

APPENDIX B - COMPLETE LIST OF RULES

- T1. Referees have ultimate authority during the competition—their rulings are final.
- T2. If a machine is **disqualified** by a referee, that machine is turned off for the remainder of the match, and any points scored during that match will be forfeited.
- T3. If a machine is **disabled** by a referee, that machine is turned off for the remainder of the match, and any points scored during that match will count.
- T4. A machine may not win a match through an advantage gained by breaking a rule, even accidentally. The effect of the infraction on the outcome will be decided by the referees.
- T5. Strategies aimed solely at the destruction, damage, or entanglement of opponents' machines are not in the spirit of the tournament and will not be allowed. Turning over an opponent's machine is not considered damaging and will be allowed, but stabbing, cutting, etc., is illegal. If a breach of this rule occurs the contestant's control system may be disabled by the referees.
- T6. Limited amounts of machine shoving will be allowed; however, if you damage opponents' machines, referees may take action against your team. Possible actions include, but are not limited to; stopping the match to allow the damaged machine to be repaired before resuming play, a complete rematch after repairs have been made, or disqualification of your machine and forfeiture of any points scored.
- T7. If a team's machine is damaged to the point that it cannot complete a round on a fair basis, that team may be eligible for a rematch. This decision will be up to the referees.
- T8. If one team intentionally damages another team's machine, it may result in disqualification. However, if the damaged team's machine is considered too flimsy to begin with, the other team may not be disqualified. The ultimate determination will be with the referees.
- T9. The playing field carpet will be directly on the floor.
- T10. Deliberately damaging the playing field, controls, or balls (using spiked wheels, for example) is strictly illegal and may result in disqualification.
- T11. A machine may not intentionally contaminate the playing field, balls, goal, or another machine with lubricants.
- T12. After a match, team member are not allowed on the playing field until referees have completed the scoring procedure.
- T13. The fence is a safety feature, not part of the playing field. Therefore, no part of any machine may react against it.
- T14. No remote communication devices, such as air phones, walkie-talkies, cellular phones, etc., may be used by teams during a match.
- T15. During the tournament, teams will be notified of their field positions at least two minutes prior to the start of their match in the staging area. Teams will be allowed a maximum of one minute to set up their machines on the field and a maximum of one minute to remove all machine parts from the playing field following a match. You will have at least 4 minutes before your next scheduled match.
- T16. If a team is not ready to setup their machine on the field, and the two minute notification period is about to expire, and they do not wish to forfeit the match, then they must call a time-out. Each team may take up to 10 minutes (cumulative) of time-outs during the double-elimination rounds. The duration of a single time-out

- may not exceed 5 minutes. If a machine is still not ready at the end of the time-out period, the team will forfeit the match.
- T17. During the finals matches (quarter-finals on), each team may take up to 10 minute (cumulative) of time-outs which can be used to delay the start of a match if their machine is not ready. The duration of a single time-out may not exceed 5 minutes. Unused time-out time from the double elimination matches is lost.
- T18. At the start of each match, machines may be placed in any orientation within the designated starting area, without touching other machines, the 4x4 boundary, or the fence
- T19. If, in an attempt to remove an opponent's balls from the field, a part of your machine drops out-of-bounds, your machine will be disabled. Any points scored will count.
- T20. If a machines goes out-of-bounds to the point that it has to apply power to any out-of-bounds surface to rejoin play, its control system will be disabled. Any points scored will count.
- T21. If one team intentionally moves another machine out-of-bounds, the machine out-of-bounds will be disabled for the remainder of the match. Points scored will count.
- T22. Balls which are knocked out-of-bounds or popped will be placed back in play next to the fence near the exit point without undue delay. Additional balls will be available for substitution.
- T23. It is not the responsibility of the referees if they damage trapping devices while attempting to retrieve balls. Please design your machine so that balls may be retrieved quickly and easily after a match is over.
- T24. **We strongly encourage you to develop and wear team uniforms, including identifying hats and t-shirts that display company and high school team names and/or logos. This will help the audience, announcers, judges and spectators identify you and your machine.**
- P1. Machines will start at equidistant locations, midway along the length of the playing field borders, as shown in Figures 1 & 2.
- P2. Each team will start with 8 small balls on the playing field and 4 small balls on the ramp of the player station. The small balls on the field will be arranged in clusters as shown in Figures 1 & 2. The clusters will be distributed at equidistant locations around the central goal at a distance of 4 feet from the flat side of the base of the goal.
- P3. Each team will start with 1 large ball on the side of the goal and 1 large ball on the playing field. The large balls on the goal will start atop the three triangular frames on the upper portion of the central goal. The large balls on the surface of the playing field will be distributed at equidistant locations around the central goal at a distance of 4 feet from the flat side of the base of the goal, as shown in Figures 1 & 2.
- P4. Each match will last for two minutes. It will begin when the control system is enabled and end when it is disabled, unless whistled dead by the referees.
- P5. Final scoring will begin when all balls come to rest or upon a referees' decision. Students and coaches will not be allowed onto the field until all scoring is complete.
- P6. Upon reaching the scoring stage, each small ball in or above the central hexagonal area of the goal is worth 3 points for the owner. Each large ball in or above the central hexagonal area of the goal is worth 10 points for the owner. Each large ball on or above the triangular frames at the three corners of the goal is worth 5 points for

the owner. Ball position will be determined by the geometric center of the ball as estimated by the referees.

- P7. The winner of each match is the team with the highest score. Ties will be won by the team owning the higher large ball in or above the hexagonal portion of the goal. If all teams that are tied have no large ball in or above the hexagonal portion of the goal, the tie will be won by the team with the large ball closer to the center of the field.
- P8. During a match, five members per team (two "drivers", two "coaches", and one "player") are allowed in the designated areas next to the field. Operator badges will be supplied by U.S. FIRST at each event and must be worn by these team members for field access. Of these five team members, at least three must be students from team partner pre-college school(s).
- P9. During a match, machines must be operated from the team operator area next to the field by two students from the pre-college team partner school(s). The coaches must also remain within the team operator area during the match.
- P10. Each team will be allowed to use one human player. Human players will be stationed at equidistant locations just outside the perimeter of the playing field, as shown in Figure 1 & 2.
- P11. The player must be a student from a pre-college team partner school, and must sit at the player station during the match.
- P12. Human players will be secured at each station by a seat-belt-like strap.
- P13. A human player may remove balls from the playing field by passing them over or under the horizontal bar at the player station, or around the outside of the vertical posts. A human player may also catch flying or bouncing balls.
- P14. If a human player returns a ball to the playing field by passing it under the horizontal bar, or after the end of the match, it will result in disqualification for the match, and any points scored by the team will be forfeited.
- P15. A human player may choose not to return balls to the playing field. However, any balls which leave the player's station, such as by rolling off the side, will be returned to the playing field near the player's station without undue delay.
- P16. For safety reasons, the player stations are not considered part of the playing field for the machines. Machines may not drive onto the ramps at the front of any player station, nor may they attempt to retrieve balls from any player station. Any machine which does so will be disabled. Any points scored will count.
- P17. For safety reasons, no part of a machine may pass through, around, or over the PVC posts at each player station or in any way touch the human players. If this occurs due to an intentional act, the machine causing the safety hazard will be disqualified and any points scored will be forfeited. If this occurs by accident, the machine causing the safety hazard will be disabled, and any points scored will count. The referees will decide whether the violation was intentional or an accident.
- P18. For safety reasons, no machine may launch a projectile of any sort, including balls, toward the player station or team drivers and coaches, with the one exception noted below. If this occurs due to an intentional act, the team causing the safety hazard will be disqualified and any points scored will be forfeited. If this occurs by accident, the machine causing the safety hazard will be disabled, and any points scored will count. The referees will decide whether the violation was intentional or an accident.
- It is acceptable for a machine to launch balls, but no other types of projectiles, toward the player station assigned to the same team as the machine.

- P19. For safety reasons, no player may intentionally touch any machine. If this happens, the player's team will be disqualified and any points scored will be forfeited.
- P20. All field dimensions shown in Figures 1 through 6 are ± 1 " non-cumulative. The large balls have a diameter of $24" \pm 2"$. The small balls have a diameter of $8" \pm 1"$. Both types of balls will be inflated to size, not pressure.
- S1. Safety first. Due to the nature of the event in which electrical equipment, springs and tools are used, safety will not be compromised.
- S2. Any machine which is determined to be a safety hazard by the referees at any time during the Competition must be sufficiently modified to the referees' satisfaction or it will be disqualified and not allowed to compete.
- S3. No energy stored in a rubber band may be used to launch any projectile. This does not apply to the latex tubing provided in the kit. However, competition balls are the only projectiles the latex tubing may be used to launch.
- S4. Projectiles must have a frontal area greater than or equal to 10 square inches and be shaped to avoid eye injury.
- S5. Do not tamper with the power supply, batteries, chargers, battery boxes, joysticks, or any other control system component except as noted in the control system rules. Tampering could result in failure or malfunction of the control system.
- S6. Safety glasses must be worn by all team members in the team boxes and player stations during matches, and in the pit area when working on machines. They are also highly recommended if your neighbor(s) in the pit are working on their machine.
- S7. Remove batteries from the holders while making adjustments to your machine. Due to the strength of the motors in the kit, it is important to keep fingers away from the gears while your machine is connected to a power supply.
- S8. The batteries may deliver more than 100 Amperes. Do not let the wires come into contact with any metal surfaces. Route wires carefully to avoid damage and short circuits, which may cause serious burns and/or fire.
- M1. The energy used by the machines in the Competition must come solely from:
- electrical energy derived from the onboard battery packs
 - storage achieved by deformation of springs or the latex tubing provided in the kit
 - compressed air (or vacuum) stored in the air accumulator
 - a change in the altitude of the device's center of gravity.
- M2. Machines must fit, unconstrained, inside a 36" cube with one face of the cube flat on the surface of the playing field. The weight of the machine including batteries may not exceed 120.0 pounds.

Size $\leq 36" \times 36" \times 36"$; Weight ≤ 120.0 pounds

Although UPS offers complimentary shipment of machines to and from competition sites, they will not ship packages as large as a full machine. Many teams have found it helpful to make ease of disassembly and reassembly one of the design goals.

- M3. All machines will be weighed and measured during the practice day at each Competition event and may be re-inspected anytime during an event. If modifications to your machine are necessary to meet the above requirements, they must be completed before seeding matches begin.

- M4. Teams are expected to design and build machines to withstand vigorous amounts of interaction with other machines. (See also rule T7.)
- M5. Until the controls are enabled at the beginning of each match, machines and any appendages, extensions or projectiles must remain unconstrained within the 36"x36"x36" starting size. Once a match begins, machines may extend beyond that limit under their own power.
- M6. Machines must be designed to operate by reacting against the surface of the playing field, the innermost face of the curb, the goal, the balls, the other machines, and the air. (See Section 2.2 for Field Diagrams.)
- M7. Machines must display their team company and school names and/or logos. The judges, referees, and announcers must be able to identify them by name.
- M8. During a match, machines may be manipulated only by the normal operation of the wireless control system.
- M9. Gaining traction by using adhesives or by damaging the surface of the playing field or the balls is not allowed.
- M10. No substitute machines are permitted; however, functionally identical replacement parts are allowed.
- M11. During any Competition event, any mechanism which will alter the operation of the machine may not be added or removed after the first match of the seeding rounds unless mandated by the judges for rule compliance reasons. (See also Section 5.3.)
- M12. Only items listed under the PNEUMATICS section of the kit list may be used to store, generate, or transmit compressed air or vacuum, with the following exceptions:
- Suction cups may be fabricated from legal kit parts, as define in rule K1 below.
 - Pneumatic fittings from Small Parts, Inc. may be used.

Custom-made pneumatic fittings, air cylinders, pumps, air accumulators, and so forth are not allowed, even if they are created from components included in the kits. Also, valves, syringes, tubing, and so forth from SPI or outside sources may not be used for pneumatics.

- C1. The control system is provided to allow wireless control of the machines. The transmitter box, receiver/relay box, servos, speed controllers, RNETs, antennas, batteries, battery chargers, battery holders, power supply and joysticks may not be tampered with, modified, adjusted or marked in any way, with the following exceptions:
- the dip switches on the transmitter may be set for custom operation.
 - the speed controllers may be calibrated as described in the Tekin REBEL Owner's Manual.
 - 1/4" bolts may be used (as self-tapping screws) in the recesses of the battery holders.

Tampering includes drilling, cutting, machining, gluing, rewiring, etc. All items listed in Rule C1 must be mounted without alteration. Do not write on or otherwise mark control system components.

- C2. Do not attach tape, stick-on hook & loop fasteners, glue, or other adhesives to control system components. We will re-use many of these components, and these items can be difficult to remove. Instead, use clamps, straps, or existing holes for mounting. The one exception to this rule is:

- Tape may be used to secure the position of the trimmers on the Joysticks in order to prevent accidental changes in calibration.

For mounting control system components, use mechanical fasteners, such as cable ties, straps, or brackets. Do not use tape, stick-on hook & loop fasteners, glue, or other adhesives.

- C3. The black project box is intended to serve as a mounting point for the rocker switches and to enclose the associated wiring. You may modify the black project box in any manner to accommodate your needs. It may not be used on the vehicle.
- C4. All motors and electrical devices connected to the receiver must be connected with the supplied wire and connectors.
- You must use 12 gauge wire for connections from the batteries to the speed controller and from the speed controller to the drill motor.
 - You must use 16 gauge jacketed cable for connections to Delco seat motors, McCord-Winn air pumps and Numatics air valves.
- C5. Do not tamper with the battery holder harness. You may not shorten the battery holder wires.
- C6. The 12V batteries must be inserted directly into the battery holders. You may restrain them in their holders by means of straps, rubber bands, etc.
- C7. RNETs may not be used in the Pit Area at any Competition event. A tether must be used for bench testing.
- C8. The Milwaukee drill motors and Tekin speed controllers, if used on your machine, must be used together as sets. Drill motors may not be powered from the receive/relay boxes. Delco seat motors, McCord-Winn air pumps, Numatics air valves, and the fan may not be powered from the speed controllers.
- C9. Two 0.1 μ F capacitors, included with each speed controller, must be installed in each drill motor as described in the Tekin REBEL Owner's Manual.
- C10. One 20A circuit breaker (provided in the kit) must be installed in series with each drill motor. The circuit breaker must be accessible for inspection at each Competition event.
- C11. Only the 9 volt power supply included with the kit should be used to power the transmit box. If you experience any problems with the 9 volt power supply, contact U.S. FIRST for a replacement. Use of an alternate power supply could damage the transmit box or RNET and is therefore prohibited.
- C12. Do not connect power or any other signals to the switch inputs (P1, P2) on the relay board.
- K1. Each machine must be constructed exclusively from materials provided in the Kit of Parts ("the kit") supplied by U.S. FIRST, with the following additions and exceptions:
- 2' x 4' x 1" ROHACELL™ structural foam shipped to each team from the U.S. FIRST.
 - Material available from outside sources, as explained below:

Additional Hardware

A specific list of materials and quantities is provided with the List of Components.

Small Parts, Inc. Catalog

Each team receives an account with a \$425 credit balance which will be debited for the actual purchases you make. You may go beyond this dollar limitation for prototyping or to purchase spare parts, but your team is responsible for paying the balance on the account. See Rule K3 and the Appendix for more details on accounting and ordering.

Up to \$425 worth of materials purchased from Small Parts, Inc. may appear on your final machine. You may use any component from the Small Parts catalog up to the \$425 limitation.

Fasteners (rivets, screws, welds, nails, cable ties, etc.), washers, and adhesives are not included in your \$425 limit on Small Parts Inc. equipment on your machine if used as fasteners.

It has been brought to our attention that the actual prices of components purchased from Small Parts, Inc. may not match the prices printed in the catalog. Please use the catalog prices when calculating the cost of machine components from SPI for compliance with the \$425 limit.

If you use only a portion of what you buy from Small Parts, you may prorate the dollar amount used to the smallest quantity listed for purchase in the catalog. For example, if you buy 5' of rod which could have been purchased by the foot, but end up using only 6", you may calculate the amount used as the purchase price for one foot.

- Fasteners, washers and adhesives from outside the kit may be used for joining and fastening purposes only.
 - Adhesive tape may be used only as an electrical insulator.
 - Lubricants may be used only to reduce friction within your own device.
 - The kit container, part packaging, and any documentation in the kit container may not be used to build the device.
 - Teams may purchase as much shrink wrap tubing of any diameter as they wish. However, shrink wrap must be used for electrical insulation only. It may not be used as a fastener.
- K2. Many of the materials in the kit are raw materials. They are intended to be used for manufacturing structural or mechanical parts for your machine.
- K3. There is no restriction on the total amount of sprockets/pulleys and chain/belt on your machine, whether bought or machined from official Kit parts. However, there is a restriction on the amount which can be obtained from outside sources—see the *Additional Hardware List* and *Rule K4* for an explanation.
- K4. Due to the high power output of the drill motors, each team may purchase from a source outside of the Official Kit of Parts (such as a bike shop or hardware store) additional sprockets (not gears) and/or pulleys and additional chain and/or belt, with the following conditions:
- On your final machine, you may use no more than a combined total of 4 sprockets and/or pulleys from outside sources.
 - On your final machine, you may use no more than a combined total of 10' of chain and/or belt from outside sources. There are no restrictions regarding pitch or width of chain and/or belt. However, you may not purchase a wide belt, slice it lengthwise, and use more than a 10' length in the final machine.

- These components must be "commercially available," strictly *off-the-shelf* only. No custom or special orders.
 - These components must be used in a power train. Power train is defined as components transmitting mechanical power to any of the vehicles' mechanisms, including propulsion, arms, projectiles, etc.
- K5. Gears (not sprockets) may be obtained only by machining them from official Kit parts or by purchasing them from Small Parts.
- K6. You may purchase one of the types of wood listed on the *Additional Hardware List*, in a 1/2" thickness with a total area of 4' x 4'. In addition, you may use any or all of the wood samples provided in the kit.
- K7. Fasteners may not be used as structural members or power transmission components except as pins in a linkage or as hinge pins.
- K8. Net material is allowed; however, if it is used to entangle opponents' machines, the referees may disallow it.
- K9. You may only use "off-the-shelf" springs, such as compression, tension, torsion, constant force; spring washers; and, the latex tubing provided in the kit. Springs in addition to those provided in the kit may be purchased only from Small Parts, Inc. You may not fabricate your own.
- K10. Pipe fittings (tees, reducers, elbows, and angles) may be purchased only to join pipe and may be used without limit in linking sections of these materials. Endcaps may also be used.
- K11. A limited number of replacement parts will be made available by U.S. FIRST upon justified request. Otherwise, lost or damaged kit materials may be replaced only with identical components of the same material, dimensions and treatment at the team's cost.
- K12. Materials in the kit may not be changed chemically with the following exceptions:
- rope ends may be singed to prevent loose ends or to bind them together
 - resin and hardener may be mixed to produce epoxy.
- K13. The balls provided in the kit may not be used during any Competition event.
- K14. All unused parts and materials must be returned to U.S. FIRST for proper recycling.
- K15. The control system is the property of U.S. FIRST and certain components must be returned at the conclusion of the competition. The control system is not for sale. Teams wishing to borrow the control system for a limited amount of time after the competition may do so by following the procedures outlined in Section 5.5. For teams that wish to operate their machines after this period, U.S. FIRST can provide basic instructions on how to refit the machines to use off-the-shelf remote control systems.