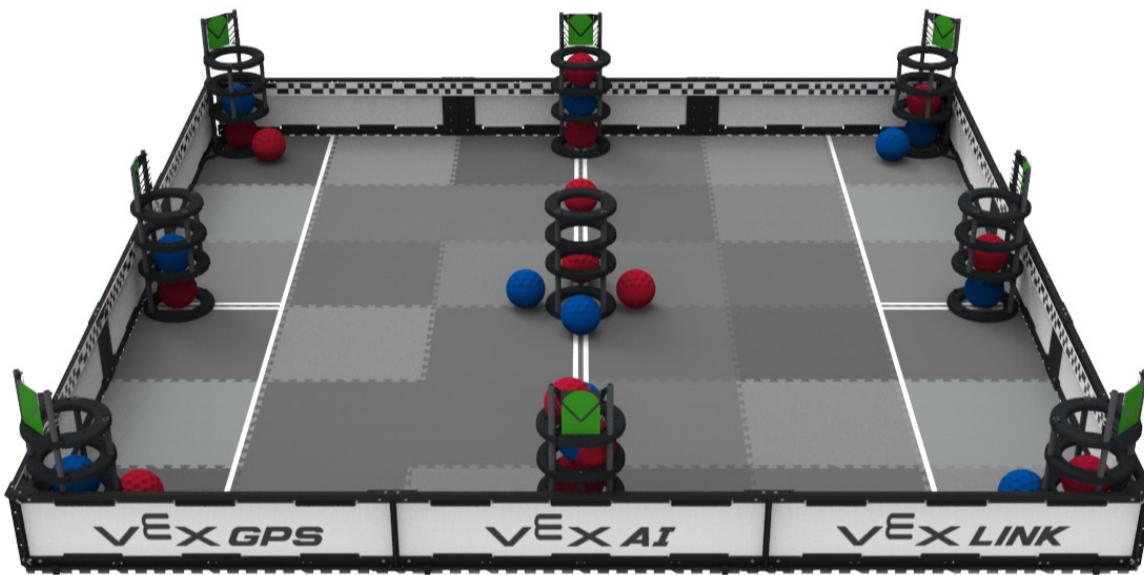




2020 - 2021
Appendix D - VEX AI Competition

Appendix D

VEX AI Competition



Introduction

Artificial Intelligence (AI) is becoming a staple in the industry today. The VEX AI Competition (VAIC) gives teams comprised of only matriculated post-secondary *Students* a chance to compete in this growing field. With just a few modifications to the field, and with additional sensors permitted on the *Robots*, Teams will be playing in one-vs-one *Matches* using two *Robots* per *Team* (i.e. four *Robots* on the field) that are fully autonomous. *Robots* will be functioning without input from drivers and instead are communicating with each other as the *Match* progresses through two minutes.

There will be an VAIC division at the 2021 VEX Robotics World Championship in April 2021. 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. VAIC is the perfect project-based supplement to many High School and University-level engineering programs and will give students the unique opportunity to demonstrate their real-world AI skills to potential employers (such as REC Foundation sponsors).

Rule Modifications: Game, Tournament

The VEX AI Competition uses the VEX Robotics Competition Change Up field with the VRC Field Position Code Strip and opaque field panels. Anyone that already has a VEX Robotics Competition Change Up field can use it for an AI Competition event with these two modifications.

Please consult the VEX Robotics Competition Change Up Game Manual for the foundation set of competition details. All the standard Game, Robot, & Tournament rules apply, except for the modifications listed in this document. This Appendix is subject to changes per <G21>.

Game Definitions

Interaction Period - The 75-second (1:15) time period that follows the *Isolation Period* after the winner of the *Isolation Period* has been determined. *Robots* react only to sensor inputs and to commands pre-programmed by the *Students* into the Robot control system and can interact with the entire field during the *Interaction Period*. The *Interaction Period* replaces the *Driver Controlled Period*.

Isolation Bonus – A point bonus of six (6) points awarded to the *Team* that has earned the most points at the end of the *Isolation Period*. The *Isolation Bonus* replaces the *Autonomous Bonus*.

Isolation Win Point – One (1) *Win Point* (WP) given to an *Alliance* that has completed their *Alliance Home Row* at the end of the *Isolation Period*. Both *Teams* can earn this WP if both *Teams* complete their *Alliance Home Row*. The *Isolation Win Point* replaces the *Autonomous Win Point*.

Isolation Line – The *Isolation Line* follows the same definition as the *Autonomous Line*, i.e. the pair of white tape lines that run across the center of the field. All rules that refer to the *Autonomous Line* are now referenced to the *Isolation Line*.

Isolation Period - A 45-second (0:45) time period during which *Robots* operate and react only to sensor inputs and to commands pre-programmed by the *Students* into the *Robot* control system on their side of the field. This *Isolation Period* replaces the *Autonomous Period* normally found in a VEX U Match.

Game and Tournament Rules

<AIG1> Instead of a 2-Team *Alliance* format, VAIC *Matches* will be played 1-Team vs. 1-Team. Each Team will use two (2) *Robots* in each match, per <AIR1>.

- a. Teams are allowed to build as many *Robots* as they would like, but only two (2) – one of each size – 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.

<AIG2> *Qualification Matches* will be conducted like normal, in the 1 v 1 format described above.

<AIG3> An elimination tournament will be conducted similar to the Middle School & High School tournament. At the end of the competition, one *Team* will emerge as the event champion.

<AIG4> All human interaction with *Robots* during the *Match*, including via the Vision Sensor, is strictly prohibited.

<AIG5> The *Isolation Period* at the beginning of every *Match* will be 45 seconds (0:45).

<AIG6> The *Interaction Period* following the *Isolation Period* will be 75 seconds (1:15).

<AIG7> Each *Robot* is allowed up to three (3) *Drive Team Members* in the *Alliance Station* during a *Match*, as stated in <G7>. (i.e. Each *Team* is allowed two *Robots* and 3 *Drive Team Members* per *Robot*, therefore, each *Team* is permitted 6 *Drive Team Members* in the *Alliance Station*.)

<AIG8> VAIC Student Eligibility.

- a. All VAIC *Team* members MUST be matriculated in a High School, Home Schol or Post-Secondary school.
- b. Professionals not enrolled in post-secondary education are not eligible to participate on a VAIC *Team*.
- c. VAIC *Team* members may only be on exactly one (1) VAIC team for the season, see <G6>.

<AIG9> Drivers must disable their *Robot* (i.e. stop their *Robot* from moving) by powering off their V5 Wireless Controller whenever the Referee instructs them to do so in cases of violations that call for disablement.

<AIG10> Match loads must be placed promptly in the field before the *Isolation Period*.

Rule Modifications: Robot

<AIR1> Teams must build two (2) Robots, subject to the following size restrictions at the start of the Match:

- a. Robot A must be smaller than 24" x 24" x 24".
- b. Robot B must be smaller than 15" x 15" x 15".

<AIR2> Teams may use any official VEX Robotics product, other than the exceptions noted below, to construct their Robot. This includes those from the VEXpro, VEX V5, and VEX IQ product lines. To figure out if a product is "official" or not, refer to the www.vexrobotics.com website. The following products are not permitted under this rule:

- a. Products intended for competition event use, such as trophies, field perimeters, or game objects.
 - i. Screws, nuts, and other small hardware found in VRC field kits are permitted.
- b. VEX IQ electronics, found on this page: <https://www.vexrobotics.com/vexiq/products/electronics>
- c. Products not intended for Robot construction, such as apparel, tools, safety glasses, etc.
- d. VEXpro electronics from the following lists:

SKU	Description
217-8080	Talon SRX
217-9191	Victor SPX
217-9090	Victor SP
217-4243	Pneumatic Control Module
217-4244	Power Distribution Panel
217-4245	Voltage Regulator Module

SKU	Description
217-4347	775pro
217-2000	CIM Motor
217-3371	Mini CIM Motor
217-3351	BAG Motor
217-6515	Falcon 500

<AIR3> Teams are allowed to fabricate their own unique components for each of their Robots from the following additional raw materials. These parts may be fabricated using techniques that may otherwise be prohibited in VRC, such as welding, brazing, casting, forging, hot/cold rolling, tempering, or gluing.

- a. An unlimited amount of non-shattering plastic from the following list: polycarbonate, acetal monopolymer (Delrin), acetal copolymer (Acetron GP), POM (acetal), ABS, PEEK, PET, HDPE, LDPE, Nylon (all grades), Polypropylene, FEP.
- b. An unlimited amount of silicone, polyurethane, or other rubber.
- c. An unlimited amount of composite materials, such as G10 (Garolite), FR-4, or carbon fiber.
- d. An unlimited number of plastic 3D printed parts.
- e. An unlimited amount of steel, aluminum, brass & bronze.

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The intent of <AIR3> is to encourage *Teams* to explore fabrication techniques like milling, 3D printing, injection molding, sheet metal punching, etc., to develop their own new robotic components in addition to the "standard" set of VEX components permitted by <AIR2>. To utilize these techniques, raw materials from the list provided in <AIR3> may be used.

However, the intent of <AIR3> is not to legalize all commercially available items made from these materials. The only commercial components (other than pneumatic components) that may be used are those purchased from VEX Robotics, as specified in <AIR2>.

For example, aluminum billet may be used to machine a custom bracket. However, purchasing a custom aluminum bracket is not within the spirit of this rule. Similarly, pre-drilled or extruded metal, such as angle aluminum, is not permitted, unless it can be found on www.vexrobotics.com.

<AIR4> Each *Robot* must utilize exactly one (1) V5 Robot Brain microcontroller and at least one (1) V5 Robot Radio connected to a V5 Controller. No other types of VEX microcontrollers are permitted.

- Teams* must abide by the power rules noted in <R20>.
- Additional power requirements can be found in <AIR6>.
- Teams* may use additional V5 Radios.

<AIR5> 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).

Note: Pneumatic actuators are permitted within the guidelines of <AIR9>.

<AIR6> There is no restriction on sensors and other additional electronics that *Robots* may use for sensing and processing, except as follows:

- 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.
- Sensors and electronics CANNOT directly electrically interface with VEX motors or solenoids.
- The additional sensors and additional electronics may only receive power from any of the following:
 - Directly from the V5 Robot Brain via any externally accessible port.
 - 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). Battery pack must operate at a maximum of 12 volts nominal.
- Only the V5 Battery can power the V5 Brain

<AIR7> *Robot* to *Robot* communication is permitted via V5 Radio(s) and other non-radio forms of communication (i.e. IR, ultrasonic, etc.). All other forms of RF communication are prohibited during *Match* play.

<AIR8> *Teams* may use the following fasteners on their *Robot*:

- Any commercially available #4, #6, #8, #10, M2, M2.5, M3, M4, or 1/4-20 screw (of any length), and any commercially available nut, washer and/or spacer to fit these screws.
- Any commercially available aluminum or steel rivet, up to 1/4" nominal diameter.

<AIR9> Teams may utilize an unlimited amount of the following commercially available pneumatic components: Cylinders, actuators, valves, gauges, storage tanks, regulators, manifolds, 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.

Team Composition

The VEX AI Competition 2020-2021 season is the inaugural season for this program. We want to see High Schools and Universities face off in a global head-to-head competition. However, schools are not limited to one *Team*, nor are members of the *Team* limited to be comprised of students from just one School. *Teams* should identify with their School when possible so that they represent their School and the support that they have received.