VEX ROBOTICS

COMPETITION

TIPPING POINT

2021 - 2022

Appendix C - VEX U

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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, there will be 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 2022 VEX Robotics World Championship. For more information on VEX U events refer to http://www.robotevents.com/ to find event details, pricing, and registration info.

Game, Robot and Tournament Rules

VEX U uses the VEX Robotics Competition Tipping Point field with no modifications. Anyone that already has a VEX Robotics Competition Tipping Point field can use it for a VEX U event or team. Please consult the VEX Robotics Competition Tipping Point Game Manual for the foundation set of competition 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 both 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 – 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 like normal, in the 1 v 1 format described above.

<VUG3> 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.

<VUG4> The *Autonomous Period* at the beginning of every 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 stated in <G7>.

<VUG7> VEX U *Student* eligibility.

a. All VEX U *Team* members MUST be matriculated in a post-secondary school.
b. Professionals not enrolled in post-secondary education are not eligible to participate on a VEX U *Team*.
c. *Students* that 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>, <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 24" x 24" x 24" at the start of the *Match*.
c. One *Robot* must be smaller than 15" x 15" x 15" at the start of the *Match*.

<VUR2> *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, VEX IQ, and VEX GO product lines. To determine if a product is "official" or not, refer to www.vexrobotics.com.

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

<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 (i.e. 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*, or or the field. 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 that have been ordered by the *Team* to be 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>, <R29>, 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 of fasteners may include (but are not limited to) screws, nuts, washers, rivets, hinges, pins, rod ends, threaded rods, or hose clamps.

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 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 <R20> and <VUR10>.

<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).

Note 1: Pneumatic actuators 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 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). Battery packs 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>.

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

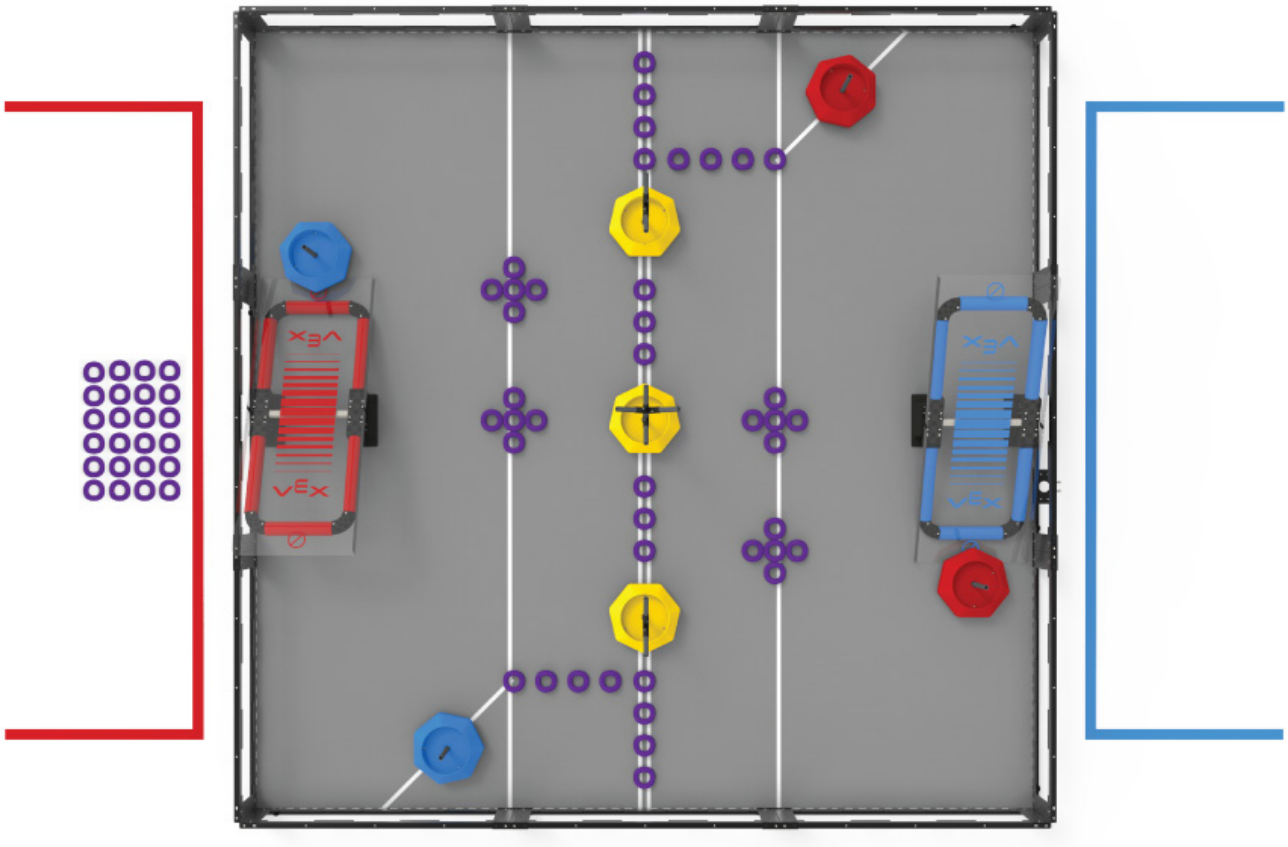
<VUR12> *Teams* may utilize an unlimited amount of the following commercially available pneumatic components: Cylinders, actuators, valves, gauges, storage tanks, regulators, manifolds, and solenoids.

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.

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 Robot Skills Challenge Matches, per <VUG1> , <VUG6>, and <VUR1>.

<VURS1> Prior to the start of *Robot Skills Matches*, each *Robot* must use its three (3) *Rings* available as *Preloads*, or add them to the *Team's* Match Loads, per <SG1>. The other six (6) *Preloads* are not used in a *Robot Skills Match*.



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* that 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.