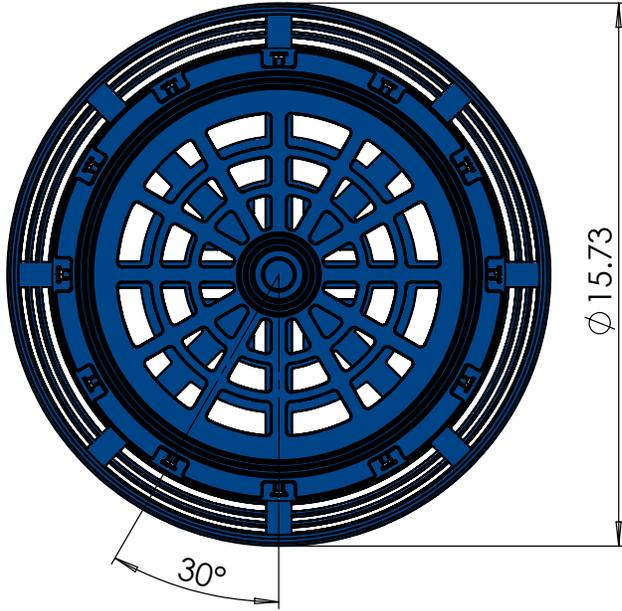
Red High Goal Spec:



Description	2022-2023 Game Specs (3)	
Dwg No	276-7500-000 Field Specifications	
Competition	VRC 2022-2023	Sheet 7 of 14
Release	11/21/2022	ALL DIMENSIONS ARE IN INCHES.

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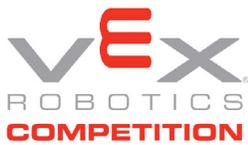
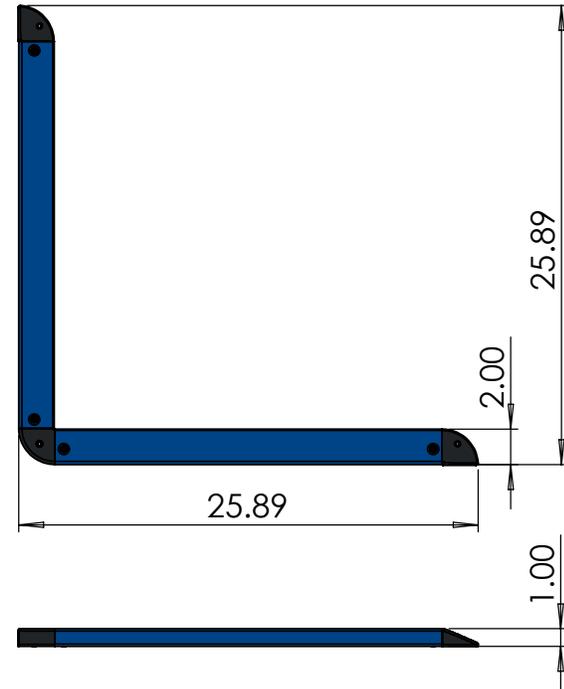
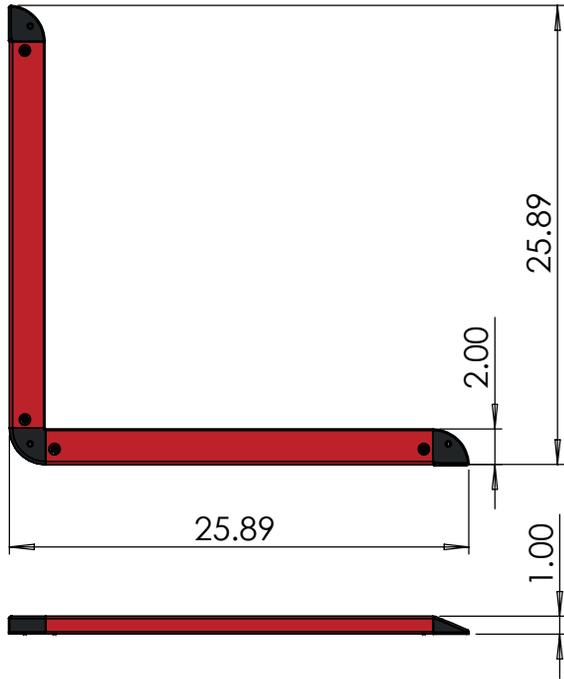
Blue High Goal Spec:



Description	2022-2023 Game Specs (4)	
Dwg No	276-7500-000 Field Specifications	
Competition	VRC 2022-2023	Sheet 8 of 14
Release	11/21/2022	ALL DIMENSIONS ARE IN INCHES.

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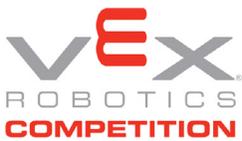
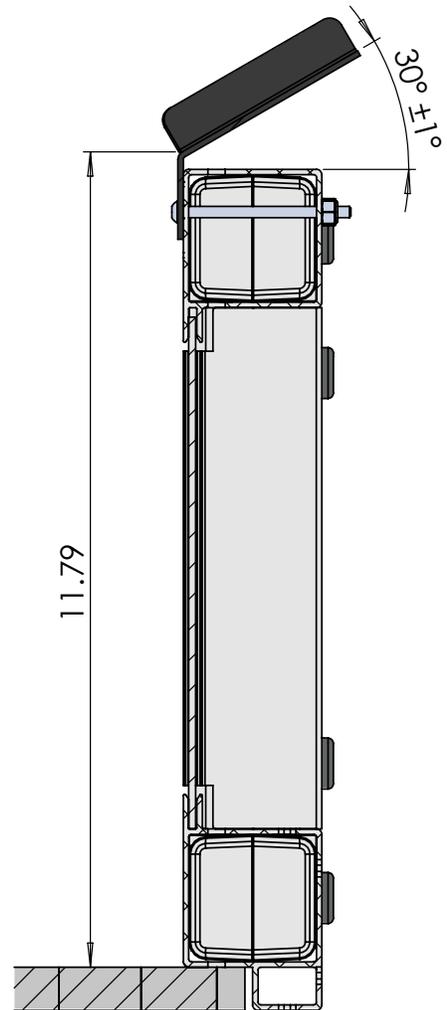
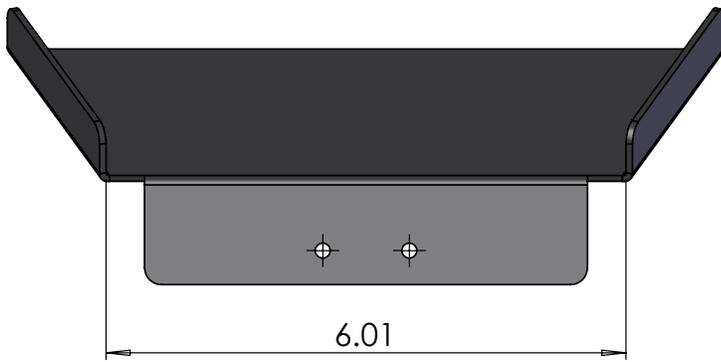
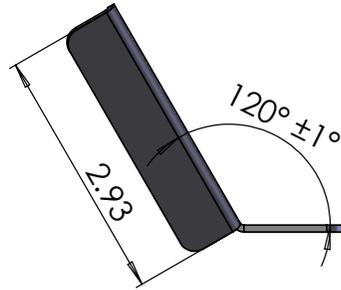
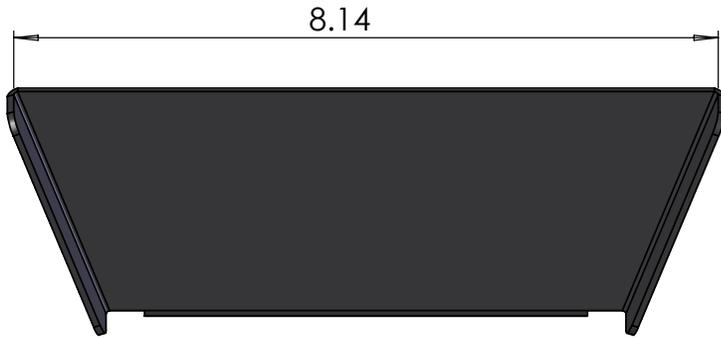
Low Goal Spec:



Description	2022-2023 Game Specs (5)	
Dwg No	276-7500-000 Field Specifications	
Competition	VRC 2022-2023	Sheet 9 of 14
Release	11/21/2022	ALL DIMENSIONS ARE IN INCHES.

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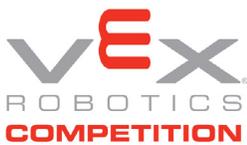
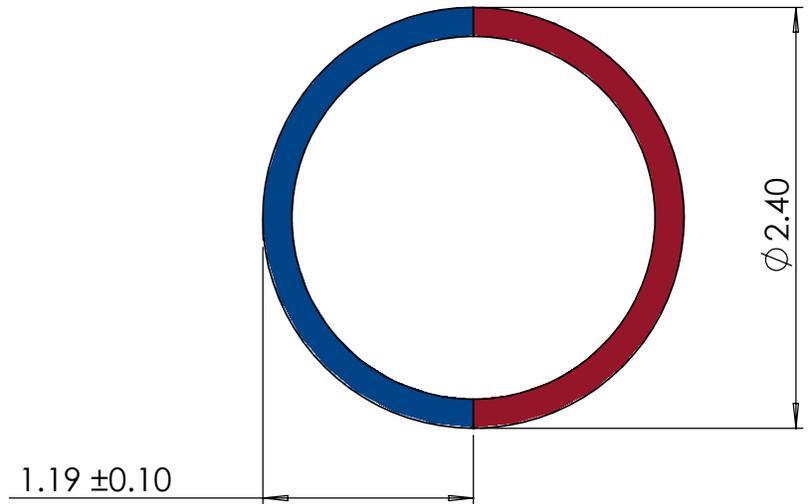
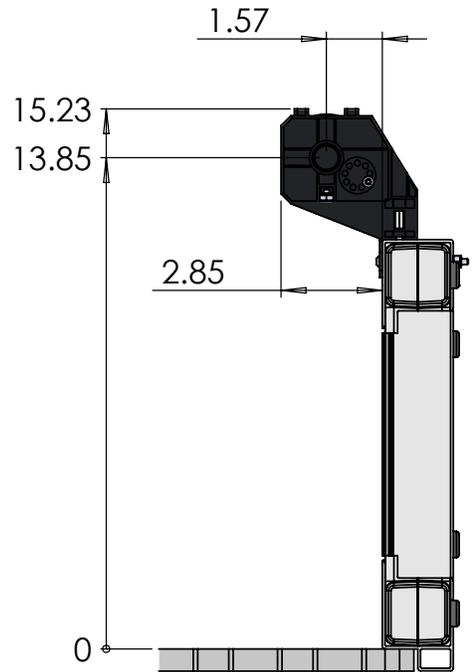
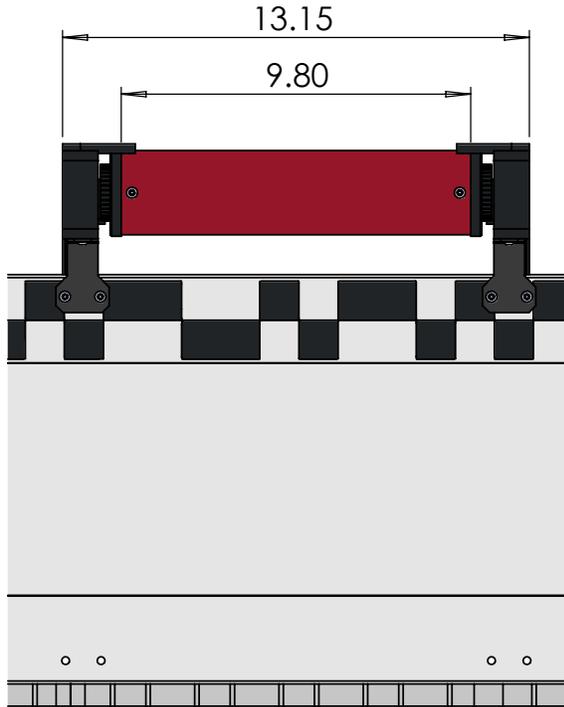
Loader Spec:



Description	2022-2023 Game Specs (6)	
Dwg No	2022-2023 Field Specification	
Competition	VRC 2022-2023	Sheet 10 of 14
Release	11/21/2022	ALL DIMENSIONS ARE IN INCHES.

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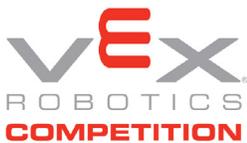
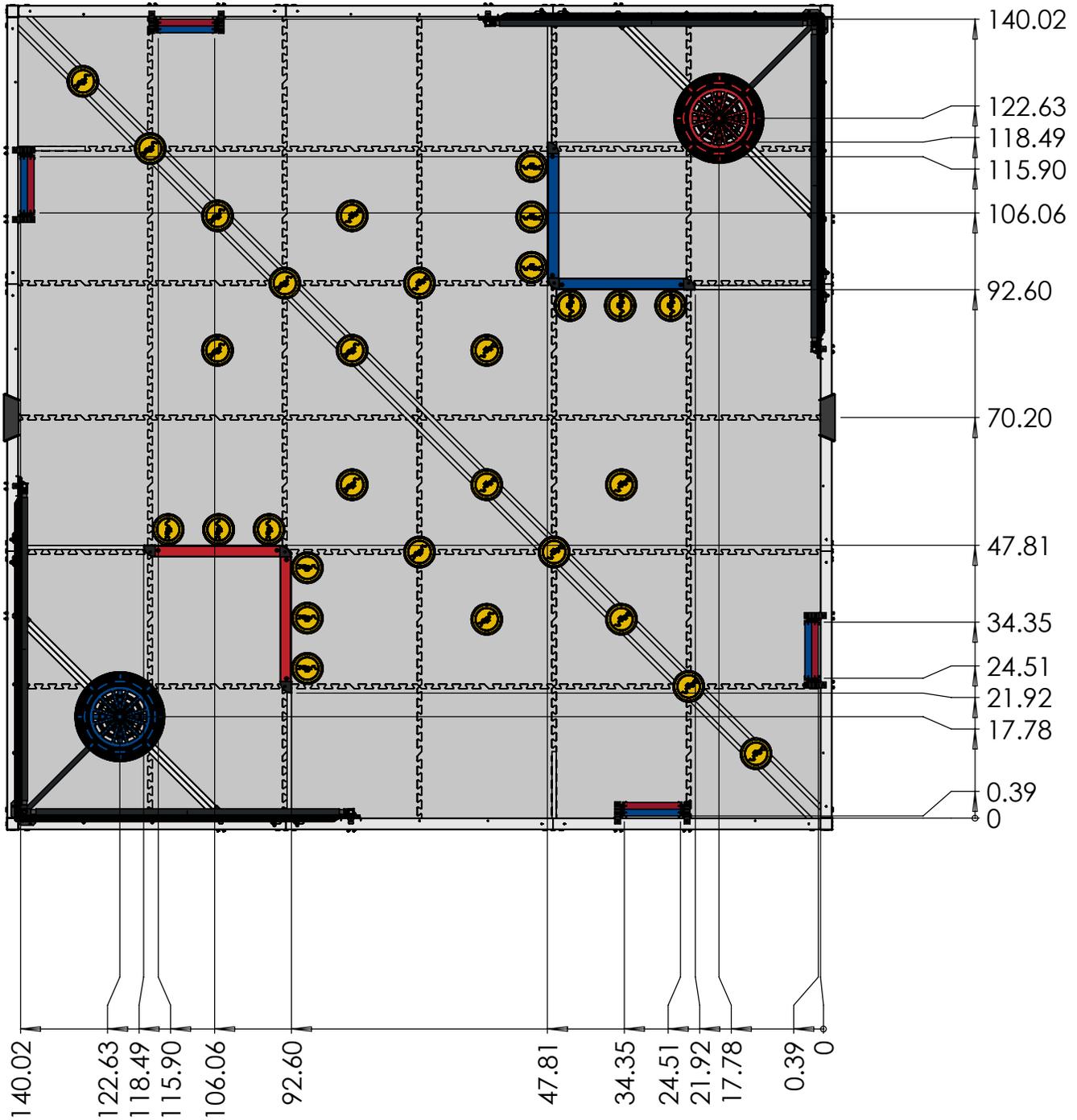
Roller Spec:



Description	2022-2023 Game Specs (7)	
Dwg No	2022-2023 Field Specification	
Competition	VRC 2022-2023	Sheet 11 of 14
Release	11/21/2022	ALL DIMENSIONS ARE IN INCHES.

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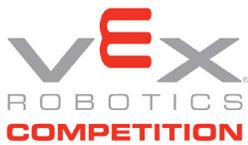
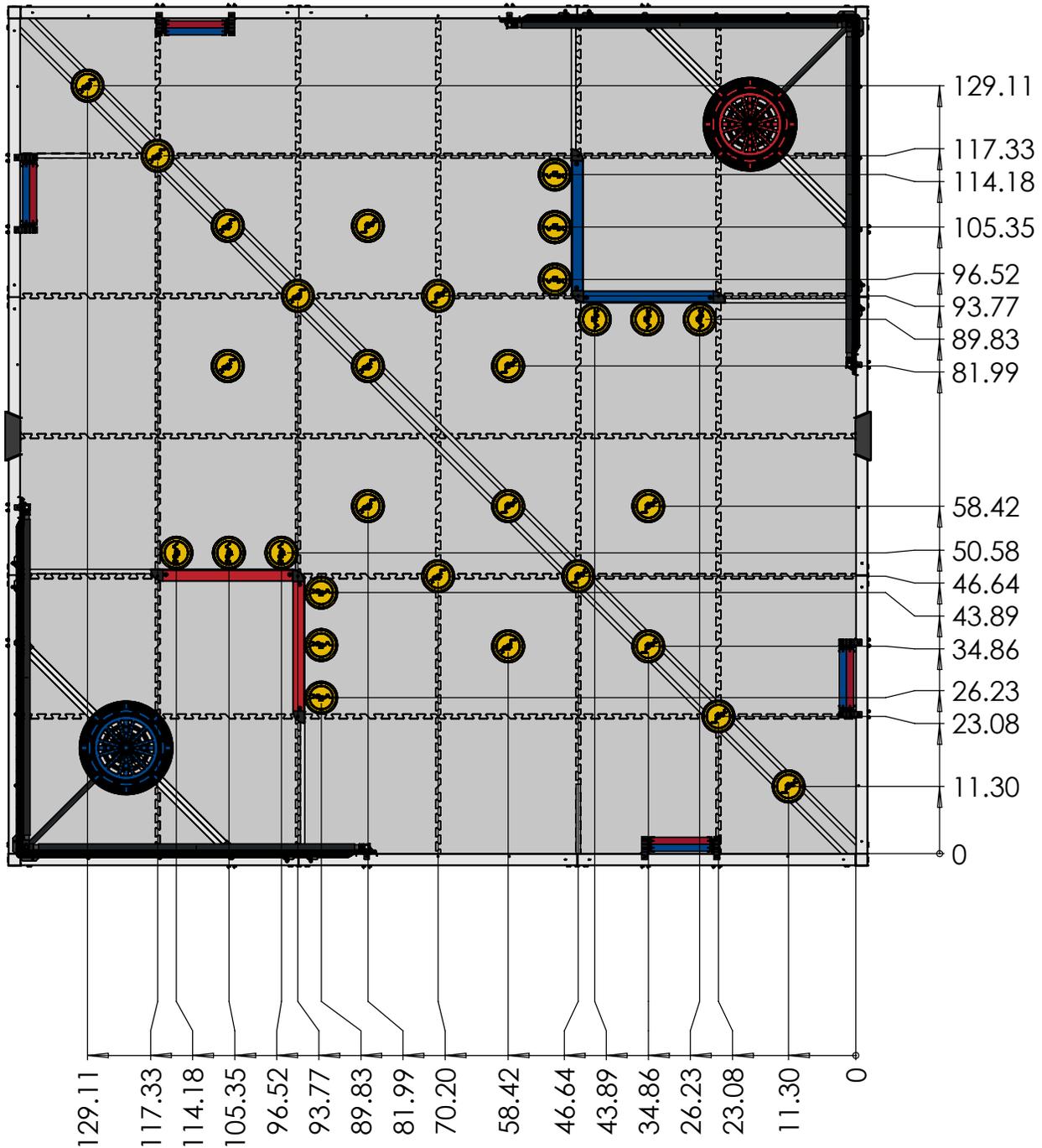
Field Reference Specs:



Description	2022-2023 Game Specs (8)	
Dwg No	276-7500-000 Field Specifications	
Competition	VRC 2022-2023	Sheet 12 of 14
Release	11/21/2022	ALL DIMENSIONS ARE IN INCHES.

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Field Reference Specs:



Description	2022-2023 Game Specs (9)	
Dwg No	276-7500-000 Field Specifications	
Competition	VRC 2022-2023	Sheet 13 of 14
Release	11/21/2022	ALL DIMENSIONS ARE IN INCHES.

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Permitted Field Modifications

Problem: Chains on Spin Up High Goal occasionally detaches from top connection points

Solution: After installing chains onto top connection points, attach a zip tie (276-1032) around the connection point and tighten. Clip the tail of the zip tie.



Problem: Chains on Spin Up High Goal occasionally detaches from lower connection ring.

Solution: After connecting all chains to the lower connection ring (276-7500-006), wrap a ~1" long piece of utility tape around the closure of the ring.



Problem: Top connection points could potentially break off of the High Goal, eliminating the ability to connect the chain to the connection point.

Solution: Replace connection point with a zip tie.

Steps:



Start



Drill two holes as pictured above.
We used a 0.159" drill bit.



String a zip tie through the holes. (276-1032)

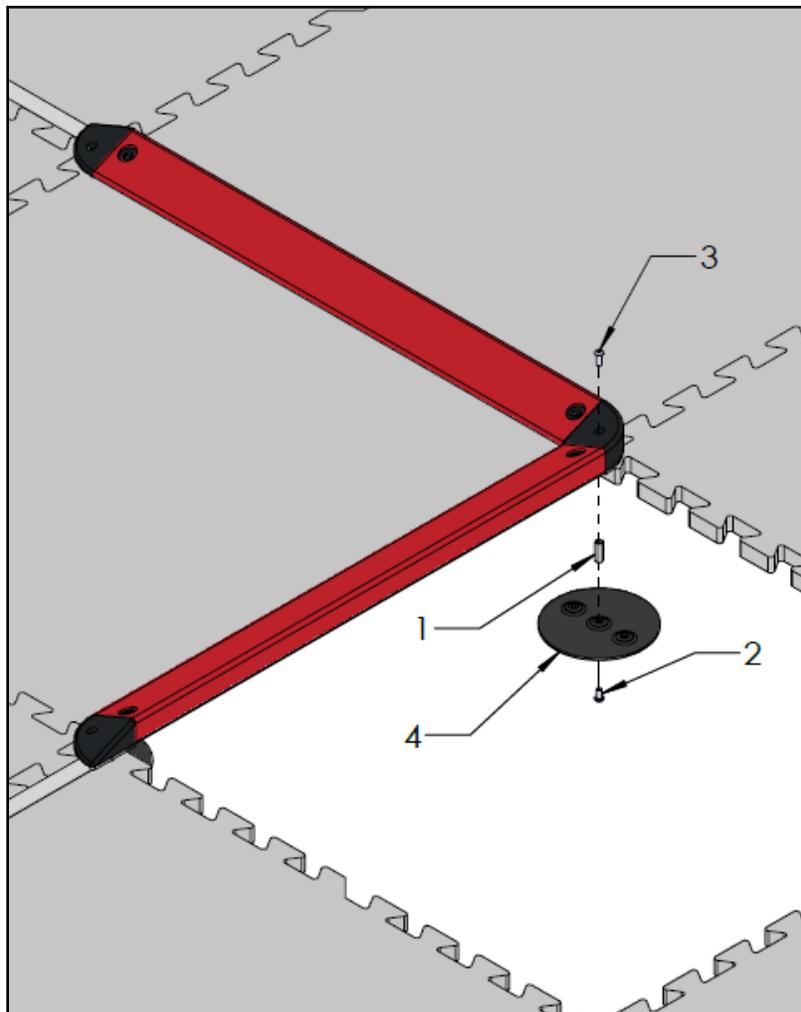


Connect zip tie through the end of the chain,
sinch tight, and trim the tail of the zip tie.

Problem: The *Low Goal* can move when it is hit by a *Robot*.

Solution: Add a small circle base plate to the center hole of each *Low Goal*. Below is a full BOM and instructions for installation. Please use the leftover small circle base plates from a previous game field if available. If you do not have any leftover please contact support@vex.com.

Item Number	Part Number	Description	Qty
1	275-1015-001	0.75" Standoff	2
2	267-4990-001	#8-32 x 3/8" Star Drive Screw	2
3	267-4992-001	#8-32 x 1/2" Star Drive Screw	2
4	276-5677-015	Small Circle Base Plate	2



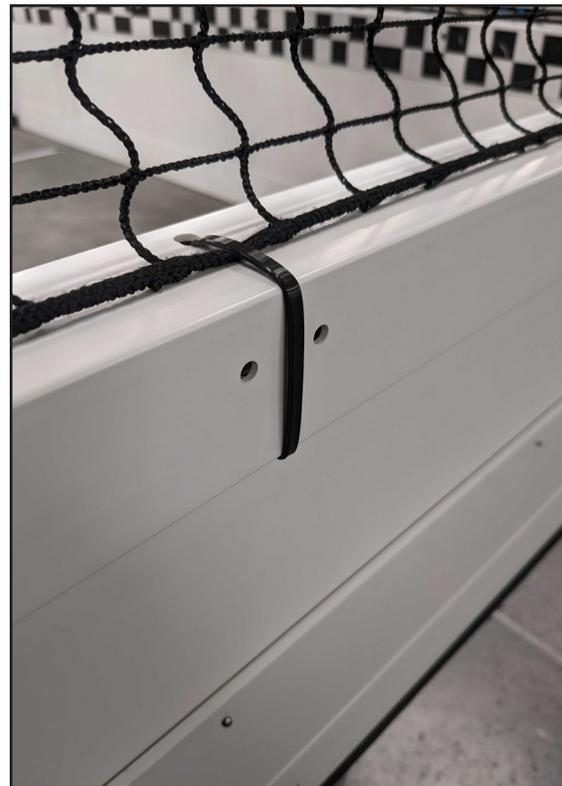
Problem: Corner connector that supports the top crossbar of the Spin Up Net assembly may slip down the vertical support even when completely tightened.

Solution: Rotate the plastic corner bracket 90 degrees so it is attached to the top crossbar and resting on the vertical support.



Problem: The IQ pieces used to secure the Spin Up Net to the top of a Portable Competition Field Perimeter may not remain attached during gameplay.

Solution: Attach a zip tie through the existing holes in the Portable Competition Field Perimeter and the bottom of the Net. Tighten the zip tie and clip the tail.





The logo features the word "VEX" in a stylized font where the "E" is red and the "V" and "X" are grey. Below it, "ROBOTICS" is in grey, "COMPETITION" is in red, and "SPIN UP" is in white text inside a grey rounded rectangle.

VEX[®]
ROBOTICS
COMPETITION
SPIN UP

2022 - 2023

Appendix B - Robot Skills Challenge

Appendix B

Overview

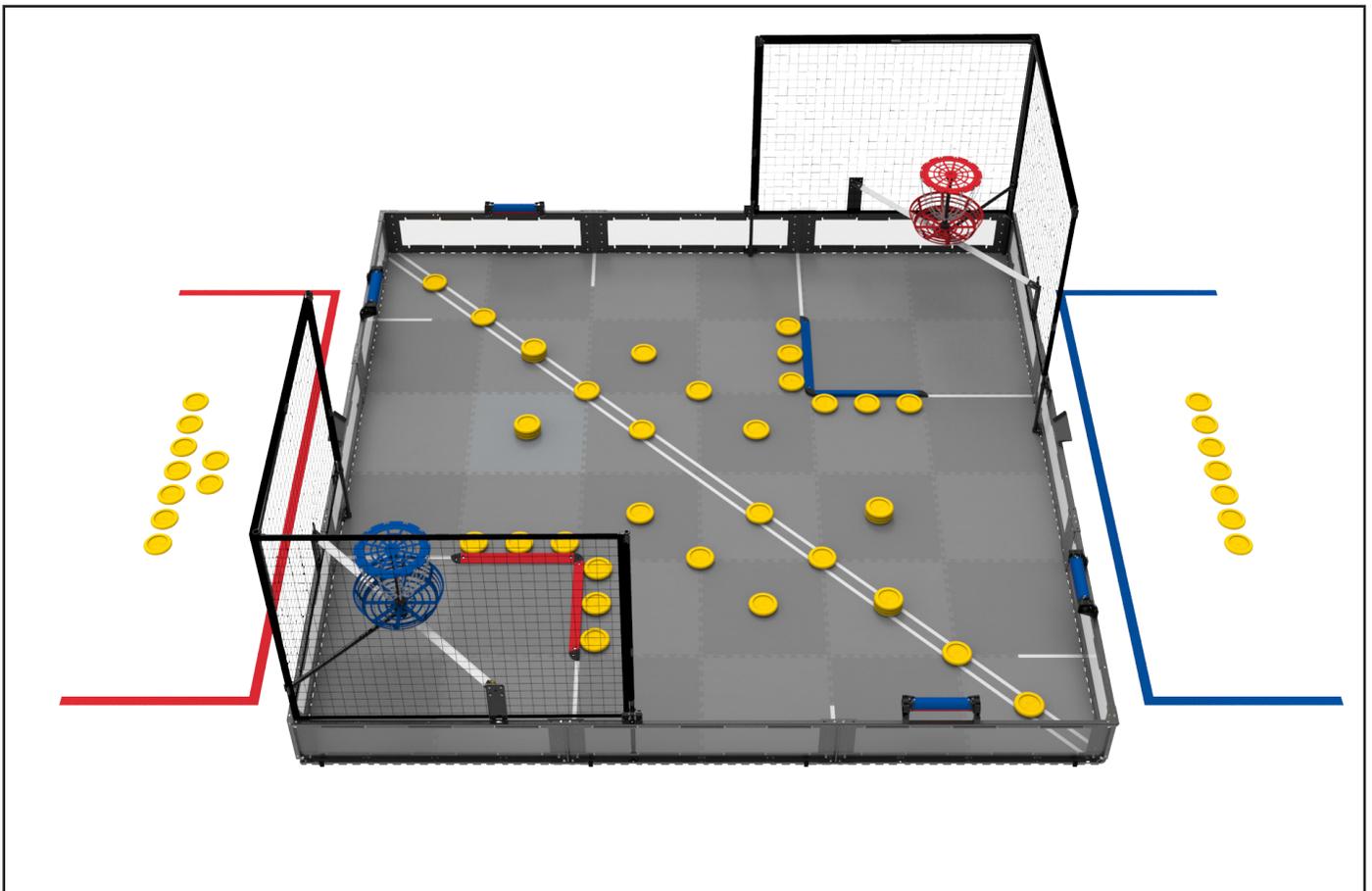
This Appendix describes the Robot Skills Challenge rules for VEX Robotics Competition Spin Up. All rules from "The Game" section of the manual apply to the Robot Skills Challenge, unless otherwise specified in this Appendix.

Robot Skills Challenge Description

In this challenge, *Teams* will compete in sixty-second (1:00) *Matches* in an effort to score as many points as possible. These *Matches* consist of *Driving Skills Matches*, which are entirely driver controlled, and *Programming Skills Matches*, which are autonomous with limited human interaction. *Teams* will be ranked based on their combined score in the two types of Skills Matches.

The Robot Skills Challenge playing field is set up almost exactly the same as a Head-to-Head VEX Robotics Competition Spin Up Match, with the following modifications:

- In *Programming Skills Matches*, the VEX GPS code strip must be installed on the field.
- Six (6) of the *Preload Discs* are not used.
- All *Rollers* start with the blue side up as shown in the image below.



Robot Skills Challenge Definitions

All definitions from “The Game” section of the manual apply to the Robot Skills Challenge, unless otherwise specified.

Driving Skills Match - A *Driving Skills Match* consists of a sixty-second (1:00) *Driver Controlled Period*. There is no *Autonomous Period*. Teams can elect to end a *Driving Skills Match* early if they wish to record a *Skills Stop Time*.

Programming Skills Match - A *Programming Skills Match* consists of a sixty-second (1:00) *Autonomous Period*. There is no *Driver Controlled Period*. Teams can elect to end a *Programming Skills Match* early if they wish to record a *Skills Stop Time*.

Robot Skills Match - A *Driving Skills Match* or *Programming Skills Match*.

Skills Stop Time - The time remaining in a *Robot Skills Match* when a *Team* ends the *Match* early.

- a. If a *Team* does not end the *Match* early, they receive a default *Skills Stop Time* of 0.
- b. The moment when the *Match* ends early is defined as the moment when the *Robot* is “disabled” by the field control system. See the “*Skills Stop Time*” section for more details.
- c. If a V5 Robot Brain or Tournament Manager display is being used for field control, then the *Skills Stop Time* is the time shown on the display when the *Match* is ended early (i.e., in 1-second increments).
- d. If a VEXnet Competition Switch is being used for field control, in conjunction with a manual timer that counts down to 0 with greater accuracy than 1-second increments, then the time shown on the timer should be rounded up to the nearest second. For example, if the *Robot* is disabled and the timer shows 25.2 seconds, then the *Skills Stop Time* should be recorded as 26.

Robot Skills Challenge Rules

All rules from "The Game" section of the manual apply to the Robot Skills Challenge, unless otherwise specified.

<RSC1> Robots may start the *Robot Skills Match* in any legal starting location for either *Alliance*.

- a. All *Drive Team Members* must begin the *Match* in the *Alliance Station* which corresponds to the chosen *Robot* starting location.
- b. *Robots* must meet all of the criteria listed in rule <SG1>.
- c. The *Team* gets two *Preloads* that must be used in accordance with rule <SG2>. If the *Team* wishes to use the *Preloads* as *Match Load Discs*, they may be added to either *Alliance Station*.
- d. The six (6) *Discs* that would be used as *Preloads* by other *Teams* in a *Head-to-Head Match* are not used.
- e. All *Rollers* on the field start on Blue.

<RSC2> The *Team* may utilize fourteen (14) *Match Load Discs*, within the guidelines set forth by <SG6>.

- a. Seven (7) *Match Load Discs* begin the *Match* in each *Alliance Station*, just as in a *Head-to-Head Match*.
- b. *Match Load Discs* must be introduced from the *Alliance Station* in which they begin the *Match*.
 - i. At any point during the *Match*, one (1) *Drive Team Member* is permitted to move between the two (2) *Alliance Stations* for the purpose of introducing *Match Load Discs*. There may never be more than one (1) *Drive Team Member* outside of the *Alliance Station* in which the *Team* began the *Match*.

Note: This rule applies to both Driving Skills Matches and Programming Skills Matches.

<RSC3> In *Robot Skills Matches*, *Teams* play as if they are on a "neutral" *Alliance*. *Robots* may freely move about the field, utilize any *Loader*, score in any *Goal*, and manipulate any *Roller*.

- a. All *Goals* are considered to belong to the same "neutral" *Alliance* as the *Team*.

For example, if a *Robot* is contacting a *Disc* in either *High Goal*, it would be considered in contact with a *Robot* of the same color *Alliance* as the *Goal*, and not be considered *Scored*, per <SC2> and <SC3>.

<RSC4> *Robots* must have moved during the *Match* in order to receive points for *Covering* field tiles.

<RSC5> *Rollers* are considered *Owned* if they are *Owned* by the red *Alliance* (i.e., "red-up") at the end of the *Match*.

<RSC6> There is no requirement that Skills Challenge fields have the same set of consistent modifications as the Head-to-Head fields. For example, there is no requirement that all Skills Challenge fields are elevated to the same height as Head-to-Head fields. However, all Skills Challenge fields at a single event must use the same type of field control and field perimeter, as described in rules <T22> and <T23>.

It is strongly recommended / preferred that all Skills Challenge fields are consistent with each other, but this may not be possible in extreme circumstances.

<RSC7> In *Robot Skills Matches*, the *Endgame* period may begin early without penalty if a *Robot* violates <SG4> or <SG5> prior to the last 10 seconds of the *Match* (i.e. if they expand beyond the standard allowable limits, either intentionally or unintentionally).

If a *Team* intends to finish the *Robot Skills Match* early and record a *Skills Stop Time*, they should still inform the *Scorekeeper Referee* prior to the *Match* per the guidelines in the *Skills Stop Time* section below. However, in lieu of a "stop the timer" signal, the *Drive Team Member* may instead provide a "begin the *Endgame*" signal; the *Scorekeeper Referee* will begin a 10-second countdown in sync with the field timer, and then end the *Match* early.

The *Skills Stop Time* will still be recorded as the time when the *Match* comes to an end, not the time when the *Endgame* began.

For example, if a *Robot* expands with :33 seconds remaining on the field timer, a *Skills Stop Time* of :23 seconds would be recorded.

Note that this rule also applies even if the expansion occurs unintentionally (e.g. accidental early deployment of an *Endgame* mechanism). In this scenario, the referee will verbally inform the *Team* that the *Endgame* has started, begin the 10-second countdown, and record the *Skills Stop Time* accordingly.

The *Endgame* period must still be 10 seconds long, i.e. a *Team* cannot decide to immediately stop the *Match* without an *Endgame* period (or with a "retroactive" *Endgame* period) if an accidental expansion occurs without informing the *Scorekeeper* referee.

Robot Skills Challenge Scoring

Points are awarded according to the same scoring rules as Head-to-Head *Matches*, unless otherwise noted above. A *Team's* score at the end of a *Robot Skills Match* is calculated by combining the scores that would have been awarded to the red and blue *Alliances*. For example, all *Discs* that end the *Match* in either *High Goal* are worth 5 points each, regardless of which side of the Field the *Robot* starts on.

Skills Stop Time

If a *Team* wishes to end their *Robot Skills Match* early, they may elect to record a *Skills Stop Time*. This is used as a tiebreaker for Robot Skills Challenge rankings. A *Skills Stop Time* does not affect a *Team's* score for a given *Robot Skills Match*.

- *Teams* who intend to attempt a *Skills Stop Time* must "opt-in" by verbally confirming with the scorekeeper referee prior to the *Robot Skills Match*. If no notification is given prior to the start of the *Match*, then the *Team* forfeits their option to record a *Skills Stop Time* for that *Match*.
 - This conversation should include informing the *Scorekeeper Referee* which *Drive Team Member* will signal the stop. The *Match* may only be ended early by a *Drive Team Member* for that *Match*.
 - If a *Team* runs multiple *Robot Skills Matches* in a row, they must reconfirm their *Skills Stop Time* choice with the *Scorekeeper Referee* prior to each *Match*.
 - Any questions regarding a *Skills Stop Time* should be reviewed and settled immediately following the *Match*. <T1> and <T3> apply to *Robot Skills Matches*.
- If the event is utilizing a V5 Robot Brain or the TM Mobile app for Robot Skills Challenge field control, a *Drive Team Member* may elect to start and stop their own *Robot Skills Matches*.
 - This V5 Robot Brain or other device running the TM Mobile app will be used to start the *Robot Skills Matches* (i.e., "enable" the *Robot*), end the *Robot Skills Match* (i.e., "disable" the *Robot*), and display the official *Skills Stop Time* to be recorded.
 - This V5 Robot Brain must be running the official field control user program.
 - For more information regarding the use of a V5 Robot Brain for Robot Skills Challenge field control, and to download the official field control user program, [visit this VEX Knowledge Base article](#).
 - For more information regarding the use of TM Mobile for field control, [see the Tournament Manager documentation](#).
- At events which do not have a V5 Robot Brain or the TM Mobile App available for Robot Skills Challenge field control, *Drive Team Members* and field staff must agree prior to the *Match* on the signal that will be used to end the *Match* early.
 - As noted in the definition of *Skills Stop Time*, the moment when the *Match* ends early is defined as the moment when the *Robot* is "disabled" by the field control system.

- The agreed-upon signal must be both verbal and visual, such as *Drive Team Members* crossing their arms in an "X" or placing their V5 Controller(s) on the ground.
 - The signal must be given by a *Drive Team Member* who is standing in the *Alliance Station*.
 - It is recommended that *Drive Team Members* also provide verbal notice that they are approaching their *Skills Stop Time*, such as by counting out "3-2-1-stop."
- It is at the *Event Partner's* discretion which method will be used to record *Skills Stop Times* at a given event. The chosen method must be communicated prior to the event (such as during a Drivers' meeting), and made equally available to all *Teams*.
 - If an event intends to use a manual timekeeping method, a *Team* may not bring their own V5 Robot Brain just for use during their own *Robot Skills Match*.
 - If an event intends to utilize a V5 Robot Brain, all *Teams* must use the same V5 Robot Brain for all *Robot Skills Matches* on a given field.
 - If an event is using multiple fields for *Robot Skills Matches*, the same method must be used at all fields, as described in rule <RSC6>. Multiple V5 Robot Brains may be used as needed (e.g., a "Field 1 Brain" and a "Field 2 Brain").
 - The default "Drive" program accessed from a V5 Controller is intended for practice only, and may not be used for an official *Robot Skills Match*.

Robot Skills Challenge Ranking at Events

For each *Robot Skills Match*, *Teams* are awarded a score as described in the Robot Skills Challenge Scoring section, and an optional *Skills Stop Time* as described in the *Skills Stop Time* section. *Teams* will be ranked based on the following tiebreakers:

1. Sum of highest *Programming Skills Match* score and highest *Driving Skills Match* score.
2. Highest *Programming Skills Match* score.
3. Second-highest *Programming Skills Match* score.
4. Second-highest *Driving Skills Match* score.
5. Highest sum of *Skills Stop Times* from a *Team's* highest *Programming Skills Match* and highest *Driving Skills Match* (i.e., the *Matches* in point 1).
6. Highest *Skills Stop Time* from a *Team's* highest *Programming Skills Match* (i.e., the *Match* in point 2).
7. Third-highest *Programming Skills Match* score.
8. Third-highest *Driving Skills Match* score.
9. If a tie cannot be broken after all above criteria, then the following ordered criteria will be used to determine which *Team* had the "best" *Programming Skills Match*:
 - a. Number of *Discs Scored* in the *High Goal*.

- b. Number of *Owned Rollers*.
 - c. Number of *Covered* field tiles.
 - d. Number of *Discs Scored* in the *Low Goal*.
- If the tie still cannot be broken, the same process in Step 9 will be applied to each *Team's* best *Driving Skills Match*.
 - If the tie still isn't broken, events may choose to allow *Teams* to have one more deciding *Driving Skills Match*, to be ranked according to the standard criteria above, or declare both *Teams* the Robot Skills Challenge Winner.

Robot Skills Challenge Ranking Globally

Teams will be ranked globally based on their Robot Skills scores from Tournaments and Leagues that upload results to robotevents.com, according to the following tiebreakers:

1. Highest Robot Skills score (combined *Programming Skills Match* and *Driving Skills Match* Score from a single event).
2. Highest *Programming Skills Match* score (from any event).
3. Highest sum of *Skills Stop Times* from the *Robot Skills Matches* used for point 1.
4. Highest *Skills Stop Time* from the *Programming Skills Match* used for point 2.
5. Highest *Driving Skills Match* score (from any event).
6. Highest *Skills Stop Time* from the *Driving Skills Match* score used for point 5.
7. Earliest posting of the Highest *Programming Skills Match* score.
 - a. The first *Team* to post a score ranks ahead of other *Teams* that post the same score at a later time, all else being equal.
8. Earliest posting of the Highest *Driving Skills Match* score.
 - a. The first *Team* to post a score ranks ahead of other *Teams* that post the same score at a later time, all else being equal.

League Events

At league events in which *Teams* may submit Robot Skills Challenge scores across multiple days / sessions, the Robot Skills scores (combined highest *Programming Skills Match* and *Driving Skills Match* scores) used for rankings will be calculated from *Matches* within the same session.

For example, consider the following scores for a hypothetical *Team* across two league event sessions:

	Programming Skills Match	Driving Skills Match	Robot Skills Score
Session 1	100	100	200
Session 2	150	40	190

This *Team* would have a Robot Skills score of 200 for this event, and their scores from Session 1 would be used for the Event and Global tiebreakers listed in the above two sections.

Robot Skills Challenge Format Options

To better accommodate varying health & safety circumstances in different regions, the 2022-2023 season will feature different avenues for *Event Partners* to host Robot Skills Challenge competitions. Regardless of the format chosen for a given event, all rules and information listed in this Appendix apply. However, some formats will have additional rules in place to ensure fair and consistent gameplay.

Robot Skills Challenge at a Standard Qualifying Tournament

The Robot Skills Challenge is an optional event for all *Teams*. *Teams* who do not compete will not be penalized in the main tournament.

- *Teams* may play *Robot Skills Matches* on a "first come, first served" basis, or by a pre-scheduled method determined by the *Event Partner*.
- *Teams* will be given the opportunity to play exactly three (3) *Programming Skills Matches* and three (3) *Driving Skills Matches*. *Teams* should be aware of when the Robot Skills fields are open so that they do not miss their opportunity. For example, if a *Team* waits until five minutes before the Robot Skills fields close, then they have not used the opportunity given to them and will not be able to compete in all six matches.

Skills-Only Event: In-Person, Live

- *Teams* may play *Robot Skills Matches* on a "first come, first served" basis, or by a pre-scheduled method determined by the *Event Partner*.
- Further details regarding Skills-Only Event logistics can be found in the [REC Foundation Qualification Criteria document](#).

Skills-Only Event: Remote

1. The Remote Skills Only environment (i.e. digital platform) may be chosen at *Event Partner* discretion.
 - a. All registered *Teams* must be able to view live the *Matches* being played by all other registered *Teams*.
 - b. REC Foundation Staff must have access to view all matches while being played live.
 - c. The online meeting environment must not be accessed or viewed by the general online public while the event is live, e.g. the event must be password protected or invite-only.
 - i. Guests invited by the *Event Partner* can be able to view, but may not have use of their microphone or camera or display anything for teams to see or hear.
 - ii. One example that would satisfy this requirement would be to use an online video conferencing application that allows for a large number of people who must register to attend. The *Event Partner* would approve spectators who can view the matches, but would only give *Teams* the ability to share their screen, camera or microphone.
 - iii. After the event is over, there are no such restrictions (i.e. the *Event Partner* may post a recording of the event if they wish).
2. Registered *Teams* will be assigned scheduled times to complete Robot Inspection and up to (3) *Programming Skills Matches* and (3) *Driving Skills Matches* over a live, online environment.
3. The minimum event staff must include one (1) *Event Partner* and at least one (1) certified *Head Referee*. A dedicated Tournament Manager operator is also recommended, but not required, if the *Head Referee* and / or *Event Partner* wish to fulfill this role.
4. At all times, there must be a minimum of (2) *Adults* over the age of 18 in the remote meeting environment before *Students* are allowed to connect. One of those *Adults* must be the *Event Partner*.
5. The *Team's* Primary Contact, or another designated *Adult Team* contact (over the age of 18), must be present in the remote meeting environment throughout the duration of the scheduled time for that *Team*. The *Team's* Primary Contact will be responsible for providing the *Adult* representative's contact information to the *Event Partner* prior to the event.
6. *Teams* will complete a full Robot inspection, in accordance with the game manual, live with the *Head Referee* prior to their first *Robot Skills Match*. This inspection process should follow the checklist on a standard inspection sheet, including a demonstration of sizing compliance as explained in.

Note: This inspection may also include an informal "Field inspection", to ensure that a *Team's* remote environment is set up properly for their *Matches*.

7. All *Team* camera footage must be streamed live, from one camera feed, with no "cuts".
 - a. Pre-recorded *Robot Skills Matches* are strictly prohibited in a Live, Remote event.
 - b. The *Drive Team Member(s)*, *Robot(s)*, *Controller(s)* and complete competition field must remain on camera at all times during the *Match*.

- c. A Stopwatch / Tournament Manager display that shows the match time must be on video the entire time during the *Match*.
 - d. The camera must be able to move around the field, with no breaks or “cuts”, so that it can verify standard *Head Referee* checks before and after the *Match*. These could include (but are not limited to) Starting Position placement, game and field element placements, and any necessary scoring verification.
 - i. If this is not feasible due to a *Team’s* equipment or facility limitations, a second camera stream must be used for these close-up checks. This is the only permissible exception to the “single-camera” rule set forth by , and *Teams* utilizing this exception should expect additional scrutiny.
8. Live, Remote Robot Skills *Matches* must include some live interaction between the *Team* and the *Head Referee*.
- a. A *Drive Team Member* must pair their Controller to their *Robot* on video prior to each *Match*.
 - b. The *Head Referee* must ask the *Team* if they are ready, and the *Team* must respond verbally / visually on video.
 - i. If the *Head Referee* needs to see a closer or different angle of the *Robot* Starting Position or any field elements, the *Team* must be able to satisfy this request.
 - c. The *Match* will begin with the *Team* member who is controlling their clock to give a countdown for the *Match* to start. This person does not need to be a *Drive Team Member*.
 - d. After the *Match*, *Teams* must move the camera per the *Head Referee’s* instructions to verify scored game elements before the field is reset. The *Head Referee* will confirm to the *Team* verbally what is being counted.
 - i. <T1> and <T3> still apply - the *Head Referee’s* judgment based on what can be seen on camera is final, as it would if they were observing it in person. There are no video or photo replays in a Live, Remote Skills-Only Event. One common example will be for a referee to ask a *Team* to move the camera over to a goal to show if *Discs* are properly scored in that Goal. The *Head Referee* will ask the *Team* a series of questions, and might ask for a couple of different camera angles, but once the referee makes a determination based on these questions and viewing angles, the referee’s decision is final.
9. *Match* replays are at the discretion of the *Head Referee*. In addition to the examples provided in <T7> , live video circumstances (such as a video cutting out, or a *Match* timing error) could warrant a *Match* replay at the *Head Referee’s* discretion.
10. Any violation of any rules will result in the *Match* score being recorded as zero. That *Match* will count as one of the *Team’s* allotted *Matches*.



VEX[®]
ROBOTICS
COMPETITION
SPIN UP

The logo features the word 'VEX' in a large, bold, sans-serif font. The 'E' is red, while 'V' and 'X' are grey. Below it, 'ROBOTICS' is in a smaller, grey, all-caps font. 'COMPETITION' is in a bold, red, all-caps font. 'SPIN UP' is in a bold, white, all-caps font inside a dark grey rounded rectangle.

2022 - 2023
Appendix C - VEX U

Appendix C

VEX U

Introduction

While many colleges and universities already use the VEX V5 system in their academic classes, many more have extensive manufacturing capabilities beyond the standard “VEX metal” library. Fabrication techniques like machining and 3D printing are more common than ever in collegiate engineering programs, and we can’t wait to see what VEX U *Teams* from around the world are able to create under these more advanced rules.

As in past years, the season will include a culminating VEX U event at the VEX Robotics World Championship, along with regional tournaments across the world. Participating schools will get the chance to prove their abilities in front of thousands of future engineers and show off what truly makes their school remarkable. VEX U is the perfect project-based supplement to many university level engineering programs, and will give students the unique opportunity to demonstrate their real-world skills to potential employers (such as VEX competition sponsors).

Event Information

Several of the University partners participating in VEX U will be holding tournament events in addition to the capstone competition at the 2023 VEX Robotics World Championship. Refer to <http://www.robotevents.com/> for event details, pricing, and registration info for VEX U events.

Game, Robot, and Tournament Rules

VEX U uses the VEX Robotics Competition Spin Up field with no modifications. Anyone that has a VEX Robotics Competition Spin Up field can use it for a VEX U event or *Team*. Please consult the VEX Robotics Competition Spin Up Game Manual for the basic set of competition rules and details. All of the standard Game, Robot, & Tournament rules apply, except for the modifications listed in this document. In the event of a rules conflict, the rules listed in this document and rulings on the VEX U Q&A take precedence.

VEX U Definitions

Additional Electronics - Any sensor, processor, or other electronic component used in *Robot* construction, and connected to the V5 Robot Brain, that is not sold by VEX Robotics. Examples could include commercially-available devices (e.g., Raspberry Pi) or custom devices designed and fabricated by the *Team*. See <VUR10> for more details.

Fabricated Part - Any component used in *Robot* construction that is fabricated by *Team* members. See <VUR3>, <VUR4>, and <VUR5> for more details.

Rule Modifications: Game, Tournament

<VUG1> Instead of a 2-Team *Alliance* format, VEX U *Matches* will be played 1-Team vs. 1-Team. Each *Team* will use two (2) *Robots* in each *Match*.

- a. *Teams* are allowed to build as many *Robots* as they would like, but only two (2) - one of each size as described in <VUR1> - may be brought from the pit to the playing field for any *Match*.
- b. All *Robots* must pass inspection before they are allowed to compete.

<VUG2> *Qualification Matches* will be conducted in the same manner as in a VRC tournament, but in the revised 1v1 format described in <VUG1>.

<VUG3> *Elimination Matches* will be conducted in the same manner as in a VRC tournament, but without an *Alliance Selection*. At the end of the competition, one *Team* will emerge as the event champion.

<VUG4> The *Autonomous Period* at the beginning of each Head-to-Head *Match* will be 45 seconds (0:45).

- a. All interaction with *Robots* during the *Autonomous Period*, including via the Vision Sensor, is strictly prohibited. The intent of this rule is to encourage collegiate *Teams* to develop advanced autonomous routines.
- b. If both *Teams* complete their routines before 45 seconds has elapsed, they have the option to signal that they wish to end the *Autonomous Period* early. Both *Teams* and the *Head Referee* must all agree on the "early stop." This is not a requirement, and the option must have been established for all *Teams* at the event, such as during the Driver's meeting.

<VUG5> The *Driver Controlled Period* is shortened to 75 seconds (1:15) and immediately follows the *Autonomous Period*.

<VUG6> Each *Robot* is allowed up to three (3) *Drive Team Members* in the *Alliance Station* during a *Match*, as modified from <G7>.

<VUG7> VEX U *Student* eligibility.

- a. All VEX U *Team* members MUST be matriculated in a post-secondary school OR have earned a post-secondary education diploma, certificate, or other equivalent during the six (6) months preceding the VEX Robotics World Championship. The intent of this rule is to permit *Students* graduating mid-year to still be able to finish their competition season.
- b. Professionals not enrolled in post-secondary education are not eligible to participate on a VEX U *Team*.

- c. *Students* who are dual-enrolled in both a secondary school and in post-secondary courses are not eligible to participate on a VEX U *Team*.
- d. VEX U *Team* members may only be on exactly one (1) VEX U *Team* for the season. See <G6>.

Rule Modifications: Robot

<VUR1> *Teams* must build two (2) *Robots*.

- a. Both *Robots* may only be built from the following materials:
 - i. Official VEX Robotics products (see <VUR2>).
 - ii. *Fabricated Parts* made by the *Team* (see <VUR3>, <VUR4>, and <VUR5>).
 - iii. Commercially-available springs and fasteners (see <VUR6> and <VUR7>).
 - iv. A legal electronics system (see <VUR8>).
 - v. Any legal *Additional Electronics* (see <VUR10>).
- b. One *Robot* must be smaller than 18" x 18" x 18" at the start of the *Match*.
- c. One *Robot* must be smaller than 15" x 15" x 15" at the start of the *Match*.

Note: <SG4> and <SG5> apply as-written to both *Robots*.

<VUR2> *Teams* may use any official VEX Robotics products, other than the exceptions listed in the tables below, to construct their *Robot*. This includes those from the VEXpro, VEX V5, VEX EXP, VEX IQ, and VEX GO product lines. To determine if a product is "official" or not, refer to www.vexrobotics.com.

SKU	Description	SKU	Description
217-8080	Talon SRX	217-4347	775pro
217-9191	Victor SPX	217-2000	CIM Motor
217-9090	Victor SP	217-3371	Mini CIM Motor
217-4243	Pneumatic Control Module	217-3351	BAG Motor
217-4244	Power Distribution Panel	217-6515	Falcon 500
217-4245	Voltage Regulator Module		

<VUR3> *Fabricated Parts* may be made using the following processes:

- a. Adding material, such as 3D printing.
- b. Removing material, such as cutting, drilling, or machining.
- c. Bending material, such as sheet metal breaking or thermoforming.
- d. Casting or molding material, such as injection molding or sand casting.
- e. Attaching materials to one another, such as welding or chemically bonding (e.g., epoxy).

<VUR4> *Fabricated Parts* must be made from raw materials. For the purpose of this rule, a “raw material” is any material that would not be considered a “pre-fabricated” part (i.e., has not undergone any of the fabrication techniques listed in <VUR3>).

- a. Standard raw material finishing processes, such as extrusion, heat treating, or anodizing, are not considered pre-fabrication.
- b. *Fabricated Parts* may not be made from raw materials which pose a safety or damage risk to the event, other *Teams*, *Field Elements*, or *Discs*. Examples of prohibited materials include, but are not limited to:
 - i. Any material intended to produce flames or pyrotechnic effects.
 - ii. Any material that is liquid at the time of the *Match* (e.g., hydraulic fluids, oils, liquid mercury, tire sealant, etc.).
 1. Fabrication processes that include the use of liquids, such as milling coolant or resin which has been cast into a solid part, are not considered a *Violation* of this rule.

<VUR5> Any *Fabricated Parts* must be accompanied by documentation that demonstrates the *Team’s* design and construction process for that *Fabricated Part*.

- a. The minimum acceptable form of documentation is an engineering drawing with multiple views for the part in question. These drawings may be included in a *Team’s* Engineering Notebook or in a standalone appendix to the Engineering Notebook.
- b. Any *Fabricated Parts* must have been physically fabricated by *Team* members. For example, parts ordered by the *Team* and 3D printed by a third party would be prohibited.
- c. *Teams* will be required to provide this documentation to inspectors, *Head Referees*, or judges at any time. Failure to provide acceptable documentation will result in the part being deemed illegal for use; therefore, <R3>, <R26>, and / or <G1> will apply.

<VUR6> *Teams* may use commercially-available springs on their *Robots*. For the purposes of this rule, a “spring” is any device used for storing and releasing elastic potential energy. Examples include, but are not limited to:

- a. Compression, tension, torsion, constant force, or conical springs made from spring steel.
- b. Springs made from elastic thread or rubber, such as surgical tubing, bungee cords, or stretchable braided rope.
- c. Closed-loop (pneumatic) gas shocks.

Note: Gas shocks are not considered pneumatic devices in the context of <VUR12>. Gas shocks may not be modified in any way.

<VUR7> *Teams* may use any commercially available fastener on their *Robot*. Examples include (but are not limited to) screws, nuts, washers, rivets, hinges, pins, rod ends, threaded rods, hose clamps, bushings, spacers, or standoffs.

- a. To be considered a legal “fastener” in the context of this rule, the primary function of the part must be to join or fasten together two otherwise legal parts. For example, a pre-fabricated non-VEX wheel (which would be illegal under <VUR5>) would not be considered a “fastener,” even though it may also technically serve the purpose of bridging the connection between tread and a shaft.

<VUR8> Each *Robot* must utilize exactly one (1) V5 Robot Brain microcontroller and exactly one (1) V5 Robot Radio connected to a V5 Controller. No other types of VEX microcontrollers or wireless communication protocols are permitted.

- a. *Teams* must abide by the power rules noted in <R18> and <VUR10c>.

<VUR9> There is no restriction on the number of V5 Smart Motors that *Robots* may use. No other motors, servos, or actuators are permitted, including those sold by VEX (e.g., the 2-Wire 393 Motor).

- a. Part “d” of rule <R20> does not apply. *Teams* may modify or make their own gear cartridges for the V5 Smart Motor, provided that no other rules are violated. No other modifications to V5 Smart Motors are permitted, other than those listed in part “c” of <R20>.

Note 1: Commercially available pneumatic actuators and pneumatic solenoids are permitted within the guidelines of <VUR12>.

Note 2: Legal Additional Electronics may include their own motor, servo, or actuator, per <VUR10>.

<VUR10> There is no restriction on sensors and other *Additional Electronics* that *Robots* may use for sensing and processing, except as follows:

- a. Sensors and electronics **MUST** be connected to the V5 Robot Brain via any of the externally accessible ports (i.e., without any modification to the microcontroller). A sensor may be connected to a processing unit which then connects to the V5 Robot Brain.
- b. Sensors and electronics **CANNOT** directly electrically interface with VEX motors and / or solenoids.
- c. The additional sensors and electronics may only receive power from any of the following:
 - i. Directly from the V5 Robot Brain via any externally accessible port.
 - ii. From an additional lithium ion, lithium iron or nickel metal hydride battery pack (only one (1) additional battery can be used for sensor / processing power). This additional battery pack must operate at a maximum of 12 volts nominal.
- d. Only the V5 Battery can power the V5 Brain.

- e. *Additional Electronics* which include a low-powered motor as an integral part of their primary sensing / processing function, such as an external processor's cooling fan or a spinning sensor, are permissible.
 - i. Standalone motors which serve no additional sensing or processing functionality (e.g., using a commercially-available brushless motor in a drivetrain) are not considered legal *Additional Electronics*, and would be considered a *Violation* of <VUR9>.
- f. Pneumatic solenoids are the only types of solenoids that are permitted as *Additional Electronics*. Solenoids used for any purpose other than opening and closing a pneumatic valve are considered an actuator and therefore prohibited, per <VUR9>.

<VUR11> No radio communication is allowed between *Robots*. However, other non-radio forms of communication are permitted (e.g., IR, ultrasonic, etc.).

<VUR12> *Teams* may utilize an unlimited amount of the following commercially available pneumatic components: cylinders, actuators, valves, gauges, storage tanks, regulators, manifolds, tubing, and solenoids.

- a. Pneumatic devices may only be charged to a maximum of 100 psi.
- b. Compressors or any other forms of "on-Robot" charging are not permitted.
- c. All commercial components must be rated for 100 psi or higher. *Teams* should be prepared to provide documentation that verifies these ratings to inspectors if requested.
- d. Components must not be modified from their original state, other than the following exceptions:
 - i. Cutting pneumatic tubing or wiring to length; assembling components using pre-existing threads, brackets, or fittings; or minor cosmetic labels.
- e. If commercially available 12V solenoids are used, these are considered *Additional Electronics* and must therefore satisfy all conditions listed in <VUR10>. 12V solenoids may be either powered by an additional power source (per <VUR10c>), or by a 5V-12V step-up converter from the V5 Robot Brain. If an external power source (or other *Additional Electronics* device) is used to interface with the solenoid, *Teams* MUST be able to demonstrate that there is no way for the solenoid to receive power while the *Robot* is receiving a Disabled state from the field controller.

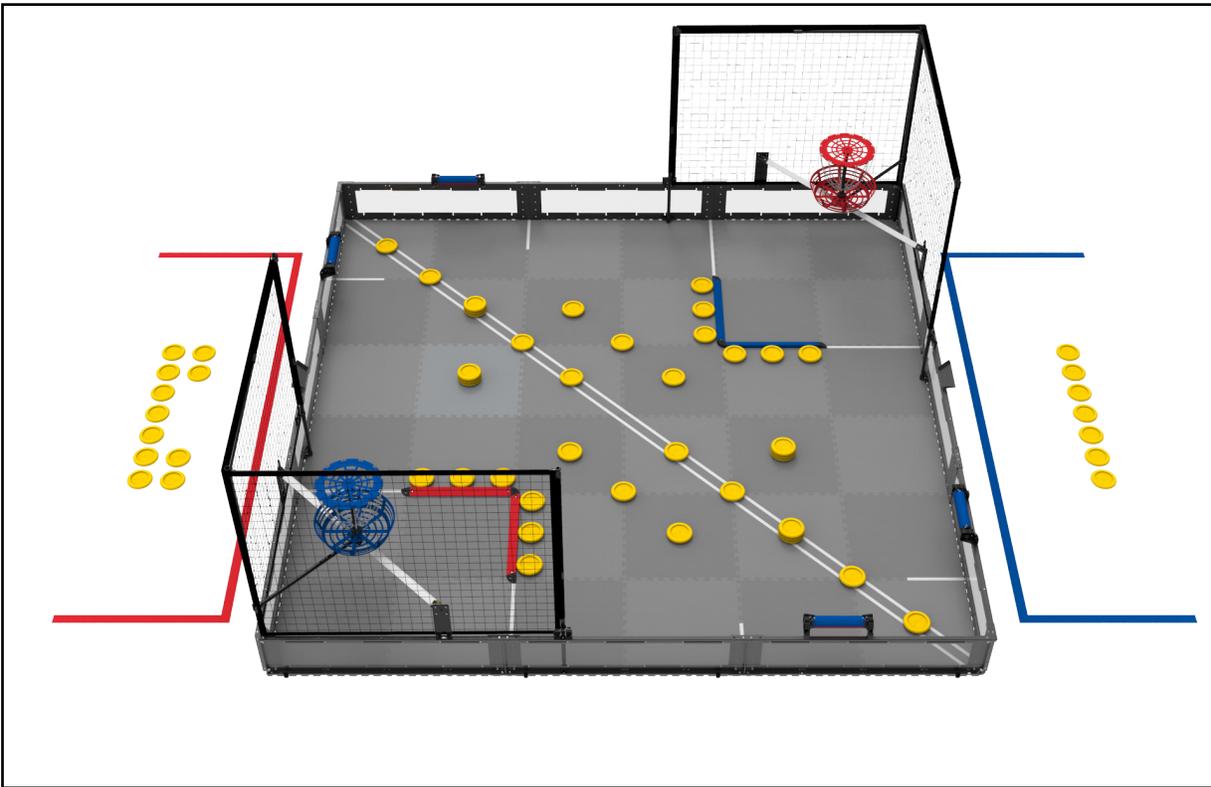
VEX U Robot Skills Challenge

All rules apply from VRC Appendix B – Robot Skills Challenge, with no modifications. VEX U *Teams* are permitted to use both *Robots* in their VEX U Robot Skills Challenge *Matches*, per <VUG1> , <VUG6>, and <VUR1>.

<**VURS1**> Prior to the start of *Robot Skills Matches*, each *Robot* must use its two (2) *Discs* available as *Preloads*, or add them to the *Team's Match Load Discs*, per <SG1>. The other four (4) *Preloads* are not used in a VEX U *Robot Skills Match*.

<**VURS2**> Both *Robots* must start on the same side of the field, and all *Drive Team Members* must stand in the corresponding *Alliance Station*.

- a. <RSC2>, regarding *Match Load Discs*, still applies in the VEX U *Robot Skills Challenge*.



Team Composition

We want to see Universities face off in a global head-to-head competition. Schools are not limited to one *Team*, and a *Team* may consist of multiple colleges, but we hope that each *Team* identifies with and proudly represents one (1) post-secondary institution. (e.g., "Clarkson University" vs. "UC Santa Barbara"). Of course, college-level "club" *Teams* and mixed composition *Teams* are encouraged to join! However, as noted in <VUG7>, *Students* who have not yet graduated secondary school are not eligible to participate in VEX U, even if they are "dual-enrolled" or taking post-secondary courses.