

APPENDIX A - COMPLETE LIST OF RULES

P Game Rules of Play

- P1. Prior to the start of each match, teams will be assigned a color: Red, White, or Blue. This color will be used to determine the placement of the robot, human player, and drivers & coaches around the playing field. Figures 1.1 & 1.2 show the color-based layout of the playing field.
- P2. During setup for each match, robots may be placed in any orientation within the designated starting area, but may not touch the central or rail portions of the goal or the field border.
- P3. 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 FIRST at each event and must be worn by these team members for field access.
- P4. The two drivers and the human player must be students from a pre-college team partner school.
- P5. During a match, the robots may only be operated by the drivers and/or by software running in the on-board control system.
- P6. The drivers and coaches must remain at the driver stations during the match, and may not reach over the playing field or player stations.
- P7. Human players must remain at the player stations during a match, and may not reach over the playing field or team operator areas. No part of a player's body may extend past the rail that divides the field from the interaction zone.
- P8. Inside the player station, adjacent to the playing field, is a three foot interaction zone. Although this is part of the player station, players may not apply weight (stand, sit, kneel, etc.) to this portion of the player station during a match. Reaching and/or leaning over the interaction zone, such as to grab or throw balls, is OK. See V13 for the penalties imposed for a player encroaching into the interaction zone.
- The interaction zone is intended as a safety feature to help prevent potentially dangerous contact between robots and humans. Please exercise caution when reaching into the interaction zone.**
- P9. Robots are allowed to extend into the player station interaction zone. Incidental contact within the interaction zone is acceptable
- P10. No robot will be allowed to steal balls from an opponents player station.
- P11. 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 or being pushed out of the boundaries, will be returned to the playing field near the player's station without undue delay.

- P12. A human player may retain a maximum of 3 balls at any one time within the player station. This includes opponent team balls as well as their own.
- P13. Human players may use only their bodies to interact with the balls. Special clothing and/or equipment will only be allowed for those who demonstrate a need based on a physical disability.
- P14. Each team will start with 3 balls in the interaction zone at their player station, and 6 balls on the playing field. The playing field balls will be arranged as shown in Figures 1.1 & 1.2.
- P15. Each match will last for two minutes. It will begin when the control system is enabled and end when it is disabled, unless the match is whistled dead by the referees.
- P16. Occasionally rematches will be run should the following Control System components or other specified items supplied by FIRST be found defective:
- 1.) Transmitter
 - 2.) Receiver
 - 3.) 12 Volt Battery
 - 4.) Antennas
 - 5.) RNet
 - 6.) Data cable for Transmitting RNet
 - 7.) 9 volt DC Power Supply or associated field wiring
 - 8.) Failures in the playing field
 - 9.) Antenna cables
 - 10.) Data cable for Receiving RNet
- Teams must notify head referee they may call for a rematch prior to exiting the field
 - Teams will have 15 minutes after their match to request the head referee to schedule a rematch
 - Blown fuses will not constitute a reason for a rematch
- P17. During The Competition, teams will be notified of their field positions at least 2 minutes prior to the start of their match.
- P18. Teams will be allowed a maximum of 1 minute to set up their robots on the field and a maximum of 1 minute to remove all robot parts from the playing field following a match.
- P19. Teams will be allowed at least 4 minutes before their next scheduled match.
- P20. From the beginning of the double elimination rounds through all finals rounds teams may call time outs but they must be in 1 minute increments. The cumulative time-outs for all competing teams in a round may not exceed 5 minutes. No time-outs are allowed once play has begun.
- P21. It is acceptable for a robot to block the goal to prevent another team from scoring.

- P21. If a team is not ready to setup their robot on the field, and the 2 minute notification period is about to expire, and they do not wish to forfeit the match, then they must inform the head referee that they are invoking a time-out.

V Game Violations

- V1. Referees have ultimate authority during The Competition--their rulings are final. No recorded replays of the incident will be reviewed by the referees.
- V2. If a team is disqualified by a referee, their robot is turned off for the remainder of the match, the human player must cease interacting with balls at the player station, and any points scored during that match will be forfeited.
- V3. If a robot is disabled by a referee, the robot is turned off for the remainder of the match, and any points scored during that match will count. The human player may continue to interact with balls at the player station.
- V4. A team may not win a match through an advantage gained by breaking a rule, even accidentally.
- V5. Strategies aimed solely at the destruction, damage, tipping over, or entanglement of opponents' robots are not in the spirit of The Competition and will not be allowed. Accidental tipping over an opponent's robot is not considered damaging and will be allowed at the discretion of the referees. Intentional stabbing, cutting, etc., is illegal. If a breach of this rule occurs the contestant's control system may be disabled by the referees.
- V6. Robot shoving will be allowed and is expected to be quite common. It is very common for machines to run into each other at full speed and get into shoving matches, and for arms and various other mechanisms to experience the resultant forces. This should be taken into consideration when robots are designed and built.
- V7. If one team intentionally damages another team's robot, it will result in disqualification. However, if the damaged team's robot is considered too flimsy to begin with, the other team may not be disqualified. The ultimate determination will be with the referees.
- V8. Deliberately damaging the playing field, controls, or balls (using spiked wheels, for example) is strictly illegal and will result in disqualification. Modification of the robot wheels to gain traction will not be allowed if this would damage the field carpet. Rounded screw heads implanted in rubber wheels may be OK but not screw points. This will be checked during robot inspection at registration on the first event day.
- V9. If a robot damages the playing field, barriers, balls, or another robot, even inadvertently, and the referees feel that further damage is likely to occur,

- V9. If a robot damages the playing field, barriers, balls, or another robot, even inadvertently, and the referees feel that further damage is likely to occur, the referees may decide that corrective measures (such as eliminating a sharp edge) are required to allow the robot to continue competing. The robot will not be allowed to compete until corrective action is approved by the head referee.
- V10. A robot may not contaminate the playing field, balls, goal, or another robot with lubricants. If so, the robot will not be allowed to compete, until corrective action and approval is given by the head referee.
- V11. After a match, team members are not allowed on the playing field until referees have completed the scoring procedure.
- V12. The outer field barriers are safety features of the playing field. Robots should not be designed to react against them. Incidental contact with the barriers is acceptable. Pushing a ball against a barrier to allow pickup of the ball or passage of the ball to the human player under the barrier in front of the player station is acceptable if the forces applied are not sufficient to damage the barrier or otherwise deform the playing field.
- V13. A player must remain in the player station zone during play. It is acceptable for a player to reach over the Interaction Zone. If a player applies weight to the interaction zone, referees will use a progressive scale of penalties depending on the effect of the infraction (see below). If a player steps out of the player station for reasons of personal safety, no penalty will be imposed. If a player inadvertently steps over the line, and it does not affect the outcome of the match, then they will receive a minor penalty. If stepping over the line affects the outcome of the match, such as when throwing a ball that scores or otherwise affects the outcome, then the team will be disqualified. Repeated minor infractions will result in increasingly severe penalties. Penalties will be indicated by Referees throwing down flags color coded to the team receiving the penalty. See rule P8.
- Minor Penalty #1: Warning
 - Minor Penalty #2: Lose 1 point (prior to doubling)
 - Minor Penalty #3: Lose additional 2 points (prior to doubling)
 - Minor Penalty #4: Lose additional 4 points (prior to doubling)
 - Minor Penalty #5/Major penalty: Disqualification
- V14. Robots which become entangled in the barriers or goal will not be freed until after the match has finished, unless the entanglement represents a safety hazard.
- V15. For safety reasons, no part of a robot may touch the human players. If this occurs due to an intentional act, the team causing the safety hazard will be disqualified. If this occurs by accident, the robot may be disabled if the referee judges the situation to be a safety hazard.

- V16. For safety reasons, no robot may launch a projectile of any sort, including balls, toward the player stations or driver stations, with the one exception noted below. If this occurs due to an intentional act, the team causing the safety hazard will be disqualified. If this occurs by accident, the robot causing the safety hazard will be disabled. The referees will decide whether the violation was intentional or an accident.
- It is acceptable for a robot to launch balls, but no other types of projectiles, toward the player station assigned to the same team as the robot.
- V17. Robot may not release any separate part of itself during a match. They must remain whole.
- V18. During a match, no team member may intentionally touch any robot, except for reasons of personal safety. If this happens, the team will be disqualified.
- V19. During a match, no driver or coach may intentionally touch a ball, except for reasons of personal safety. If this happens, the team will be disqualified.
- V20. If a robot goes out-of-bounds to the point that it has to apply force to any out-of-bounds surface to rejoin play, its control system will be disabled. A machine should not be designed to react with an out-of-bounds surface for any reason. Refer to Section 2 for playing field boundaries.
- V21. If one team moves another robot out-of-bounds, the robot out-of-bounds will be disabled for the remainder of the match.
- V22. A robot cannot inhibit the movement of another robot by pinning against a field border, goal, etc. for more than 10 seconds. The pinning robot will be told by the referee to release the robot and back away approximately 3 feet. If the referee determines this to be a regular intentional occurrence the violator will be disabled.
- V23. If a robot goes out-of-bounds and it is holding balls and is turned off, balls that are securely held by the robot will not be returned to the playing field. This is a practical matter designed to prevent damage to the robots and/or balls. If the balls are easily retrieved or fall from the robot to the floor, they will be returned to the playing field.
- V24. Balls which are knocked out-of-bounds will be placed back into play next to the field border near the exit point without undue delay. Balls returned to play will not be fed directly to a robot or human player.
- V25. Balls which are popped will be replaced without undue delay. If a ball pops while being held by a robot, the referees may opt to pause the match and place the replacement ball in the hold of the robot.
- V26. It is not the responsibility of the referees or field staff if they damage trapping devices while attempting to retrieve balls. Please design your robot so that balls may be retrieved quickly and easily after a match is over.

- V27. No remote communication devices, such as air phones, walkie-talkies, cellular phones, etc., may be used by team members at the playing field. These devices can cause interference of remote control signals and malfunction of robots. If such devices are used, a team will be disqualified from the that match and forfeit the next match. A remote camera is allowed if specific permission is granted by FIRST.
- V28. No team may build a device, even if it is from Kit parts, to hinder the operation of another team's control system. Disabling an opponent's control system is not in the spirit of the competition. That team will be disqualified
- V29. Any robot which causes a safety hazard during a match will be disabled.

SC Scoring

- SC1. Final scoring will begin when all balls launched before a round ends come to rest or upon a referees' decision. Team members will not be allowed onto the field until all scoring is complete.
- SC2. All decisions regarding scoring will be made by the referees.
- SC3. The winner of a match is the team with the highest score.
- SC4. Final Scoring.
1. Each ball placed on any rail goal will be worth points as follows. Balls placed on the outer third of the rail goal (closest to the field border) will be worth 3 points, on the inner third 2 points, and on the inner third (closest to the central goal) 1 point. A ball must be contacting both rails of a rail goal to be counted.
 2. Each ball in the central goal will double the points of the balls placed on the rail goals. A ball will be considered in the goal if the center plane of the ball is below the top edge of the goal and the center plane of the ball is within the outside edge of the goal.
 3. Balls placed in the central goal will count as doublers only and will not be counted as point balls.
- SC5. In the event of a tied score the following tie breaking conditions will be applied in the order below until the tie is broken:
1. The team with the least penalties or warnings during the match.
 2. The team with the greatest number of balls on the rail goals.
 3. The team with greatest number of balls in the highest scoring position (vertically) on any of the rail goals. When more than 1 team's ball is in this position, the next highest ball level will be the determining factor.
 4. The team with the most balls in the central goal.
 5. The team with the highest ball in the central goal.
 6. The team with the most opponent's balls in their player station.

S Safety Rules

- 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. Safety glasses must be worn by all team members in the driver stations during matches (drivers and coaches).
- S3. Human players must wear the provided safety helmets with face shields properly positioned during matches.
- S4. Safety glasses must be worn by team members when working on their robot in the pit area. They are also highly recommended if adjacent neighboring team(s) are working on their robot(s).
- S5. Any robot which causes a safety hazard during a match will be disabled.
- S6. If at any time the referees determine that a robot is likely to cause safety hazards in future matches, the robot must be modified to the referees' satisfaction or it will not be allowed to compete.
- S7. Balls are the only projectiles that may be launched.
- S8. Latex tubing may be used for the purpose of storing energy to launch balls so long as no more than the quantity provided in the Kit is used.
- S9. **Do not tamper with the power supply, batteries, chargers, speed controllers, 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, and lead to a safety hazard or damage to the robot.
- S10. Remove the battery from the robot while making adjustments to your robot. Due to the strength of the motors in the Kit, it is important to keep fingers away from the gears while your robot is connected to a power supply.
- S11. The battery can 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, fire, and/or permanent destruction of the batteries.

M Machine Design & Operation Rules

- M1. The energy used by the robots in The Competition must come solely from:
 - 1. Electrical energy derived from the onboard battery
 - 2. Storage achieved by deformation of springs or the latex tubing
 - 3. Compressed air (or vacuum) stored in the air accumulator (the accumulator may be charged prior to the start of a match, but only by the pump furnished in the Kit)
 - 4. A change in the altitude of the device's center of gravity.

M2. Robots must sit, unconstrained, inside a 36X30 " rectangular footprint and be no more than 48" high at the start of a match. The weight of the robot, including battery and control system, may not exceed 130.0 pounds.

Size \leq 36" long dimension x 30" short dimension x 48" high; Weight \leq 130.0 pounds

Tip: Keep in mind that these are maximum dimensions. It is recommended that robots be designed for slightly smaller dimensions and weights in order to allow a degree of tolerance for oversized/overweight mechanisms and differences in measurement between the team and the official inspection. Many teams have discovered the hard way that reducing size and weight while preserving functionality is no easy task after the robot has been constructed.

Also, many shippers such as UPS will not ship packages as large as a full robot. Many teams have found it helpful to make ease of disassembly and reassembly one of their design goals.

- M3. All robots will be inspected, and weighed and measured during the practice day at each Competition event. The robot must pass inspection before competing in any seeding or elimination match. Teams may be re-inspected anytime during an event at FIRST's discretion. If modifications to your robot are necessary to meet the above requirements, they must be completed before seeding matches begin. If a team wishes to have their robot re-inspected to insure rules compliance, they may ask FIRST officials to do so. If Team A suspects Team B of a violation, Team A may approach FIRST officials and ask them to take another look at the Team B's robot. This is an area where "Gracious Professionalism" is very important.
- M4. **Teams are expected to design and build robots to withstand vigorous amounts of interaction with other robots.** (See also rules V6-V8.)
- M5. Until the controls are enabled at the beginning of each match, robots and any appendages, or extensions must remain unconstrained within the 36"x30"x48" starting size. Once a match begins, robots may extend beyond that limit under their own power.
- M6. Robots must be designed to operate by reacting against the surface of the playing field, the innermost face of the 4x6 field border, the goal, the balls, the other robots, and the air. Robots should not be designed to react off of the top face of the border. If your robot inadvertently drives on the top of the 4x6 field border, you won't be penalized unless the playing field is damaged. (See Section 2.2 for Field Diagrams.)
- M7. **Robots must display their team company and school names and/or logos. The judges, referees, and announcers must be able to easily identify them by name. In addition, team numbers must be displayed on at least two opposite sides (180 degrees apart) of the robot. Numbers should be at least 5 inches high and clearly visible from a distance of not less than 50 feet.**

- M8. "Non-functional" decorations may be added to machines under the following conditions:
- Decorations must not cause the weight or initial size requirements for the robot to be exceeded.
 - Decorations must not affect the outcome of the match. For example, flashing lights are OK as long as they do not blind opponents.
 - Any decorations which involve broadcasting a signal to/from the robot, such as remote cameras, must be cleared with FIRST prior to use.
 - Decorations may draw power from the control system (batteries or relay outputs) as long as they do not affect the operation of other control system components.
 - Non-functional decorations do not count against the \$425 limit or Additional Hardware List.
 - Decals
- M8. Robots must be designed to be operated by the wireless programmable control system.
- M9. Gaining traction by using adhesives or by damaging the surface of the playing field or the balls is not allowed. (*See also Rules V9-10.*)
- M10. During any Competition event, any mechanism which will alter the operation of the robot may not be added or removed after the first match of the seeding rounds unless mandated by the judges for rule compliance reasons. However, mechanisms existing on the robot may be reconfigured between matches. Also, the control system may be reprogrammed as described in the control system rules between matches.
- M11. No substitute robots are permitted; however, functionally identical replacement parts are allowed.
- 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 defined 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.

C Control System Rules

C1. The control system is provided to allow wireless control of the robots. The Transmitter, Receiver, servos, speed controllers, RNet, antennas, batteries, battery chargers, power supply, data cables, circuit breakers, fuse, and joysticks may not be tampered with, modified, adjusted or marked in any way, with the following exceptions:

- The dip switches on the Transmitter and Receiver may be set for custom operation.
- The user programmable code in the Receiver may be customized.
- The speed controllers may be calibrated as described in Owner's Manual.
- The connectors on the ends of the 12 AWG PWM wires on speed controllers must be removed. Do not remove the connector on the 24 AWG, 3 wire PWM cable.
- Cut the red 24 AWG wire and insulate both resulting cut wire ends. This must be done to assure trouble free operation.

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. FIRST will re-uses many of these components, and these items can be difficult to remove. Instead, use clamps, straps, or existing holes for mounting. The only exceptions to this rule are:

- Tape may be used to secure the position of the trimmers on the Joysticks in order to prevent accidental changes in calibration.
- Stick-on hook & loop fasteners may be used to attach the speed controllers and RNet.
- Position the RNet so that it is easily accessible and can be swapped in and out. This will be done during competition during set up when there is limited time available.

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 potentiometers and to enclose the associated wiring. You may modify the project box in any manner to accommodate your needs.

- C4. Only the wire supplied in the Kit may be used to conduct electricity. Additional wire is not permitted.
- C5. Electrical devices may only be wired as described in Section 4. Other important facts are also listed here.
- C6. The 10 gauge wire must be used for connections from the battery to the speed controllers, from the speed controllers to any motors, and from the battery to the Receiver.
- C7. The 16 gauge jacketed cable must be used for any device connected to a relay output.
- C8. The 24 gauge wire may only be used for connecting sensors (limit switches, reed switches, rocker switches, air pressure switches, potentiometers, optical sensors) to inputs or for extending the PWM cables.
- C9. **Relay outputs may not power more than one device per output.** (The double-solenoid valve is considered one device, because the diodes may be used to route power to only one solenoid at a time.)
- C10. **Only the Receiver, speed controllers, optical sensor, and muffin fan may be connected directly to the fused battery outputs.**
- C11. The drill motors and van door motors may be powered only by the speed controllers.
Do not connect the drill motors or van door motors to the relay outputs.
- C12. No more than one drill motor or van door motors may be powered by each speed controller.
- C13. The seat motors and tape drives may be powered by the speed controllers or the relay outputs. A maximum of two seat and/or tape drive motors may be powered by each speed controller.
- C14. Two 0.1 μ F capacitors, included with each Tekin speed controller, must be installed on each drill motor connected to a speed controller, as described in the Owner's Manual.
- C15. One 30A circuit breaker (provided in the Kit) must be installed in series with each drill motor and each van door motor. The circuit breaker must be accessible for inspection at each Competition event.
- C16. The battery fuse (provided in the Kit) must be installed in series with the positive terminal of the battery, such that all battery output flows through this fuse before being distributed to the Receiver, speed controllers, fan, or optical sensors. This fuse must be accessible for inspection at each Competition event.
- C17. Only the 9 Vdc power supply included with the Kit may be used to power the Transmitter. Use of an alternate power supply could damage the Transmitter or RNet and is therefore prohibited.

- C18. Do not connect 12 Vdc power or ground wires to the relay outputs. Doing so will cause a short circuit and may damage the Receiver.
- C19. Do not connect 12 Vdc power, relay, speed controller, or PWM outputs to the sensor port on the Receiver. Power for sensors is available from the sensor port.
- C20. All sensors used on the robot must be connected directly to the sensor port on the Receiver, and may not be wired in series with the motors, pumps, or valves.
- C21. RNets may not be used in the Pit Area at any Competition event. A tether must be used for bench testing.
- C22. If the control system is damaged due to improper wiring or misuse, FIRST will charge for repair or replacement of the affected items. (*See Section 3.4 for details.*)
- C23. During the competition your robot may only be operated with a battery provided by FIRST.
- C24. When recharging Kit batteries you may only use the charger provided by FIRST.
- C25. **For safety reasons the battery fuse provided in the kit must be wired in series with the positive output terminal of the battery. No device may be connected between this fuse and the battery terminal.**
- C26. All wires distributing power with a constant polarity (i.e. not a relay or speed controller output) must be color coded as follows:
- Use Red 10 AWG, Red 24 AWG, or White 16 AWG wire for +12 Vdc.
 - Use Black 10 AWG, Black 24 AWG, or 16 AWG wire for Ground.
- C27. **Teams are responsible for any software bugs introduced into the Receiver's control program when using a custom program. If a software bug negatively impacts the performance of a robot during a competition match, it will not be grounds for a rematch or even a pause in the match.**
- C28. Position the Receiver within your robot so that the LED's may be seen during operation in a match. This will greatly facilitate analysis in case of problems and will be beneficial to you and field personnel during the Competition.
- C29. Position the 12 Vdc battery within your robot so that it is accessible and may be easily changed out between matches.

K Kit Materials Usage & Limitations

- K1. Each robot must be constructed exclusively from materials provided in the Kit of Parts ("the Kit") supplied by FIRST, with the following additions and exceptions:

- Material available from outside sources, as explained below.
- Material satisfying the unlimited quantity criteria, as explained below.
- The Kit containers, part packaging, and any documentation in the Kit container may not be used to build the device.
- Adhesive tape may not be used except as an electrical insulator.
- Lubricants may not be used except to reduce friction within your own robot.

Outside Sources - 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 Appendix D for more details on accounting and ordering.

Up to \$425 worth of materials purchased from Small Parts, Inc. (SPI) may appear on your final robot. Items which appear below in the unlimited quantity category do not count against the \$425 limit when used as described. When your robot is inspected at a competition, you will be asked to verify that you have not used more than \$425 worth of materials on your robot. Be prepared to show documentation to support this requirement, e.g. a bill of materials and purchase prices.

It has been brought to our attention in the event 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 robot 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.

Outside Sources - Additional Hardware List

Materials on the Additional Hardware List may be obtained from any supplier, but in limited quantity. A specific list of materials and maximum quantities/dimensions is provided in Section 3.3. Cost is not considered.

If an item on the Additional Hardware List is available from Small Parts, Inc., then it may be purchased from SPI without being counted against the \$425 limit on materials purchased from SPI. However, any amount of the item purchased from SPI above and beyond the quantity allowed in the Additional Hardware List will count against the \$425 limit on SPI parts used on the robot. Obviously, any item purchased from SPI will count against your credit limit, regardless of whether or not it is listed in the Additional Hardware List.

Unlimited Quantity Items

The following items may be used in unlimited quantity subject to the following criteria. (See rule K9)

- Fasteners, washers, nuts and adhesives -- if used only for joining and fastening purposes. These items are not to be used to fabricate a structure or device that is not the item's normal function (with the exception of the next stated criteria).
- Pins in a linkage or hinge.
- Crimp-on spade connectors -- if used to conduct electricity, used with the proper gauge wire, crimped properly, and fully insulated, such as the spade connectors provided in the Kits. Other types of crimp-on connectors are not allowed.
- Adhesive tape -- if used as an electrical insulator.
- Lubricants -- if used to reduce friction within your own device.
- Teflon tape -- if used around the threads of pneumatic fittings to prevent leaks.
- Shrink wrap tubing of any diameter -- if used for electrical insulation.
- Pipe fittings (tees, reducers, elbows, and angles) -- if used to join sections of pipe
- Endcaps -- if used to cap pipe.
- Pipe flanges -- if used on the ends of pipe.

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 robot.

K3. There is no restriction on the total quantity of sprockets/pulleys and chain/belt that can appear on your robot. However, there is a restriction on the amount which can be obtained from outside sources other than SPI. (See the *Additional Hardware List and Rule K4* .) Any quantity above the amount listed on the Additional Hardware List must therefore be purchased from SPI, or manufactured from raw materials available from either the Kit, the Additional Hardware List, or SPI.

K4. As denoted in the Additional Hardware List, each team may purchase from an outside source sprockets (not gears) and/or pulleys and additional chain and/or belt, with the following conditions:

- On your final robot, you may use no more than a combined total of 4 purchased sprockets and/or pulleys from outside sources other than SPI.
- On your final robot, you may use no more than a combined total of 12' of chain and/or belt from outside sources other than SPI. 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 12' length in the final robot.

- These components must be "commercially available," strictly *off-the-shelf* only. No custom or special orders. Within the SPI catalog there are custom lengths of a specific cross section item available for standard parts with special orders. These items may be ordered and are considered *off-the-shelf*. Unless the catalog specifically mentions sizes other than those listed for a given part are available, do not special order parts via SPI. One of the reasons for using the SPI catalog is to insure all teams have equal access to parts. Allowing a team to use a part others did not know was available would be unfair.
 - A double-sprocket or double-pulley assembly counts as two sprockets or pulleys, respectively.
- K5. Gears (not sprockets) must be purchased from SPI, or manufactured from raw materials available from either the Kit, the Additional Hardware List, or SPI.
- K6. The dimensions for sheets and boards listed in the Additional Hardware List represent the maximum length and maximum width which may be purchased, not the total area. The thickness represents a fixed quantity, not a maximum.
- K7. The dimensions for rods and shafts listed in the Additional Hardware List represent the maximum length that may be purchased for a given diameter of rod/shaft.
- K8. You may purchase only either 1/2" plywood or 7/16" chipboard listed in the Additional Hardware List.
- K9. If any item listed as an Unlimited Quantity Item is used for a purpose other than its specified use, it must either:
- Be purchased from SPI against the \$425 limit
 - Be manufactured from raw materials available in the Kit or the Additional Hardware List or SPI.
- K10. Items which present a risk of entanglement may be disallowed by the referees.
- K11. For safety reasons, you may not fabricate your own springs. However, it is acceptable to elastically deform and relax materials not designated as springs as long as the rate at which the energy is released does not exceed the rate at which the energy was stored. This is intended to allow reasonable use of the elastic properties of materials without creating unsafe conditions caused by sudden the release of stored energy in materials not designed to act as springs. Materials which are designated as springs include: All items listed in the Springs section of the Kit List, and compression, tension, torsion, constant force, Latex tubing, and washer springs available from Small Parts, Inc. You may not modify a pneumatic actuator in any way to use it as a spring.

- K12. A limited number of replacement parts will be made available by FIRST upon justified request. Otherwise, lost or damaged Kit materials may be replaced only with identical components of the same material, dimensions and treatment.
- K13. Materials in the Kit may not be changed chemically with the following exceptions:
- Resin and hardener may be mixed to produce epoxy.
- K14. The mailing tube provided in the Kit are considered packaging material and may not be used during any Competition event.
- K15. The control system is the property of 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 5.11. For teams that wish to operate their robots after this period, FIRST can provide basic instructions on how to refit the robots to use off-the-shelf remote control systems.

F Notes on Playing Field Construction

- F1. All field dimensions listed in Section 2 are specified on the drawings provided with the 1998 Manual.
- F2. Balls will be inflated as specified on label with ball in kit.
- F3. The playing field carpet will rest directly on the floor or a protective floor covering except where otherwise noted.
- F4. The central goal will rest directly on the floor or a protective floor covering. The carpet will completely cover the circular disk which serves as a base for the central goal. The central goal will be attached to the disk by bolts that extend through bolt clearance holes in the carpet.