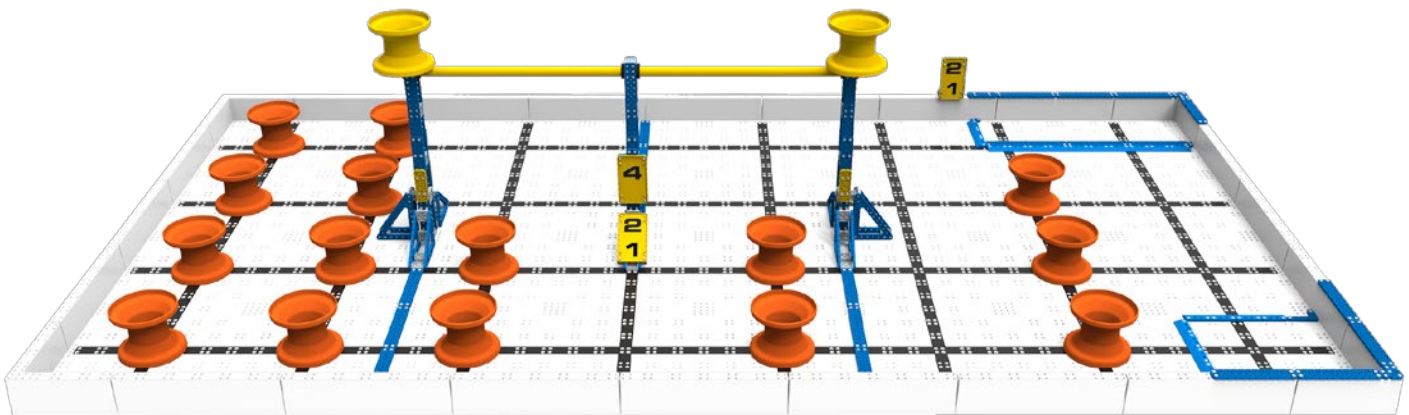
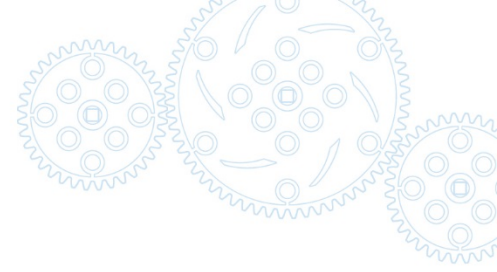


# VEX IQ CHALLENGE NEXT LEVEL

# Game Manual



# VEX IQ Challenge Next Level – Game Manual



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The *VEX IQ Challenge Next Level* Game Manual also includes a series of Appendices. These can be found on [www.vexrobotics.com](http://www.vexrobotics.com) or [www.roboticseducation.org](http://www.roboticseducation.org), or directly by clicking the links below:

FIELD APPENDIX (PDF)	<a href="https://link.vex.com/docs/VIQC-next-level/FieldAppendix">https://link.vex.com/docs/VIQC-next-level/FieldAppendix</a>
FIELD ASSEMBLY INSTRUCTIONS (ZIP)	<a href="https://link.vex.com/docs/VIQC-next-level/BuildInstructions">https://link.vex.com/docs/VIQC-next-level/BuildInstructions</a>
AWARDS APPENDIX (PDF)	<a href="http://link.roboticseducation.org/vexiq_nextlevel_awardsappendix">http://link.roboticseducation.org/vexiq_nextlevel_awardsappendix</a>



## The Game



### Game Description

Matches are played on a field set up as illustrated in the figures throughout. The **Robot Skills Challenge** and the **Teamwork Challenge** use the exact same field and set up.

In the Teamwork Challenge, an *Alliance* of two (2) *Robots*, operating under driver control, work together in each *Match*.

In the Robot Skills Challenge, one (1) *Robot* attempts to score as many points as possible. These matches consist of *Driving Skills Matches*, which will be entirely driver controlled, and *Programming Skills Matches*, which will be autonomous with limited human interaction.

The object of the game is to attain the highest score by *Scoring Hubs* in *Building Zones*, by *Removing Hubs* from the *Hanging Structure*, and by *Hanging Robots* at the end of the *Match*.

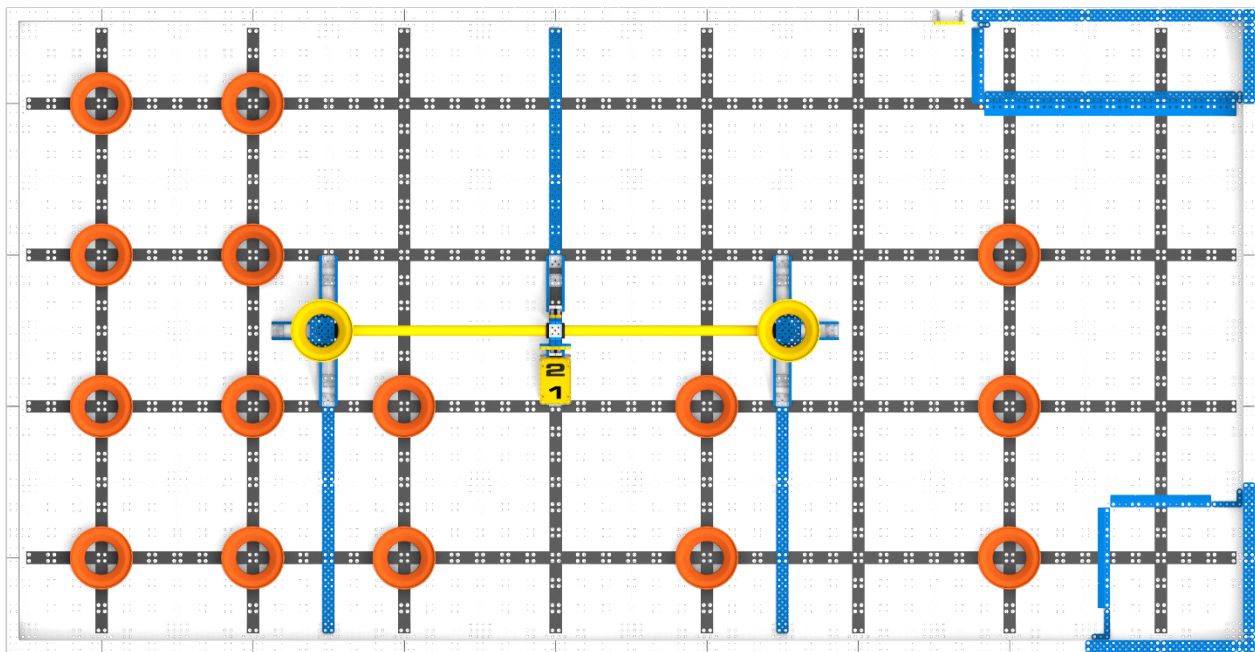


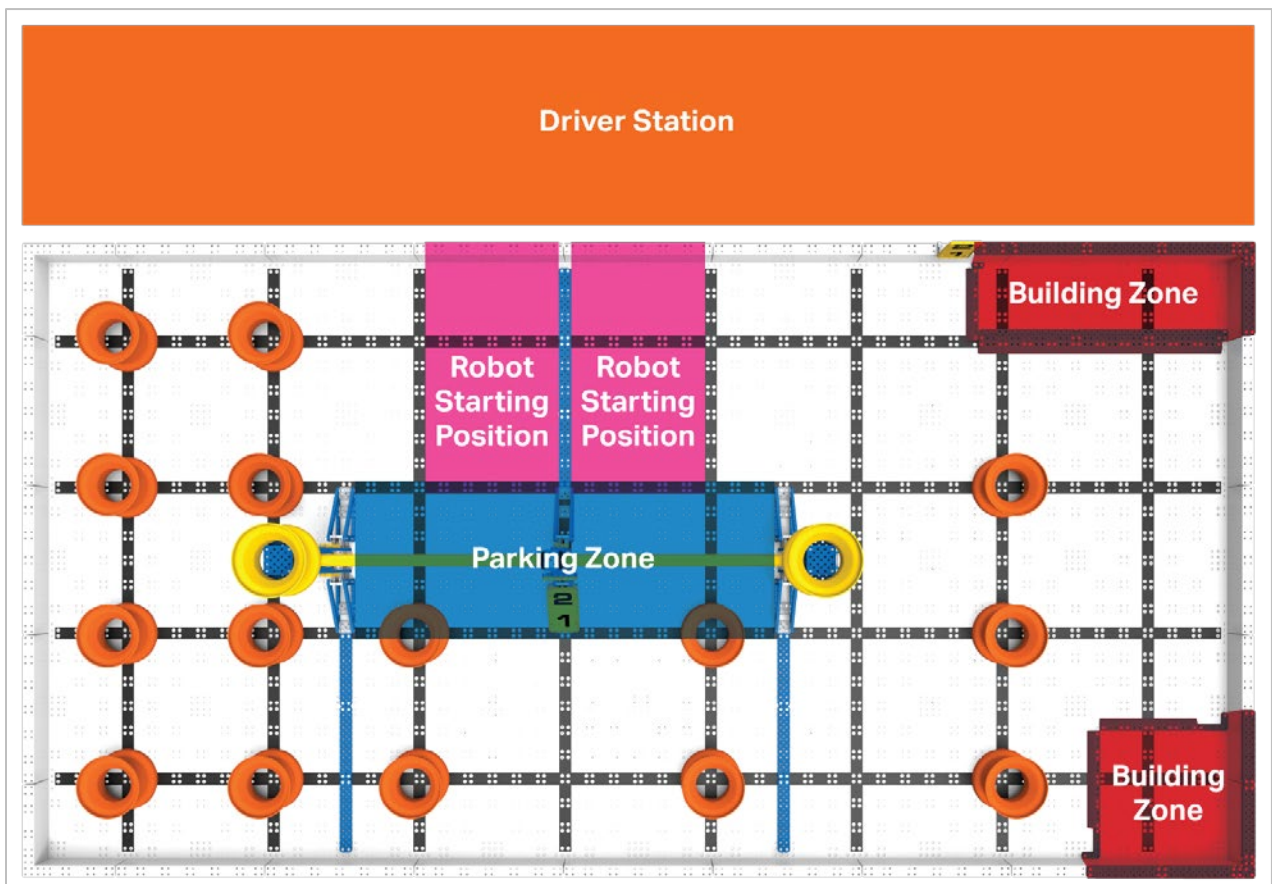
Figure 1 – Starting Configuration of the Field

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Each **VEX IQ Challenge Next Level Match** includes the following:

- Seventeen (17) *Hubs*
  - Fifteen (15) *Standard Hubs* that start on the *Floor*
  - Two (2) *Bonus Hubs* that start atop the *Hanging Structure*
- Two (2) *Building Zones*
- One (1) *Hanging Bar*
- One (1) *Parking Zone*



**Figure 2** – Overhead view of the Field. The Starting Positions, Building Zones, Parking Zone, and



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## Game Definitions

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

**Alliance Score** – Points scored in a *Teamwork Match* awarded to both *Teams*.

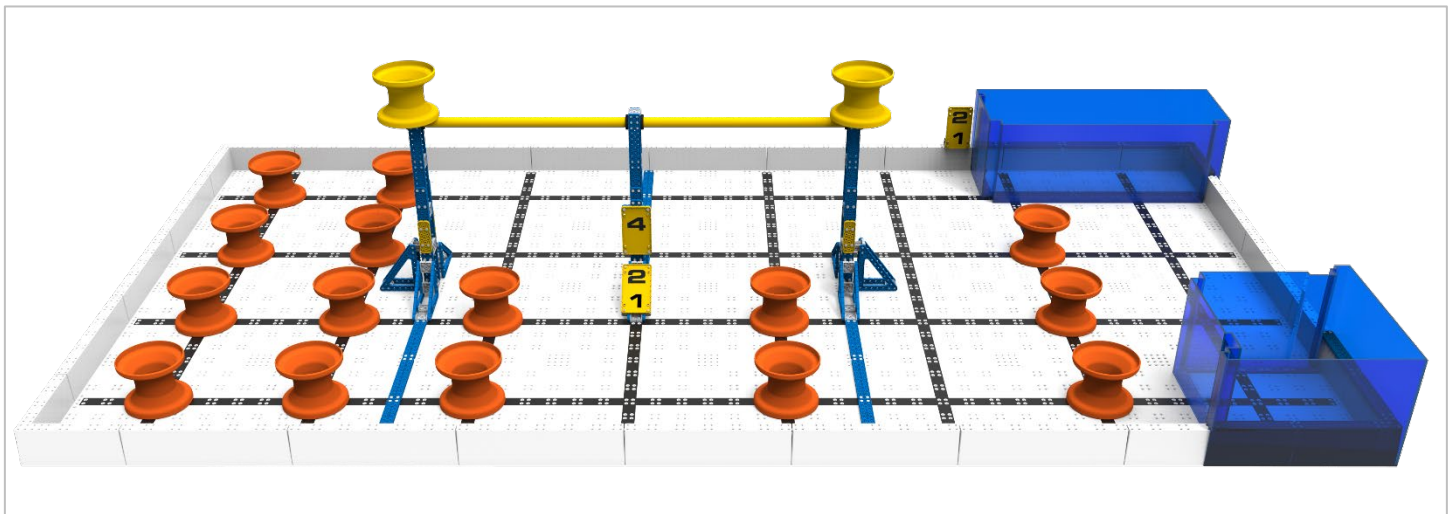
**Autonomous** – A *Robot* that is operating and reacting only to sensor inputs and to commands pre-programmed by the *Students* into the *Robot* control system. The *Robot* is operating without input from a VEX IQ Controller.

**Barrier** – The blue and/or white VEX IQ parts that outline the *Building Zones*. See Figures 2 and 3.

**Bonus Hub** – One of two (2) yellow *Hubs* that begin the *Match* on *Bonus Pegs*.

**Bonus Peg** – One of two (2) pegs built out of VEX IQ pieces on the top of the *Hanging Structure*, where *Bonus Hubs* start the *Match*. *Bonus Hubs* can be *Removed* by *Robots* to earn points.

**Building Zone** – One of the two (2) infinitely tall 3-dimensional volumes on the corners of the *Floor* bordered by the *Floor* and the *Barriers*. The *Barriers* are part of the *Building Zone*. See Figure 3.



**Figure 3** – View of the field depicting the two *Building Zones*. These 3D volumes extend infinitely upwards.

**Disablement** – A penalty applied to a *Team* for a rule violation. During *Disablement*, a *Team* is no longer allowed to operate their *Robot*, and the *Drivers* will be asked to place their Controller on the ground. A *Disablement* is not the same as a *Disqualification*.

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**Disqualification** – A penalty applied to a *Team* for a rule violation. A *Team* that is *Disqualified* in a *Match* receives zero (0) points. If a *Team* is *Disqualified* in a *Match*, the Head Referee will notify the *Team* of their violation at the end of the *Match*. At the Head Referee's discretion, repeated violations and *Disqualifications* for a single *Team* may lead to *Disqualification* for the entire event.

**Driver** – A *Student* team member responsible for operating and controlling the *Robot*.

**Driver Controlled** – A *Robot* operating under the control of a *Driver*.

**Driving Skills Match** – A *Driver Controlled* period that is sixty seconds (1:00) long with only one (1) *Robot* on the *Field*.

**Driver Station** – The region behind the *Field*, where the *Drivers* must remain during their *Match* unless legally interacting with their *Robot*.

**Field** – The entire playing field, including the field perimeter and field tiles.

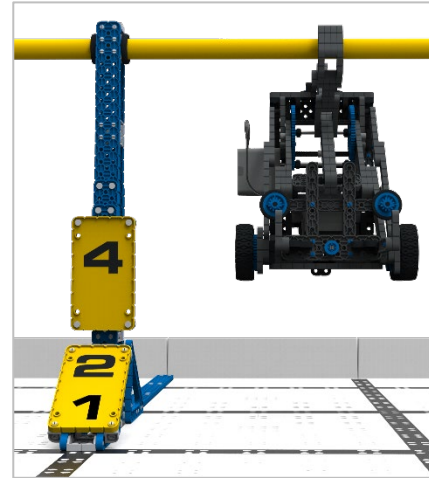
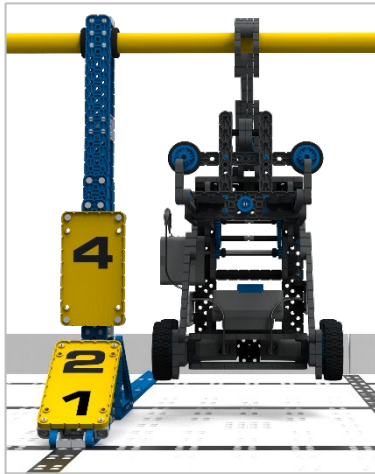
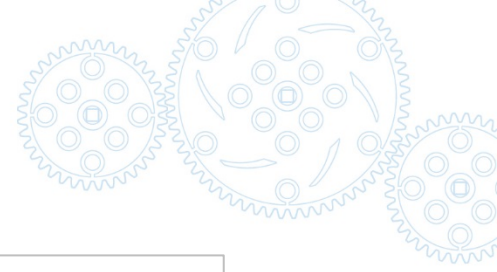
**Field Element** – The field perimeter, *Floor*, *Hanging Bar*, *Hanging Structure*, *Building Zones*, *Barriers*, and any other supporting structures.

**Floor** – The part of the playing field that is within the field perimeter. The white/black field tiles, and the blue VEX IQ parts that are used for terrain or *Barriers*, are considered part of the *Floor*.

**Hanging Bar** – The horizontal yellow PVC pipe in the center of the *Field*. The *Hanging Bar* is 16" (406.4mm) high, 34" (863.6mm) wide, and 0.86" (21.84mm) in diameter.

**Low Hanging** – A *Robot* is *Low Hanging* if it is contacting the *Hanging Bar*, not contacting the *Floor*, and not *Supported* by any *Hubs*. Referees can check to see if a *Robot* is *Low Hanging* by sliding a piece of paper between the *Robot* and the *Floor*, and can check to see if a *Robot* is supported by any *Hubs* by gently removing the *Hub* in question.

**High Hanging** – A *Robot* is *High Hanging* if it is contacting the *Hanging Bar*, is not supported by any *Hubs*, and is completely above a horizontal plane that is the height of an upright *Hub* above the *Floor* (roughly 4.0" or 101.6mm). Referees can check to see if a *Robot* is *High Hanging* by sliding a *Hub* underneath it, or by comparing its height to the bottom of the yellow decorative "4" plate on the *Hanging Structure*. Referees can check to see if a *Robot* is supported by any *Hubs* by gently removing the *Hub* in question. A *High Hanging Robot* does not also count as a *Low Hanging Robot*.



**Figure 4 (left)** – Example of a Low Hanging Robot. Note that the Robot is off of the Floor, but below the bottom edge of the decorative “4” plate.

**Figure 5 (right)** – Example of a High Hanging Robot. Note that the Robot is above the bottom edge of the decorative “4” plate.

**Hanging Structure** – The structure made of VEX IQ parts in the center of the *Field* that supports the *Hanging Bar*. The *Bonus Pegs* and decorative plates used to judge *High* or *Low Hanging Robots* are part of the *Hanging Structure*.

**Hub** – A hollow cylindrical plastic scoring object that can be manipulated by *Robots* and Scored in the *Building Zone*. *Hubs* are roughly 4.0” (101.6mm) tall, with a diameter of 5.0” (127mm) at their widest point, a diameter of 2.84” (72mm) at their narrowest point, and have a mass of roughly 0.187 lb (85 g).

**Match** – A *Driving Skills Match*, *Programming Skills Match*, or *Teamwork Match*.

**Parked** – A *Robot* is considered *Parked* if it is contacting the *Parking Zone*.

**Parking Zone** – The area of the *Floor* underneath the *Hanging Bar* bordered by the *Hanging Structure* and the black lines that run parallel to the *Hanging Bar*. The black lines are part of the *Parking Zone*; the *Hanging Structure* itself is not part of the *Parking Zone*. See Figure 2.

**Programming Skills Match** – An *Autonomous* period that is sixty seconds (1:00) long with only one (1) *Robot* on the *Field*.

**Removed** – A *Bonus Hub* is considered *Removed* from its *Bonus Peg* if the *Bonus Hub* is not contacting the *Bonus Peg* at the end of the *Match*.

**Robot** – Anything that has passed inspection that a *Team* places on the *Field* prior to the start of a *Match*.

# VEX IQ Challenge Next Level – Game Manual



**Scored** – A *Hub* that is *Low Scored* or *High Scored*. See Figures 6-9.

**Low Scored** – A *Hub* is *Low Scored* at the end of a *Match* if it meets the following criteria:

1. The *Hub* is contacting a *Barrier* or the *Floor* inside of a *Building Zone*.
2. The *Hub* is not contacting the *Floor* outside of a *Building Zone*.
3. The *Hub* is not contacting a *Robot*.

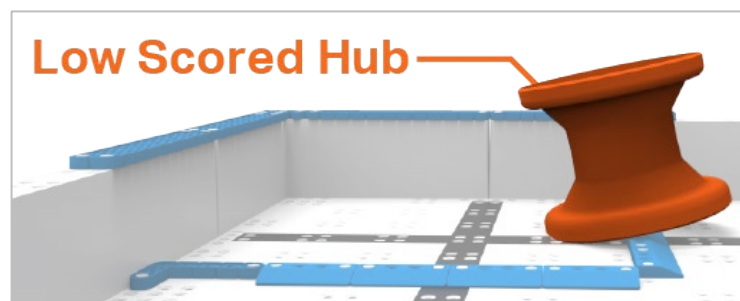
Note: *Teams* can receive points for a maximum of four (4) *Low Scored Hubs* in each *Building Zone*. If there are more than four (4) *Low Scored Hubs* in a *Building Zone*, points are awarded for the four (4) *Low Scored Hubs* that would receive the most points (e.g. any *Bonus Hubs*).

**High Scored** – A *Hub* is *High Scored* at the end of a *Match* if it meets the following criteria:

1. The *Hub* is completely or partially within the 3D volume of a *Building Zone*.
2. The *Hub* is not contacting the *Floor* or a *Barrier*.
3. The *Hub* is not contacting a *Robot*.
4. The *Hub* is contacting at least one *Hub* that would be considered *Scored*.
  - a. Note: *Low Scored Hubs* that do not receive points (due to the Note above) may still be considered *Scored* for the purposes of point 4. Thus, contacting a *Low Scored Hub* that did not receive points still satisfies this requirement.

When trying to determine if a *Hub* is *Scored* or not, you can usually ask these questions:

- Is the *Hub* contacting a *Robot*, or the *Floor* outside of the *Building Zone*? If not, then we need to ask a few more questions to determine if it is *Low Scored* or *High Scored*.
- Is the *Hub* touching a *Barrier* or the *Floor* within the *Building Zone*? If so, then the *Hub* is **Low Scored**.
- If the *Hub* is *not* touching a *Barrier* or the *Floor*, is the *Hub* touching a *Low* or *High Scored Hub*, and within (fully or partially) the 3D volume of a *Building Zone*? If so, then the *Hub* is **High Scored**.



**Figure 6** – Example of a *Low Scored Hub*. The *Hub* is contacting the *Floor* within the *Building Zone* (and a *Barrier*), and is not contacting the *Floor* outside of the *Building Zone*.



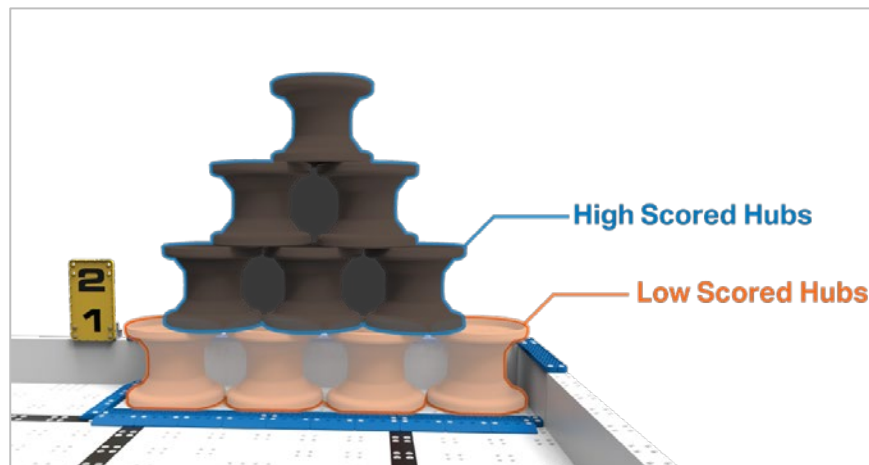


Figure 7 – Examples of Low Scored (light) and High Scored (dark) Hubs.

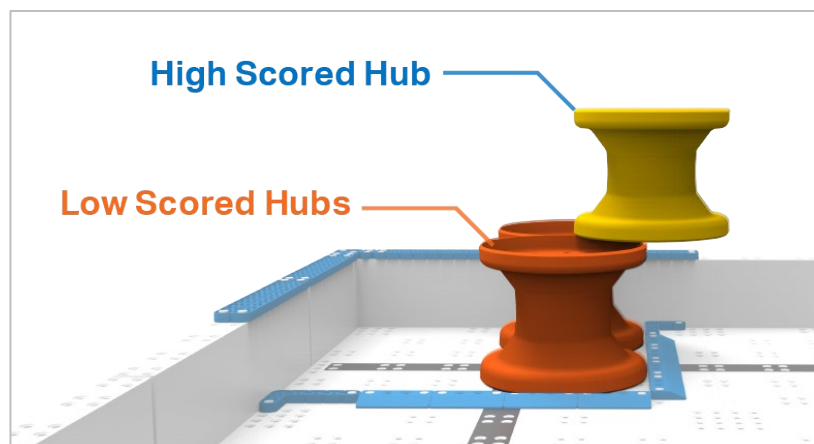


Figure 8 – Examples of Low Scored and High Scored Hubs. The yellow Hub is High Scored because it is partially within the 3D volume of the Building Zone, contacting other Scored Hubs, and not contacting the Floor outside of the Building Zone.

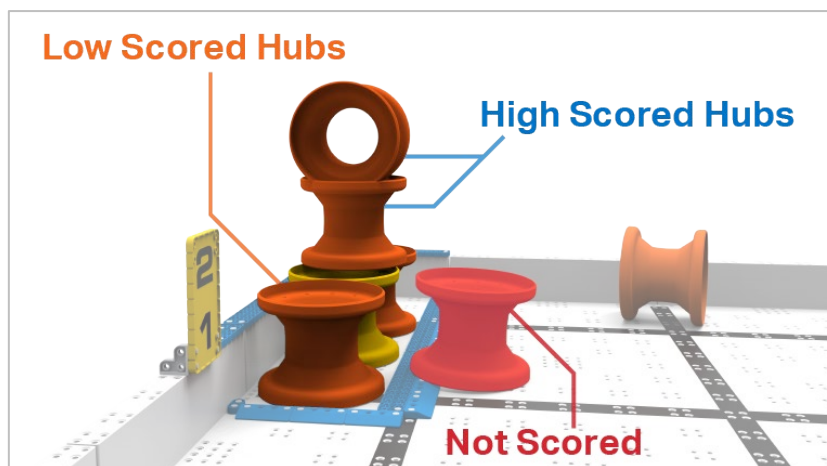
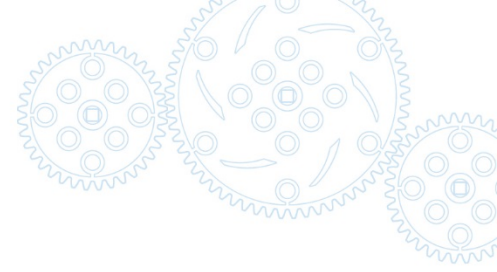


Figure 9 – Examples of Low Scored and High Scored Hubs, as well as a Hub which is not Scored at all. The red Hub is not Scored because it is contacting the Floor outside of a Building Zone.

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**Skills Match** – A *Driving Skills Match* or *Programming Skills Match*.

**Starting Positions** – The two (2) designated 11" x 20" (279mm x 508mm) spots on the field where *Robots* must start the *Match*. *Starting Positions* are bounded by the inner edges of the long black lines, outer edge of the short black line, and the top most outer edge of the field perimeter. See Figures 2 and 11.

**Student** – Anyone born after April 30, 2005 (age 13 or lower) or enrolled in grade 8 or lower on April 30, 2019. Anyone enrolled in grade 9 on April 30, 2019 is only eligible to participate on a VEX IQ Challenge team when enrolled in a middle school or district, which includes grade 8, but not grade 10. **Students are the individuals who design, build, repair, and program the *Robot* with minimal adult assistance.**

- **Elementary School Student** - A Student enrolled in grade 5 or lower, or enrolled in grade 6 in a school which includes grade 5, but not grade 7 (e.g., K-6, 2-6, 3-6, 4-6, 5-6).
- **Middle School Student** – Any eligible *Student* that is not an *Elementary School Student*.

**Team** – Two or more *Students* make up a team. A *Team* is classified as an *Elementary School Team* if **all** members are *Elementary School Students*. A *Team* is classified as *Middle School* if **any** members are *Middle School Students*. *Teams* may be associated with schools, community/youth organizations, or a group of neighborhood *Students*.

**Teamwork Match** – A *Driver Controlled* period that is sixty seconds (1:00) long with one (1) *Alliance* on the *Field*.



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## Safety Rules

**<S1>** If at any time the *Robot* operation or *Team* actions are deemed unsafe or have damaged any *Field Elements* or *Hubs*, the offending team may be *Disabled* and/or *Disqualified* at the referees' discretion. The *Robot* will require re-inspection before it may again take the field.

## General Game Rules

**<G1> Treat everyone with respect.** All *Students* and adults associated with a *Team* are expected to conduct themselves in a respectful and positive manner while participating in the VEX IQ Challenge. If *Team* members are disrespectful or uncivil to staff, volunteers, or fellow teams at an event, the team may be *Disqualified* from their current or upcoming *Match*. Judges may also consider team conduct and ethics when determining awards.

In all aspects of the VEX IQ Challenge program, the *Students* make the decisions and do the work with adult mentorship. The VEX community prides itself on being a positive learning environment where no one is bullied, harassed, or berated. *Teams* avoid placing unnecessary stress upon students and/or event volunteers; instead, challenging situations are viewed as teachable moments to model positive behaviors and good sportsmanship.

This rule exists alongside the REC Foundation Code of Conduct. Violation of the Code of Conduct can be considered a violation of <G1> and can result in *Disqualification* from a current *Match*, an upcoming *Match*, an entire event, or (in extreme cases) an entire competition season. The Code of Conduct can be found at [http://link.roboticseducation.org/recf\\_codeofconduct](http://link.roboticseducation.org/recf_codeofconduct).

**<G2> VEX IQ is a student-centered program.** Adults may assist *Students* in urgent situations, but adults should never work on or program a *Robot* without *Students* on that *Team* being present and actively participating.

Some amount of adult mentorship, teaching, and/or guidance is an expected and encouraged facet of the VEX IQ Challenge. 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 reference.

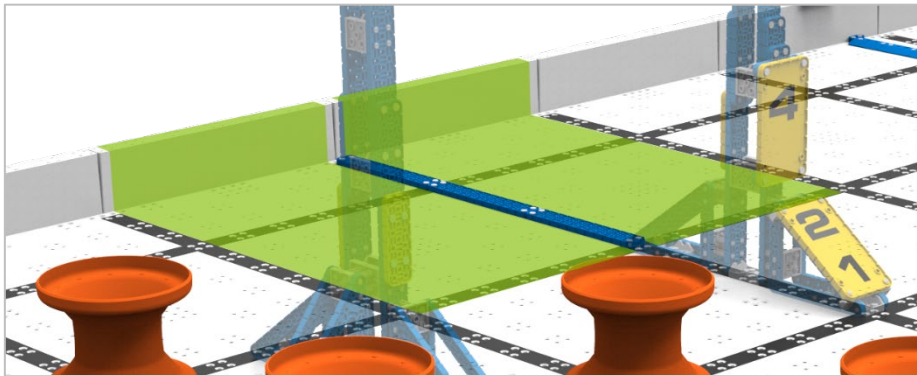
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**<G3> Use common sense.** When reading and applying the various rules in this document, please remember that common sense always applies in the VEX IQ Challenge.

**<G4> Pre-match setup.** At the beginning of a *Match*, each *Robot* must meet the following criteria:

1. Only be contacting the *Floor*.
2. Fit within an 11" x 20" (279mm x 508mm) area, bounded by the *Starting Position* (see Figure 11).
3. Be no taller than 15" (381mm).



**Figure 11** – Close-up of the legal Starting Positions, shaded for clarity.

An offending *Robot* will be removed from the *Match* at the Head Referee's discretion. They will not receive a *Disqualification*, but they will not be permitted to play in the *Match*.

**<G5> Expansion is limited during a Match.** During the *Match*, *Robots* may not expand beyond an 11" x 20" (279mm x 508mm) area. However, *Robots* are permitted to expand beyond the 15" (381mm) high starting requirement.

Violations of this rule will result in a warning for minor offenses that do not affect the *Match*. Major and/or score affecting offenses will result in a *Disqualification*. *Teams* who receive multiple warnings may also receive a *Disqualification* at the Head Referee's discretion.

**<G6> Drivers switch Controllers midway through the Match.** Each team shall include two *Drivers*. *Teams* with only one *Student* in attendance at an event are granted an allowance to use another qualified *Driver* from the event. No *Student* may fulfill the role of *Driver* for more than one *Team* at a given event, or in a given season.

During a *Match*, *Robots* may only be operated by the *Drivers*. No *Driver* shall operate a *Robot* for more than thirty-five seconds (0:35). The two *Drivers* must switch their controller between twenty-five seconds (0:25) and thirty-five seconds (0:35) remaining in the *Match*. The second *Driver* may not touch his/her *Team's* controls until the controller is passed to him/her. Once the controller is passed, the first *Driver* may no longer touch his/her *Team's* controls.



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Violations of this rule will result in a warning for minor offenses that do not affect the *Match*. Score affecting offenses will result in a *Disqualification*. *Teams* who receive multiple warnings may also receive a *Disqualification* at the Head Referee's discretion.

**<G7> Only Drivers, and only in the Driver Station.** During a *Match*, *Drivers* must remain in their *Driver Station*, except when legally interacting with their *Robot* as per <G16>. *Drivers* are not allowed to use any communication devices during their *Match*. Devices with communication features turned off (e.g. a phone in airplane mode) are allowed.

**<G8> Hands out of the Field.** *Drivers* are prohibited from making intentional contact with any *Field Element* or *Robots* during a *Match*, except for the allowances in <G16>. Any intentional contact may result in a *Disqualification*. Accidental contact will not be penalized. However, accidental contact which affects the score of the *Match* may result in a *Disqualification* at the Head Referee's discretion.

**<G9> Keep Hubs in the Field.** *Hubs* that leave the *Field* during a *Match* will not be returned.

**<G10> When it's over, it's over.** Scores will be calculated for all *Matches* immediately after the *Match* is complete and once all *Robots* and *Game Objects* on the *Field* come to rest. Any *Scoring*, *Removing*, *Parking*, or *Hanging* that takes place after the *Match* due to *Robots* continuing to drive will not count.

- Referees or other event staff are not allowed to review videos or pictures from the *Match*.
- If there is a concern regarding the score of a *Match*, only the *Drivers* from that *Match*, not an adult, may share their questions with the referee.
- This rule's intent is for *Driver* inputs and *Robot* motion to cease at the end of the *Match*. A *Robot* that uses a brake mode to hold its position (such as to remain *Hanging*) would be fine.

**<G11> Keep your Robot together.** *Robots* may not intentionally detach parts or leave mechanisms on the *Field* during any *Match*. If an intentionally detached component or mechanism affects game play, the *Team* may be *Disqualified* at the Head Referee's discretion.

**<G12> Don't clamp your Robot to the field.** *Robots* may not grasp, grapple, or attach to any *Field Elements* other than the *Hanging Bar*. Strategies with mechanisms that react against multiple sides of a *Field Element* (other than the *Hanging Bar*) in an effort to latch or clamp onto said *Field Element* are prohibited.

The intent of this rule is to prevent *Robots* from unintentionally damaging the *Field* or from anchoring themselves to the *Field*. Minor violations of this rule that do not affect the *Match* will result in a warning. Score affecting offenses will result in a *Disqualification*. *Teams* that receive multiple warnings may also receive a *Disqualification* at the Head Referee's discretion.

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Note: While the *Hanging Bar* is excluded from this rule, the *Hanging Structure* is not. Incidental contact with the *Hanging Structure* while *Hanging* will not be penalized, but *Teams* are not permitted to grapple, clamp, or attach to the *Hanging Structure*.

The key words in this rule are "clamping" or "anchoring". Bumping into the Hanging Structure while Hanging or using Field Elements for alignment are both fine.

**<G13> Let go of Hubs after the Match is over.** *Robots* must be designed to permit easy removal of *Hubs* from their *Robot* without requiring that the *Robot* have power or remote control after the *Match* is over.

**<G14> Be prepared for minor field variance.** Field tolerances may vary by as much as  $\pm 1$ " unless otherwise specified. *Teams* must design *Robots* accordingly.

**<G15> Replays are allowed, but rare.** *Match* replays are at the discretion of the Event Partner and Head Referee, and will only be issued in the most extreme circumstances.

**<G16> Handling the Robot mid-match is allowed, under certain circumstances.** If a *Robot* goes completely outside the playing field, gets stuck, tips over, or otherwise requires assistance, the *Team's Drivers* may retrieve & reset the *Robot*. To do so, they must:

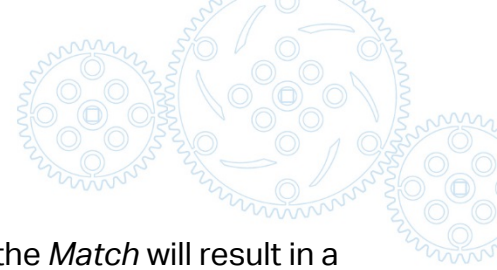
1. Signal the Referee by placing their VEX IQ Controller on the ground.
2. Move the *Robot* to any legal Starting Position.
3. Any *Hubs* in possession of the *Robot* while being handled must be removed from the *Robot* and taken out of play for the remainder of the *Match*.

Note: Any *Hubs* in the *Starting Position* may be moved out of the *Starting Position*, provided that they are not moved into a *Scored* position and are not moved as part of a strategy to gain an advantage.

This rule is intended so *Teams* can fix damaged *Robots* or help get their *Robots* "out of trouble." It is not intended for *Teams* to use as part of a strategy to gain an advantage during a *Match*. If a Head Referee sees *Teams* strategically exploiting this rule, they may be *Disqualified* from said *Match*.

**<G17> Hub control is limited.** *Robots* may not directly or indirectly lift or hold more than one (1) *Hub* off of the *Floor* at a time. Pushing, shoving, pulling, or plowing multiple *Hubs* along the *Floor*, field perimeter, or *Field Elements* (e.g. *Barriers*) is not considered a violation, as long as these *Hubs* remain in contact with the *Floor*. However, if a *Robot* controls multiple *Hubs* that are not in contact with the *Floor* (such as pushing a *Hub* with two *Hubs* stacked on top of it), this would be a violation.

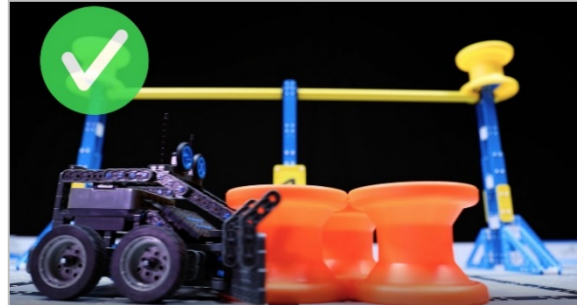
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Minor, momentary, or incidental violations of this rule that do not affect the *Match* will result in a warning. Score affecting offenses will result in a *Disqualification*. *Teams* that receive multiple warnings may also receive a *Disqualification* at the Head Referee's discretion.



**Figure 12 (left)** – Example of a Robot holding more than one Hub off of the Floor at once, in violation of <G17>.



**Figure 13 (right)** – Example of a Robot pushing multiple Hubs that remain in contact with the Floor. This is permitted within <G17>.

This rule primarily refers to Robots which lift Hubs off of the Floor. Any mechanisms which are designed to lift Hubs can only do so one Hub at a time. If you design your Robot to only lift one Hub at a time, you will probably not violate this rule.

The key part of this rule is "off of the Floor". Robots may manipulate multiple Hubs, so long as it is clear to the referee that they have remained in contact with the Floor.

**<G18> This manual will have three scheduled updates.** All rules in this manual are subject to changes, and not considered official until August 17th, 2018. There will also be scheduled manual updates on June 15th, 2018 and April 5th, 2019. While we do not expect there to be major changes outside of these scheduled updates, *Teams* are strongly encouraged to review the VEX IQ Forum and/or the Q&A system (see <G19>) for rule updates and clarifications: [www.vexiqforum.com](http://www.vexiqforum.com)

- a. The Game Design Committee reserves the right to make changes to this manual in the April 5th, 2019 release specifically for the VEX Robotics World Championship. The specific item that will be considered for changes is the number of *Hubs* on the *Field*.

**<G19> The Q&A system is an extension of this Game Manual.** All *Teams* must adhere to all VEX IQ Challenge Rules as written and must abide by the stated intent of the rules. Every *Team* has the opportunity to ask for official rules interpretations in the VEX IQ Challenge Question & Answer System. All responses in this Q&A system should be treated as official rulings from the VEX IQ Challenge Game Design Committee, and they represent the correct and official interpretation of the VEX IQ Challenge Rules. The Q&A system is the only source for official rulings and clarifications.

The Q&A system can be found at <https://www.robotevents.com/VIQC/2018-2019/QA>



## Robot Inspection



### Description

Every *Robot* will be required to pass a full inspection before being cleared to participate in the Challenge. This inspection will ensure that all *Robot* rules and regulations are met. Initial inspections will typically take place during team registration/practice time. Every *Team* should use the rules below as a guide to pre-inspect their *Robot* and ensure that it meets all requirements.

### Definitions

*Robot* – An operator-controlled vehicle designed and built by a VEX IQ Challenge team to perform specific tasks on the *Field*. The *Robot* may be constructed using only the VEX IQ platform parts and mechanical/structural components from the VEX Robotics by HEXBUG product line. No other parts will be allowed on the *Robot*. Prior to participating in matches, each *Robot* will be required to pass an inspection. Additional inspections may be required at the discretion of event personnel.

### Inspection Rules

**<R1>** The *Team's Robot* must pass inspection before being allowed to participate in any *Matches*. Noncompliance with any *Robot* design or construction rule may result in *Disqualification* of the *Robot* at an event.

- a. If significant changes are made to a *Robot*, it must be re-inspected before it will be allowed to participate in a *Match*.
- b. If a robot has multiple functional configurations, all possible configurations must be inspected before being used in competition.
- c. *Teams* may be requested to submit to random inspections by event personnel during the event. Refusal to submit will result in *Disqualification*.
- d. Referees or inspectors may decide that a *Robot* is in violation of the rules. In this case, the *Team* in violation will be *Disqualified* and the *Robot* will be barred from the *Field* until it passes re-inspection.

**<R2>** Only one (1) *Robot* will be allowed to participate per *Team* in the VEX IQ Challenge. Though it is expected that *Teams* will make changes to their *Robot* at the event, a *Team* is limited to only one (1) *Robot*, and a given *Robot* may only be used by (1) *Team*. The VEX IQ system is intended to be a mobile robotics design platform. As such, a VEX IQ Challenge *Robot*, for the purposes of the VEX IQ Challenge, has the following subsystems:



# VEX IQ Challenge Next Level – Game Manual



**Subsystem 1:** Mobile robotic base including wheels, tracks, 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 VEX IQ legal battery, a VEX IQ control system, and associated Smart Motors for the mobile robotic base.

**Subsystem 3:** Additional mechanisms (and associated Smart Motors) that allow manipulation of *Hubs* or navigation of *Field* obstacles.

Given the above definitions, a minimum *Robot* for use in any VEX IQ Challenge event (including Skills Challenges) must consist of subsystem 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 are no longer legal.

- a. *Teams* may not participate with one *Robot* while a second is being modified or assembled.
- b. *Teams* may not switch between multiple *Robots*. This includes using different robots for *Skills Challenge* and *Qualification / Elimination Matches*.
- c. Multiple *Teams* may not use the same *Robot* during a competition or season. 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 <R2a>, <R2b>, and <R2c> are 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 <R2>. Above that, use common sense as referenced in <G2>. If you can place two robots on a table next to each other, and they look like two separate (legal/complete) robots, then they are two separate robots. Trying to decide if changing a pin, a wheel, or a motor constitutes a separate robot is missing the intent and spirit of this rule.



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**<R3>** To participate in an official VEX IQ Challenge Event, a *Team* must first register on [robotevents.com](http://robotevents.com). Upon registering they will receive their VEX IQ Challenge Team Number and two (2) VEX IQ Challenge License Plates. Every *Robot* should have their VEX IQ Challenge License Plates displayed on two opposing sides with their VEX IQ Challenge Team Number clearly written or printed upon it.

- a. The VEX IQ Challenge License Plates are considered a non-functional decoration, and cannot be used as a functional part of the *Robot*.
- b. These number plates must fulfill all *Robot* rules.
- c. License Plates must be clearly visible at all times. For example, License Plates must not be in a position that would be easily obstructed by a *Robot* mechanism during standard *Match* play.

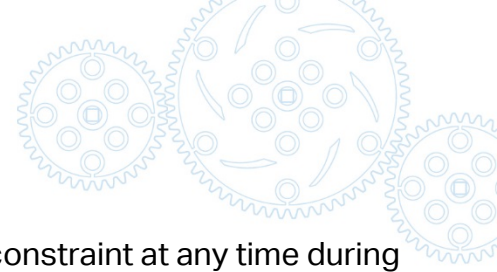


**Figure 14** – A VEX IQ Challenge License Plate with a VEX IQ Challenge Team Number written upon it.

**<R4>** At the start of each *Match*, the *Robot* must satisfy the following constraints:

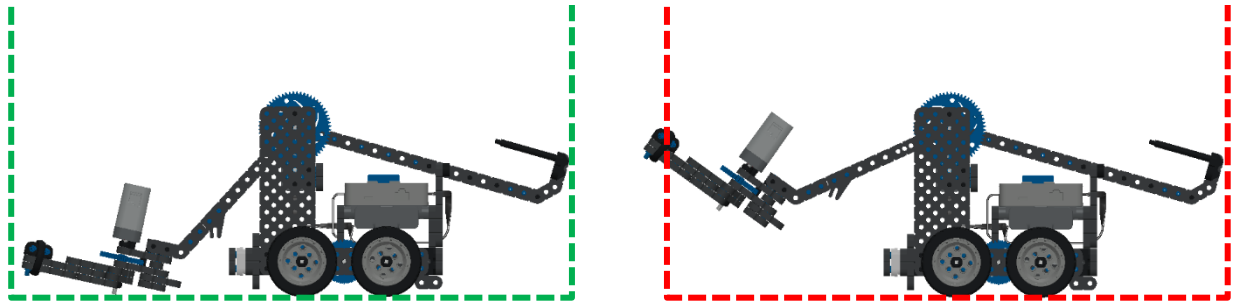
- a. Only contact the *Floor*.
- b. Fit within an 11" x 20" (279mm x 508mm) area, bounded by the *Starting Position* (see Figures 2 and 11).
- c. Be no taller than 15" (381mm).

# VEX IQ Challenge Next Level – Game Manual



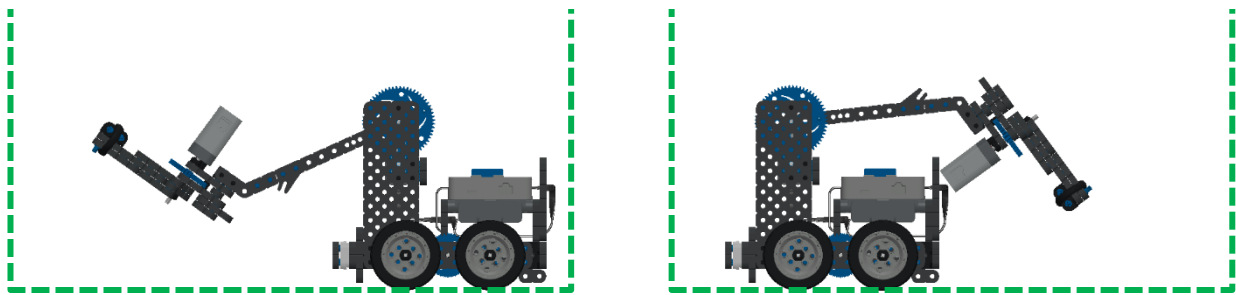
**<R5>** A Robot may not expand beyond its 11" x 20" (279mm x 508mm) constraint at any time during the Match. However, Robots are permitted to expand beyond their 15" (381mm) starting height constraint at any time during the Match.

Note: **The 11" x 20" (279mm x 508mm) limit includes the full range of motion by any appendages.** For example, an arm that extends out of these constraints while operating during the Match would make the Robot illegal.



**Figures 15 & 16** – A Robot which starts the match with the legal size constraints (left), but becomes too large as the arm rotates (right).

Note 2: The 11" x 20" (279mm x 508mm) limit is not restricted to the same orientation or relative position to the Robot as the 11" x 20" (279mm x 508mm) Starting Position. For example, a Robot with a mechanism that can extend out of two sides of the Robot is legal, so long as the Robot never exceeds 11" x 20" (279mm x 508mm) at any point during the Match.



**Figures 17 & 18** – A Robot with a mechanism that can extend in multiple directions, but never exceeds the maximum size constraint.

**<R6>** The starting configuration of the Robot at the beginning of a Match must be the same as a Robot configuration inspected for compliance, and within the maximum allowed size.

- a. Teams using more than one Robot configuration at the beginning of Matches must tell the Inspector(s) and have the Robot inspected in its largest configuration(s).
- b. A Team may NOT have its Robot inspected in one configuration and then place it in an uninspected configuration at the start of a Match.

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**<R7>** Robots may be built ONLY from Official Robot Components from the VEX IQ product line, unless otherwise specifically noted within these rules.

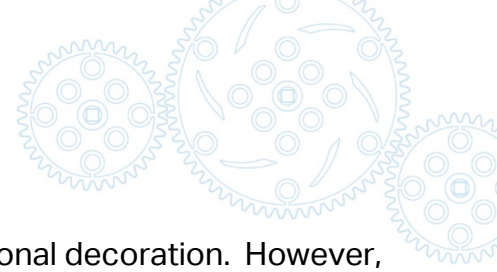
- a. Official VEX IQ products are ONLY available from VEX Robotics & official VEX Resellers. To determine whether a product is “official” or not, consult [www.vexiq.com](http://www.vexiq.com).
- b. If an Inspector or event official questions whether something is an official VEX IQ component, the *Team* will be required to provide documentation to an Inspector that proves the component’s source. Such types of documentation include receipts, part numbers, or other printed documentation.
- c. Only the VEX IQ components specifically designed for use in *Robot* construction are allowed. Using additional components outside their typical purpose is against the intent of the rule (i.e. please don’t try using VEX IQ apparel, team or event support materials, packaging, *Field Elements*, or other non-robot products on a VEX IQ Challenge *Robot*).
- d. Products from the VEX EDR or VEXpro product line cannot be used for *Robot* construction. Products from the VEX EDR product line that are also cross-listed as part of the VEX IQ product line are legal. A “cross-listed” product is one which can be found in both the VEX IQ and VEX EDR sections of the VEX Robotics website.
- e. Mechanical/structural components from the VEX Robotics by HEXBUG product line are legal for *Robot* construction. However, electrical components from the VEX Robotics by HEXBUG product line are illegal for *Robot* construction.
- f. Official Robotics Components from the VEX IQ product line that have been discontinued are still legal for *Robot* use. However, *Teams* must be aware of <R7a>.
- g. 3D printed components, such as replicas of legal VEX IQ parts or custom designs, are not legal for *Robot* use.

Note: A comprehensive list of legal parts can be found in the VEX IQ Challenge Legal Parts Appendix, at <https://www.vexrobotics.com/vexiq/competition/viqc-current-game>.

**<R8>** Robots are allowed to use the following additional “non-VEX IQ” components:

- a. Appropriate non-functional decorations, provided that these do not affect the *Robot* performance in any significant way or affect the outcome of the *Match*. These decorations must be in the spirit of the event. Inspectors will have the final say in what is considered “non-functional”.
  - i. Any decorations must be backed by legal materials that provide the same functionality, (i.e. if your *Robot* has a giant decal that prevents *Hubs* from falling out of the *Robot*, the decal must be backed by VEX IQ material that also prevents the *Hubs* from falling out).

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- ii. The use of non-toxic paint is considered a legal non-functional decoration. However, any paint being used as an adhesive or to impact how tightly parts fit together would be classified as functional.
- b. Rubber bands that are identical in length and thickness to those included in the VEX IQ product line (#32 & #64).

**<R9>** Additional VEX IQ products that are released during the season are legal for use.

- a. Some “new” components may have certain restrictions placed on them upon their release. These restrictions will be documented on their VEX IQ product webpage, or in the VEX IQ Legal Parts appendices.

**<R10>** Robots are limited to one (1) VEX IQ Robot Brain.

- a. Robot Brains, microcontrollers, or other electronic components that are part of the VEX Robotics by HEXBUG, VEX EDR, or VEXpro product lines are not allowed.
  - i. The Robot AA Battery Holder (228-3493) is the only exception to this rule, per <R12>.
- b. Robots must use one (1) VEX IQ 900 MHz radio, VEX IQ 2.4 GHz radio, or VEX IQ Smart Radio in conjunction with their VEX IQ Robot Brain.
- c. The only legal method of driving the Robot during *Teamwork* and *Driving Skills Matches* is the VEX IQ Controller.

**<R11>** Robots may use up to six (6) VEX IQ Smart Motors.

- a. Additional motors cannot be used on the Robot (even ones that aren’t connected).

**<R12>** The only allowable sources of electrical power for a VEX IQ Challenge Robot is one (1) VEX IQ Robot Battery or six (6) AA batteries via the Robot AA Battery Holder (228-3493).

- a. Additional batteries cannot be used on the Robot (even ones that aren’t connected).

**<R13>** Parts may NOT be modified.

- a. Examples of modifications include, but are not limited to, bending, cutting, sanding, or melting.

**<R14>** The following types of mechanisms and components are NOT allowed:

- a. Those that could potentially damage *Field Elements* or *Hubs*.
- b. Those that could potentially damage other Robots.
- c. Those that pose an unnecessary risk of entanglement.

# VEX IQ Challenge Next Level – Game Manual

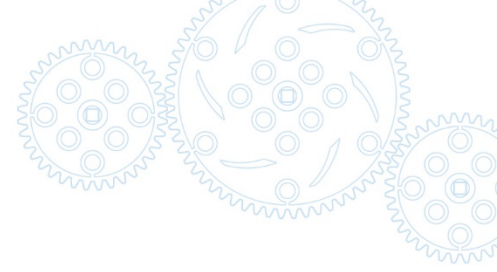


**<R15>** A *Robot* is deemed successfully inspected when it has been recorded as “passed” by an Inspector and the inspection form has been signed by both the Inspector and a *Student Team* member.

**<R16>** *Teams* must be prepared to play when they bring their *Robots* to the *Field*. For example, *Teams* should ensure that their batteries are charged and their VEX IQ Controller is paired with their *Robot* before placing the *Robot* on the *Field*.

**<R17>** *Teams* should make sure that their VEX IQ firmware (VEXos) is up to date. *Teams* can download the latest version of VEXos at [www.vexiq.com/vexos](http://www.vexiq.com/vexos) .





## The Event

### Description

The VEX IQ Challenge will consist of:

- Teamwork Challenge
  - Each Teamwork Challenge *Match* consists of two *Teams*, operating as an *Alliance*, to score points. The Teamwork Challenge may include *Practice*, *Qualifying*, and *Finals Matches*. After the *Qualifying Matches*, *Teams* will be ranked based on performance.
  - Typically, the top *Teams* will then participate in *Finals Matches* to determine the Teamwork Challenge champions. The number of *Teams* participating in the *Finals Matches* is determined by the Event Partner.
- Robot Skills Challenge
  - In this challenge, *Teams* will compete in sixty second (1:00) long *Matches* in an effort to score as many points as possible. These *Matches* consist of *Driving Skills Matches*, which will be entirely *Driver* controlled, and *Programming Skills Matches*, which will be autonomous (no VEX IQ Controller) with limited human interaction.
  - Each *Match* will consist of only one *Robot*.

Awards may be given to top *Teams* in each format, as applicable. Awards may also be given for overall performance in the judged criteria. Please review the Awards Appendix for more details, available in the VEX IQ Challenge Next Level section of [www.vexrobotics.com](http://www.vexrobotics.com) or [www.roboticseducation.org](http://www.roboticseducation.org).

### Definitions

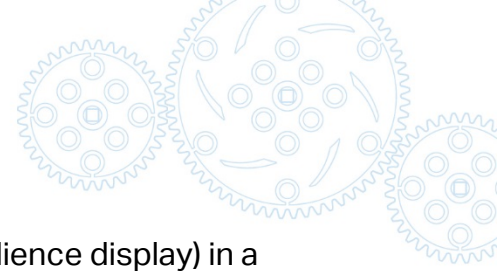
*Disqualification* – A penalty applied to a *Team* for a rule violation. A *Team* that is *Disqualified* in a *Match* receives zero (0) points. If a *Team* is *Disqualified* in a *Match*, the Head Referee should notify the *Team* of their violation at the end of the *Match* and record it on their score sheet. At the Head Referee's discretion, repeated violations and *Disqualifications* for a single *Team* may lead to its *Disqualification* for the entire event.

*Finals Match* – A *Teamwork Match* used to determine the Teamwork Challenge champions.

*Practice Match* – An un-scored *Match* used to provide time for teams to get acquainted with the official playing field.

*Qualifying Match* – A *Teamwork Match* used to determine the event rankings.

# VEX IQ Challenge Next Level – Game Manual



*Match Stop Time* – The time remaining (i.e. displayed on the timer or audience display) in a tiebreaker *Finals Match* when an *Alliance* ends the *Match* early by placing their controllers on the ground. The *Match Stop Time* is rounded down to the nearest even number. For example, if controllers are set down when the displayed time is 13 seconds, the *Match Stop Time* is recorded as 12 seconds. If an *Alliance* does not finish the *Match* early, they receive a default *Match Stop Time* of 0 seconds.

## Teamwork Challenge

### Practice Matches

At the event, *Practice Matches* may be played from registration time until the *Team* meeting begins. Every effort will be made to equalize practice time for all *Teams*, but these *Matches* may be held on a first-come, first-served basis. These *Matches* are not scored, and will not affect *Team* ranking.

### Qualifying Match Schedule

- The *Qualifying Match* schedule will be available prior to opening ceremonies on the day of the event. This schedule will indicate *Alliance* partners and *Match* pairings. For events with multiple *Fields*, the schedule will also indicate on which *Field* the *Match* will take place.
- The *Qualifying Matches* will start immediately after opening ceremonies in accordance with the *Qualifying Match* schedule.
- *Teams* will be randomly assigned an *Alliance* partner to collaborate in each *Qualifying Match*.
- All *Teams* will be scored on the same number of *Qualifying Matches*.
  - In some cases, a *Team* will be asked to play in an additional *Qualifying Match*, but this extra *Match* will not count towards their overall ranking.

### Teamwork Challenge Rankings

- At the conclusion of each *Match*, the *Alliance Score* will be determined.
  - Each *Team* will receive the points scored for the *Alliance Score*.
- If no member of a *Team* is present in the *Driver Station* at the start of a *Qualifying Match*, that *Team* is considered a “no show” and will receive zero (0) points.
  - The *Alliance* partner that does play will still receive all points scored in this *Match*.
- Points earned in each *Qualifying Match* are added to get the *Team's* total qualifying points.
- A certain amount of a *Team's* lowest scores will not count towards their rankings.
  - If an event has between four (4) and seven (7) *Qualifying Matches* per *Team* (i.e. “rounds”), then each *Team's* lowest score will not be counted towards their rankings.
  - If an event has between eight (8) and eleven (11) rounds, then each *Team's* two (2) lowest scores will not be counted.
  - If an event has twelve (12) or more rounds, then each *Team's* three (3) lowest scores will not be counted.

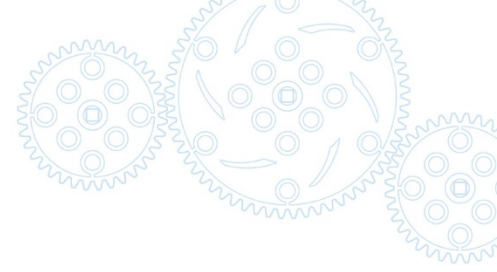
# VEX IQ Challenge Next Level – Game Manual



- *Teams* are ranked by their average *Match* points. This average is calculated using the total qualifying points, excluding the lowest-scoring *Matches*, as explained above.
- Ties in ranking are broken by:
  - Removing each *Team*'s lowest score and comparing the new average score.
  - If still tied, the next lowest score will be removed (on through all scores).
  - If still tied, teams will be sorted by a random electronic draw.

## Teamwork Challenge Finals Matches

- At the conclusion of *Qualification Matches*, the top *Teams* will advance to *Finals Matches*.
- The number of *Finals Matches* will be determined by the event organizers.
- The first and second ranked *Teams* form an *Alliance*, third and fourth ranked *Teams* form another *Alliance* (and so on) for the *Finals Matches*.
- Starting with the lowest ranked *Alliance*, each *Alliance* participates in one (1) *Finals Match*. After all *Finals Matches* are played, the *Alliance* with the highest score of those *Matches* is the Teamwork Champion. The *Alliance* with the second highest score finishes in second place, and so on.
- If there is a tie for first place, the tied *Alliances* will each play one tiebreaker *Match*. The lower seeded *Alliance* will play their *Match* first, followed by the higher seeded *Alliance*. The *Alliance* with the highest score in their tiebreaker *Match* will be declared the winner.
  - If there is a tie in the tiebreaker *Matches*, the *Alliance* with the higher *Match Stop Time* will be declared the winner.
  - If there is a tie and both *Alliances* have the same *Match Stop Time*, a second set of tiebreaker *Matches* (one (1) per *Alliance*) will take place. This *Match* will follow the same logic as the first tiebreaker *Match* (i.e. the highest score, or the highest *Match Stop Time* in the event of a tie, will be declared the winner).
  - If they still remain tied after the second set of *Matches*, then the higher seeded *Alliance* will be declared the winner. (Thus, the lower seeded *Alliance* must exceed the higher seeded *Alliance* in order to be declared the winner.)
- If there is a tie other than first place, the higher seeded *Alliance* will receive the higher rank. For example, if the #4 and #6 *Alliances* both post a score that ties them for 3<sup>rd</sup> place, the #4 *Alliance* will be considered the 3<sup>rd</sup> place *Alliance*, and the #6 *Alliance* would be considered the 4<sup>th</sup> place *Alliance*.



## Teamwork Challenge Rules

<T1> Referees have ultimate authority during the event, including all three types of *Matches*. **The Referees' rulings are final.**

- a. Referees and event staff are not allowed to review any photo or video *Match* recordings to settle disputes.
- b. Referees will review the *Field* at the end of each *Match* and accurately record the game score. If there is a disagreement with the scoring, only the *Drivers*, not an adult, may share their questions or concerns with the referee. **Once the *Field* is cleared for the next *Match*, *Drivers* can no longer dispute the *Match* score.**

<T2> The only people from a *Team* permitted to be by the playing *Field* are the two *Drivers*, who are identified by their drive team badges. These badges are interchangeable, but not during a *Match*.

<T3> During *Matches*, two (2) *Teams* form an *Alliance* that will play on the *Field*.

<T4> There are no time outs in *Qualifying Matches* or *Finals Matches*.

<T5> If an *Alliance* wants to end a *Qualifying Match* or a *Finals Match* early, both *Teams* should signal the referee by placing their controllers on the ground. The referee will then signal to the *Teams* that the *Match* is over and will begin to tally the score.

- a. If the *Match* is a tiebreaker *Finals Match*, then the *Match Stop Time* will also be recorded.

<T6> At many events, the playing *Field* will be placed on the ground. Some events may choose to elevate their *Fields*. At the 2019 VEX Robotics World Championship, the *Fields* will be 18" high.

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## Robot Skills Challenge

### Robot Skills Challenge Rules

Please note that all rules from “The Game” section of the manual apply to Robot Skills, unless otherwise specified.

At the beginning of each *Skills Match*, the *Robot* may be placed in either of the two (2) *Starting Positions* on the *Field*.

### Robot Skills Challenge Scoring

**All scoring is the same as outlined in “The Game” section of this manual.**

- A *Hub* that is *Low Scored* in a *Building Zone* is worth one (1) point.
- A *Hub* that is *High Scored* in a *Building Zone* is worth two (2) points.
- A *Bonus Hub* that is *Removed* from its *Bonus Peg* is worth one (1) point.
- A *Bonus Hub* that is *Low Scored* in a *Building Zone* is worth two (2) points.
- A *Bonus Hub* that is *High Scored* in a *Building Zone* is worth four (4) points.
- A *Parked Robot* is worth one (1) point.
- A *Low Hanging Robot* is worth two (2) points.
- A *High Hanging Robot* is worth four (4) points.

### Robot Skills Challenge Format

- The Robot Skills Challenge *Field* is set up as described in “The Game” section of this manual.
- *Teams* will play *Skills Matches* on a “first come, first served” basis.
- The Event Partner will determine how many *Skills Matches* a given *Team* is allowed to play.
- There will be two (2) *Drivers* for a *Driving Skills Match*. *Drivers* must switch their controller with between thirty-five (0:35) and twenty-five seconds (0:25) remaining in the *Driving Skills Match*. If a *Team* only has one (1) *Driver*, that *Student* may only operate the *Robot* for a maximum of thirty-five seconds (0:35).

### Programming Skills Match Specific Rules

**<PSC1>** A *Team* may handle their *Robot* as many times as desired during a *Programming Skills Match*.

- a. Upon handling the *Robot*, it must be immediately brought back to any legal *Starting Position*.
  - i. *Drivers* may reset or adjust the *Robot* as desired from this position, including pressing buttons on the *Robot Brain* or activating sensors.



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- b. If the *Robot* is possessing any *Hubs* when the *Robot* is being handled, these *Hubs* will be removed from the *Field* and can no longer be used.
- c. If there are any *Hubs* in the *Starting Position* where the *Robot* is being placed, these may be moved out of the *Starting Position*, provided that they are not moved into a *Scored* position and are not moved as part of a strategy to gain an advantage.

**<PSC2>** *Teams* must bring their VEX IQ Controller to the field with them. Although *Drivers* will start the *Robot* by pressing a button on the Robot Brain or manually activating a sensor, they may not otherwise engage the *Robot* with the VEX IQ Controller during the *Programming Skills Match*. The VEX IQ Controller must be turned OFF during the *Programming Skills Match*.

- a. Because there is no VEX IQ Controller handoff, only one (1) *Driver* is required for *Programming Skills Matches* (though *Teams* may still have two (2) if desired). <G7> still applies to any *Drivers* participating in the *Match*.

## Robot Skills Challenge Rankings

- For each *Skills Match*, teams are awarded a score based on the above scoring rules.
- *Teams* will be ranked based on the sum of their highest *Programming Skills Match* score and *Driving Skills Match* score, with the team with the highest sum being declared the *Robot Skills Challenge Winner*.
- In the case where two teams are tied for the highest score, the tie will be broken by looking at both teams' next highest *Programming Skills Match* score. If the teams remain tied, the tie will be broken by looking at both teams' next highest *Driver Skills Match* score. This process will repeat until the tie is broken.
- If the tie cannot be broken (i.e. both teams have the exact same scores for each *Programming Skills Match* and *Driver Skills Match*), then the following ordered criteria will be used to determine which team had the "best" *Programming Skills Match*:
  - Number of points for *High Scored Hubs* and *Bonus Hubs*
  - Number of points for *Low Scored Hubs* and *Bonus Hubs*
  - Number of points for *High Hanging*
  - Number of points for *Low Hanging*
  - Number of points for *Parking*
- If the tie still cannot be broken, the same process in the step above will be applied to the teams' highest *Driver Skills Match*.
- If the tie still isn't broken, events may choose to allow *Teams* to have one more deciding match or both *Teams* will be declared the winner.