



BEST Generic Game Rules

GMRK00001 Revision 11; July 2014

1.0 Overview

This is a student oriented contest. The students will gain the most if they do the work. Mentors and coaches are to provide guidance only and not to make parts, detail design, nor force their will on the students.

The rules governing the BEST competition consist of the following:

1. Game Specific Rules (may supercede Generic Game Rules)
2. BEST Generic Game Rules (this document)
3. Returnable Kit List
4. Consumable Kit List
5. On-line Question and Answer (Q&A) system

Most questions about the game can be answered by first **READING THE RULES THOROUGHLY**. All questions concerning these rules (during the 6-week design and construction phase, not during the competition) must be submitted to the Game Committee in writing through the web-based interface at **<http://www.bestinc.org>**. All questions and answers will be distributed to all teams via the web. Responses to the posted questions on the web site are an extension of the rules. In the event of contradiction between the rules and the Q&A responses, the Q&A responses supersede the rules.

2.0 Safety

Safety may not and will not be compromised.

1. Safety is a priority.
2. The referees will disqualify any machine that appears to be a safety hazard.
3. Batteries, chargers, and other components of the BEST Control System Kit may not be tampered with or altered in any way.
4. Except for a power drill/driver and a soldering iron (or soldering gun), no power tools (including battery operated) will be allowed in the pit area during any BEST activity. Common hand tools will be allowed. The power drill/driver may be used for drilling and/or hardware insertion/removal, but not for grinding, sawing, routing, etc. The allowed power tools can only be operated only in the pit area or in the hub designated workstation area.
5. All individuals working on the machine in the pit area must wear safety gear appropriate to the activity (e.g., safety glasses should be used when soldering or drilling).
6. Any illegal tools may be confiscated for the day.

3.0 Robot Constraints

3.1 Material Constraints

Each team receives two kits: a Returnable Kit and a Consumable Kit. Each machine must be constructed using only the materials that appear on the returnable and consumable kit lists (provided in separate documents). Exceptions to this rule are described in Section 3.1.4.

The Returnable Kit List and Consumable Kit List are the official references for parts; therefore, they define the type and quantity of parts that can legally be used on the machine. The team is responsible for confirming that items in the received kits are consistent with the items on the lists and include no excess parts. Excess parts may not be used.

3.1.1 Construction Requirements

1. All robot construction is to occur during the six week competition period. There should be no part construction prior to the Game Kickoff Day nor reuse of parts from previous competitions. Robot parts may be permanently marked (via scribing, drilling holes, etc.) by BEST personnel in order to identify the year in which they were built.

2. The VEX Cortex microcontroller and battery must be secured to the robot. The Cortex microcontroller must be mounted to your robot through the holes provided on its base (suggest using #8 machine screws to avoid damaging the Cortex).

3.1.2 Returnable Kit

1. All Returnable Kit items, including boxes and packing, **must be returned** at the conclusion of the contest in the same condition as received except as noted in item 2 below.
2. Returnable Kit equipment cannot be modified in any way, with the following exceptions:
 - a) The belt stock supplied in the returnable kit may be modified as needed (e.g., cut, holes punched, etc.); however, the belt that is provided as loop may not be modified.
 - b) Servo horns may be modified as desired.
3. The Returnable Kit List specifies certain items that may not be attached to the machine (e.g., the battery chargers).
4. The motors and servos may not be opened for any reason. For example, it is illegal to change the gearing or to re-wind the armature of any motors.
5. The pulleys, bearings, and shoulder screw included in the return kit may not be modified. You may not use any glue or adhesive tape on these items
6. Tape/adhesive/glue may not be applied to any returnable item unless specifically allowed (see Section 3.1.4.10). The adhesive portion of the supplied Velcro™ brand hook and loop fastener may not be attached to the battery or to any other returnable item.
7. Paint may not be applied to any returnable item.
8. The VEXnet Joystick, servos, VEX Cortex microcontroller, VEXnet Keys, batteries, and battery chargers may not be tampered with, modified, or adjusted in any way. The only exception is that the VEX Cortex microcontroller may be programmed as desired.
9. Teams may not put labels or rubber bands on the VEXnet Joystick, nor make internal, reversible modifications to the joysticks.
10. Wires may be soldered to the motor power lugs.
11. Only the motor controllers or servo power adapter cables may be plugged directly into the VEX Cortex microcontroller motor ports. Motor ports 1 and 10

cannot be used (do not plug the screw terminal motor interface cables into these ports). Only the screw terminal sensor interface cables may be plugged directly into the VEX Cortex microcontroller digital/analog input/output ports. No other connection methods to the Cortex may be used. Soldering to the Cortex microcontroller or to any of the interfacing cables is not allowed.

12. The 7.2 Volt NiMH 3000mAh batteries are the only allowed source of electrical power for the functional components of your entire machine.
13. The 7.2 Volt batteries may **only** be connected to the VEX Cortex microcontroller through the supplied mating connectors. Do not attempt to connect the 7.2 Volt batteries to any other Cortex input other than the battery connector.
14. Only one 7.2 Volt battery may be used on the machine during a match. Even if unconnected, the other battery may not be on the machine.
15. On Game Day, replacement batteries will only be provided upon proof of battery failure (e.g., a bad connection) on an exchange basis (you must turn in the bad battery).
16. You must play all your Game Day matches using the 7.2 Volt batteries supplied by BEST. Team-owned batteries (that power the robot) are not allowed on the field or in the pit area on Game Day; however, team-owned batteries are allowed during other BEST activities.
17. You may use the provided AAA rechargeable batteries or team provided batteries in the VEX Joystick.

3.1.3 Consumable Kit

1. Consumable Kit parts may be modified as desired within the constraints of these rules.
2. Limited numbers of replacement parts may be available from your local hub, upon a justified request. Otherwise, lost or damaged kit material may only be replaced with identical components. Replacement parts purchased by the team must have the same:
 - a. material as the kit part;
 - b. treatment or grade as the kit part; and;
 - c. dimensions as the kit part.

e.g., replacement plywood must be the same grade as the kit material; a 1x4 may **not** be replaced with a 2x4 of the same total volume.

3. The Consumable Kit includes optional items that may be provided by the team and used on the machine.
4. Team supplied pennies may not be altered.
5. The only Consumable Kit item that may be used to conduct electricity is the provided wire (and also the soldering material at the wiring connections). The only exception is that any of the Consumable Kit provided/allowed metallic materials may be use as part of a sensor circuit.

3.1.4 Additional Materials, Constraints and Exceptions

1. Lubricants may be used for lubrication only. A machine may not intentionally contaminate the playing field or an opponent's machine with lubricant.
2. Paint, stickers, and/or decals may be used on the robot as decorations only. They cannot be applied to any of the returnable items.
3. Other non-functional decorations are only permitted as long as they do not aid the machine in performing the game. If you can remove it or cover it up (and you may be asked to) and your machine behaves the same, it is probably non-functional. Prohibited decorations include:
 - a. strobe lights;
 - b. cameras,
 - c. any device that transmits or receives signals to/from an external device.
4. Non-functional decorations may use a separate power source (e.g., 9V battery).
5. The use of markers/paint/printouts/et al. may be used to provide visual static (unchanging) information that does not aid the team in performing the game. Examples of what is allowed would be things such as labeling machine parts with a marker, placing a copy of the Cortex port use schematic on the machine, and so on. The Game Specific Rules may provide further clarification on what types of visual information is allowed.
6. You may solder electrical wire connections using your own solder except where electrical connectors are provided. Where connectors have been provided (i.e., on the VEX Cortex microcontroller, servo power adapter cables, servo extension wires, batteries and other returnable items), they must be used without soldering to the connector. Solder may be applied to connectors included in the Consumable Kit (e.g., bullet connectors or quick-disconnect connectors).
7. No welding, brazing or structural soldering is allowed.

8. Metal, rubber, and plastic items may be heated and reformed, but may not be melted and re-cast.
9. Materials may not be changed chemically. The exceptions are that strings may be singed to prevent loose ends and that kit allowed resin and hardener may be mixed to result in epoxy.
10. No residue “painters” tape may be used on any Returnable Kit items except the Joystick.

3.2 Size

1. At the start of each match, the machine must fit, **unconstrained**, within a cubic space that is 24 inches on a side. The machine must remain within the maximum size limit, unconstrained, until the beginning of the match.
2. Once the match begins, the machine may unfold and change size through its own power.
3. There is no size requirement at the end of the match (i.e., the machine does not have to return to its initial configuration).

3.3 Weight

1. The weight of the machine may not exceed 24 pounds, including the battery and all parts and devices of your machine (e.g., detaching pieces, optional equipment, tethered parts, etc.).

3.4 Energy Sources

1. The energy used by the machine must come solely from:
 - a. electrical energy derived from the single onboard battery pack;
 - b. storage achieved by the deformation of the springs provided in the kit;
 - c. a change in the altitude of the center of gravity of any part of the machine; and/or;
 - d. stretched rubber from the inner tube, rubber bands, or shock cord, provided that the part is attached to the machine so that it will not fly off if broken.

3.5 Compliance

1. All machines will be inspected for compliance with the regulations before the competition. Machines must meet these regulations to qualify for the competition.

The winning machines may be inspected again following the competition. Failure to comply with the regulations will result in disqualification.

2. No substitute machines are allowed. Machines may be modified between rounds but must still meet all the regulations after the modifications are made. The compliance official must approve all modifications prior to the next round of competition.
3. Random re-checks of machines will be performed throughout the day at the discretion of the referees. Any machine found to be non-compliant will not be allowed to continue the competition until brought into compliance and may be disqualified from prior matches.
4. The machines may not leave the competition site between the time they are checked for compliance and the start of the competition without approval from the competition officials.
5. Teams that place high enough to advance to a regional/national competition are allowed to make repairs and/or functional improvements to their machine. Machines will be rechecked for compliance prior to the regional/national competition.

3.6 General

1. Machines must be designed to operate by reacting only against the surfaces of the playing field (including the PVC pipes, ramps, etc), the opponents' machines, and the air. Machines are allowed to clamp to anything in the field except another machine.
2. During a match, the machine may only be controlled through normal operation of the VEXnet system. Touching the robot will result in penalty or disqualification as described in section 4.3.
3. No external devices may be connected to the joystick during match play (with the exception of the auxiliary joystick field power supply if provided).
4. Machines must prominently display their team number and the school's or team's name or logo.
5. Powered tandem devices are permitted and may use an umbilical to connect the two devices. This umbilical is considered part of the machine and is subject to the same constraints as the rest of the machine.
6. All projectiles must have a frontal area greater than 10 square inches. A projectile is anything launched through the air, whether free flying or tethered. Parts that detach or fall from a machine and remain on the playing surface are not considered projectiles.

7. Gaining traction or gripping game pieces by the use of adhesives, or by abrading or breaking the surface of the field is not allowed.
8. Spiked wheels are allowed only if the portion of the spike in contact with the field has at least one dimension greater than 1/4 inch.
9. Strategies aimed only at destruction, damage (e.g., stabbing, cutting, etc.), overturning, or entanglement of an opponent's machine are not in the spirit of the competition and are not allowed. Turning over an opponent's machine may or may not result in a penalty depending on the opinion of the referees. Review section 4.3 for a description of penalties for overly aggressive actions.
10. Machines may deploy detachable components on the field. A component is considered "detached" if it has no kit parts connecting it, directly or indirectly, to the set of kit parts that includes the battery. Such components may be used to capture, contain, manipulate game pieces, and/or block another machine. Such components may not be launched at, deliberately attached to, or otherwise deliberately used to entangle another machine. Incidental contact between any machine and such detachable components after deployment will not result in a penalty for any team. Detached components will not count as "part of the machine" unless otherwise stated.
11. Following the contest, all items provided in the Returnable Kit must be returned to the hub (local BEST organization). The rest of the machine may be retained by its respective school.

4.0 Head-to-Head Competition

4.1 General

1. Referees have ultimate authority during the competition. No protests will be allowed.
2. On Game Day there will be individuals identified to answer questions about the game or rules. Do not approach referees (or others) with questions.
3. A referee will untangle machines that become entangled with part of the field, or each other, for more than 10 seconds or that may appear to be damaging the field because of the entanglement.

4.2 Field Colors

Specific team locations on the field (e.g., driver/spotter locations, robot starting area, allowed team maneuvering areas, team scoring areas, etc.) are designated through the following four color scheme.

Bright Red	Bright Green
Bright Blue	Bright Yellow

4.3 Drivers and Spotters

1. During a match, only one student member of each team is allowed in the team driver's area and one student member is allowed in the team spotter's area. Adult coaches and teachers are not allowed in either of the areas during matches. Students are not allowed to stand on platforms of their own construction (or each other) to get a better view.
2. Only one person per match is allowed to drive the machine (i.e., operate the VEXnet Joystick). Prior to the competition, each team must submit a driver list to the organizers. The minimum number of student team members on the driver list is shown in the following table:

Student team members present at competition	Minimum number of students on driver roster
2-4	2
5-6	3
7-8	4
9 or more	5

Please note that the previous table reflects the minimum number of drivers required; BEST encourages participation by as many team members as possible. Also note that the number of student team members present at the competition is used to determine the minimum number of drivers on the list.

3. The first person on the driver list is the driver for the first match; the second person on the list is the driver for the second match, etc. This rotation will continue for successive matches until the list is exhausted, at which time the rotation will start again at the top of the list. Rotation in successive phases of the competition (e.g., seeding, semi-finals, and finals) will begin where the previous phase rotation left off. If the organizers eliminate a match for any reason, the driver rotation will continue in accordance with the driver list with the driver

scheduled for the eliminated match (or matches) being the first driver for the following match.

4. The spotter may be any student from the team.
5. Spotters and drivers are not allowed to handle the game pieces prior to a match.
6. During a match, spotters and drivers may not communicate with anyone through the use of any electronic devices or other signaling technique that involves a signaling aid that is not part of the human body (e.g., signs, sticks, marked gloves, etc. are not allowed).

4.4 Penalties

1. A 20-second suspension may be assessed for a variety of infractions that are detailed elsewhere in this document. This penalty requires the driver to surrender his or her VEXnet Joystick to a referee for a period of 20 seconds. The referee will return the joystick to the driver upon expiration of the penalty and the machine may continue the match. Penalty decisions of the referees will be final.
2. If a driver touches his or her own machine before any part of it has left the starting area, a 20-second penalty will be assessed after contact ceases. Machine contact within the starting area is allowed only for the purpose of debugging a defective machine (e.g., turning on the on/off switch). If a spotter or driver otherwise touches their own or another team's machine, the machine of the individual doing the touching will be disqualified.
3. Spotters and drivers are not allowed to enter the field during a match. If a spotter or driver enters the field during a match, his or her machine will be disqualified.
4. If a spotter or driver leaves the designated spotter or driver area, a 20-second penalty will be assessed as described in item 1 of this section.
5. Machines that touch the ground outside the field boundary will be assessed a 20-second penalty as described in item 1 of this section. Machines that completely leave the field will be stopped for the duration of the match.
6. Damaging any portion of the field or game pieces may result in disqualification. Intentionally moving or tipping over static portions of the field is considered damaging the field, and will result in disqualification.
7. Referees may instruct the driver of an aggressive machine to cease an action if the referee feels that another machine or the field may be damaged by that action. Referees will disqualify a team from a match if a major breach of the rules occurs.

8. Disqualification is on a match basis, except for non-complaint machines as noted in Section 3.5. Any team that is disqualified will receive zero points for that match.

4.5 Match Protocol

1. There will be at least five referees during each match. The Head Referee will act as timekeeper and the other four referees will monitor each of the teams.
2. Each match will be three minutes long and will be played with four teams, if possible. The scoring software will assign teams to a match and will determine the team's quadrant/color for each match.
3. Teams will be notified of their field and position assignment at least two minutes before the match. Teams must be in the staging area at the end of the preceding match.
4. Prior to the beginning of the match, teams must wait at the designated staging area until the beginning of the setup period. Once signaled, teams have the duration of the setup period to place their robot into a valid starting position. Refer to the Game Specific Rules to clarify valid starting positions.
5. As a guide, a maximum setup time of 30 seconds will be allowed once the team arrives at the field. If a team has not successfully placed their robot by the end of the setup period, the head referee has discretion to allow the team to continue to place their robot and assess a 20-second penalty to be applied at the beginning of the match or whenever the team is ready to begin play.
6. At the start of each match, the machine must be placed at the designated starting area. The spotter or driver may enter the field prior to the start of the match to place the machine in its starting location and prepare it for the match. Temporary alignment marks on the field are not permitted. Additional team members may be allowed to assist in setting up the machine, but must leave the field area prior to the start of the match.
7. The machine, driver and spotter must be in the designated location(s) at the start of the match to score any points during the match. The driver and spotter must remain in the designated areas during the match.
8. A maximum of 30 seconds will be allowed at the end of each match for removal of the machines. Additional team members may be allowed to assist in removing the machine.

4.6 Competition Protocol

There will be four phases to the head-to-head competition:

- a seeding phase,
- a wildcard phase,
- a semi-final phase, and
- a finals phase.

This protocol will be the same for both hub contests and regional contests.

The Game Specific Rules define any tiebreakers for determining which team advances from one phase to another in the event of a tie.

4.6.1 Seeding Phase

The Seeding Phase will consist of a round robin competition among all participating teams. Each team will typically participate in up to eight matches against randomly selected opponents. Fewer than eight matches per team may be played when time limitations exist, but no fewer than five matches. All teams will participate in the same number of matches. Match scheduling will attempt to ensure that each team plays on each quadrant of the field and that back-to-back matches are limited.

The team ranking during this phase will be based on the average of the points scored during the seeding matches excluding the teams' lowest match score. Consult the Game Specific Rules for any variation to this ranking method.

For competitions with 32 or fewer teams, the top 7 teams from the seeding phase will automatically advance to the semi-finals phase. The final team to advance into the semi-finals phase will be selected from the remaining teams using a single "wild card match" between the four teams with the highest BEST design notebook scores.

For competitions with greater than 32 teams, the top 14 teams from the seeding phase will automatically advance to the semi-finals phase. The final two teams to advance into the semi-finals phase will be selected from the remaining teams during the "wild card phase"

4.6.2 Wildcard Match Phase

For competitions with 32 or fewer teams, the wildcard phase will consist of a single match between the four (4) teams with the highest BEST project engineering notebook scores, which have not automatically advanced to the semi-final phase. The team achieving the highest score during the wildcard phase will advance to the semi-finals.

For competitions with greater than 32 teams, the wildcard phase will consist of two matches between the eight (8) teams with the highest BEST design notebook scores which have not automatically advanced to the semi-final phase. This phase will consist of 2 matches of 4 teams (as all matches are limited to 4 teams), which may be played in parallel. The two (2) teams achieving the highest scores during the wildcard phase will advance to the semi-finals.

The wildcard phase will be conducted according to the rules for the seeding phase. Each wildcard team will play in only one match during this phase.

4.6.3 Semi-Finals Phase

During the semi-finals phase, each team will participate in three (3) matches based on the rotation shown in Table 1 or 2. The team ranking at the end of the semi-finals will be based on the total points each team accumulated during their three matches. No scores will be dropped and the scores from all previous phases will be disregarded. Game play will be the same as previously described for the seeding phase. Only the top four (4) ranked teams from the semi-finals phase will advance to the finals, regardless of the number of teams competing in the semi-finals.

Table 1. Field Position Assignments for 8-team Semi-Finals

Semi-Final Match	Field Position Assignment			
	Yellow	Blue	Red	Green
1	Seed 4	Seed 1	Seed 5	Seed 8
2	Seed 2	Seed 8	Seed 3	Seed 7
3	Seed 6	Seed 4	Seed 7	Seed 1
4	Seed 3	Seed 2	Seed 4	Seed 5
5	Seed 5	Seed 7	Seed 8	Seed 6
6	Seed 1	Seed 3	Seed 6	Seed 2

Table 2. Field Position Assignments for 16-team Semi-Finals

Semi-Final Match	Field Position Assignment			
	Yellow	Blue	Red	Green
1	Seed 4	Seed 13	Seed 5	Seed 16
2	Seed 2	Seed 10	Seed 3	Seed 15
3	Seed 5	Seed 9	Seed 8	Seed 14
4	Seed 16	Seed 1	Seed 6	Seed 11
5	Seed 8	Seed 4	Seed 2	Seed 12
6	Seed 7	Seed 11	Seed 9	Seed 10
7	Seed 3	Seed 14	Seed 13	Seed 6
8	Seed 10	Seed 12	Seed 1	Seed 5
9	Seed 14	Seed 2	Seed 16	Seed 7
10	Seed 11	Seed 8	Seed 15	Seed 13
11	Seed 1	Seed 7	Seed 4	Seed 3
12	Seed 6	Seed 15	Seed 12	Seed 9

4.6.4 Finals Phase

The four (4) top ranked teams will participate in three (3) matches during the finals phase. Field assignments per match will rotate as shown in Table 3. The final team ranking will be based on the total points accumulated by the team during these 3 finals matches. No scores will be dropped and the scores from all previous phases will be disregarded. Game play is the same as previously described for the seeding phase. The winner is the team with the most points accumulated during the three final matches.

Table 3. Field Position Assignments for Finals

Final Production Match	Field Position Assignment			
	Yellow	Blue	Red	Green
1	Semi-Final 1	Semi-Final 2	Semi-Final 3	Semi-Final 4
2	Semi-Final 4	Semi-Final 3	Semi-Final 2	Semi-Final 1
3	Semi-Final 3	Semi-Final 1	Semi-Final 4	Semi-Final 2

5.0 Other

1. Student eligibility is left to each individual school.
2. All contestants on the gym floor must wear shoes appropriate to the gym floor surface as determined by the sponsoring BEST organization.
3. Each team will be provided with their own workspace in the pit area in which they may place a table with a surface area no greater than 2400 square inches, if a table is not provided by the hub. Each team will have access to one electrical plug for battery charging. The exact specifications may vary from hub to hub.
4. Each team may bring a toolbox with basic hand-tools subject to the safety constraints listed in Section 2.0. If a part is broken during competition and the team cannot repair it with tools or material they have, consult the sponsoring BEST organization. They will make their best effort to help the team replace the part, given local shop and/or spare material availability.
5. Practice time may be available preceding Game Day. Consult the sponsoring BEST organization for times and locations. Tables and electricity will be available on a shared basis and teams must provide their own tools. The same safety rules will apply to practice days as they do during the competition.

6.0 Revision History

This section is not part of the Generic Game Rules, but is provided to aid in determining changes to this document.

Rev	Date	Impact	Summary of Changes
11	July 2014	New Section	Added generic match protocol and competition protocol sections. Moved some material from other sections to new sections as well. Removed reference to 802.11. Restated that additional team members <u>may be allowed</u> to assist in setup/removal of machines from the field. Original text simply stated that this is allowed. This may be game dependent or up to the hub.
10	June 2013	Minor	Revise the allowed use of painters tape. Clarified practice time as optional (5.0)
9	June 2012	Minor	Allow painters tape. New rules regarding new kit items (pennies, potentiometer) and use of Cortex analog ports. Removal of requirement to explicitly use the provided motor mounts. Move the explicit field color designations to field drawings.
8	August 2011	Minor	Merge all rules from Generic Kit Notes into this document. Updated rules on decorative items. Added option for joystick field power supplies.
7	June 2011	Minor	Created section 3.1.1 Construction Requirements (merge of existing rules). Updated sections 3.1.2 Returnable Kit and 3.14 Additional Material Constraints for changes in Return Kit components and their use.
6	August 2010	Minor	Added rule in section 3.6 covering connection of external devices to joystick during match play.
5	June 2010	Minor	Replaced references to R/C and BRAIN with VEX components. Modified section 3.6 item 9. Removed requirement for safety glasses. Added 4.2 on field colors.
4	October 2008	Minor	Added specific restriction and penalty for drivers and spotters leaving designated area during match.
3	May 2008	Minor	Removed references to DSP & BRAIN specific rules & kits to be consistent with exclusive use of the BRAIN-based kit. Removed references to speed controllers.
2	July 2007	Minor	Included references (Section 1.0) to rules governing use of the BRAIN system.
1	January 2006	Minor	Modified rules for returnable belt use (Section 3.1.1, Item 5). Added item 9 to section 4.1
0	August 2005	N/A	Initial release.