

# OCCRA 2013 RULES: “GRID LOCK”

## League Structure:

The League will consist of a series of four local competitions and a county championship tournament. The local competitions may be attended by any of the teams that wish to participate. Teams will be scheduled for a set number of matches at each of the competitions (usually 4 matches). In each of these matches, the teams will be randomly paired with an alliance partner who shares the points won. The alliances change with each seeding match. At the local tournaments, the team with the most points at the end of the seeding rounds wins the tournament. The points accumulated at the local events will be combined with the seeding points at the county championship for ranking in a double elimination tournament. Regardless of the number of matches played, a team's twelve (12) best matches will determine the seeding (ranking) for the championship elimination matches. At the county championship, the team with the most points at the end of the cumulative seeding rounds gets first choice of an alliance partner for the second phase: the double elimination tournament. Each team may participate in the double elimination tournament. The semifinals and finals will be the best two out of three matches to determine the 2013 Oakland County Competitive Robotics Association League Champions.

Once again for OCCRA in 2013: VEX robots will not compete in matches alongside big robots. There will be a separate OCCRA VEX Tournament played on December 1, 2013 using the official VEX rules for the 2013-14 game: “VEX Toss Up.” The rules for this game can be found on the VEX website:

[http://www.vexforum.com/wiki/index.php/Toss\\_Up](http://www.vexforum.com/wiki/index.php/Toss_Up) . This tournament will have a high school division that follows the same format of seeding, alliance selection and elimination matches that are used in the OCCRA tournaments for the large robots. There will also be a middle school division at the tournament that will follow the same game rules except teams in the alliance pairings will automatically be from the same school. There will be VEX inspections, technical assistance, and exhibition matches held at several of OCCRA's “big ‘bot” tournaments.

## General Game Rules:

### Definitions:

**ALLIANCE:** A pairing of two teams who act as partners during a match and share their match points.

**BONUS GOAL:** The place where a scored ball counts for 3 points each; it consists of a tall, stationary ball container (tower) located below a 16-inch opening in the backboard of an opponent's GRID GOAL.

**CELL:** one of the twenty-five 12-inch, square enclosures that comprise the GRID GOAL.

**CORNER PANEL:** A sloped, triangular wood panel mounted in the interior corner of the playing field.

**DESCORING:** Removing a ball from a goal during a match.

**GAME BALL:** an 8.5 -inch diameter “tennis ball” that can score point(s) if placed in a GRID GOAL or BONUS Goal.

**GOAL VIOLATION:** The positioning or contact by of some part of a robot on the GRID GOAL or BONUS GOAL structure (does not include incidental contact.)

**GOAL SCORING:** The positioning of a ball inside of one of the Bonus GOALS or CELLS so that the ball is supported off the ground by the goal structure and not held in place by a robot of the same color.

**GOALTENDING:** Blocking the opening of an opponent's goal.

**GRID GOAL:** One of the two goals, either red or blue, that consist of 25 scoring compartments arranged in a 5 by 5 square matrix, approximately 6' by 6' in size and at a 45 degree angle to the floor.

**GRIDLOCK:** Situation in which all of the CELLS in one of the GRID GOALS become filled with balls; three additional points will be added to the alliance's score.

**HANG BAR:** A 6' long horizontal bar mounted 30" above the floor on either side of the ramp along the center line of the field.

**HANGING BONUS:** A three-point bonus added to an alliance's score when a robot is totally supported by the HANG BAR and the entire robot is off the floor at the conclusion of a match.

**HEIGHT VIOLATION:** When a robot extends taller than 48" while on their alliance's side of the field. A 3-point penalty may be assessed.

**HOLD or HOLDING:** possession of a ball; holding occurs when the ball is off the carpet and at least partially supported by an HP or robot.

**HOLDING VIOLATION:** When a robot HOLDS more than 3 balls at a time; a 3-point penalty may be assessed.

**HP:** the Human Player; the high school student who inbounds balls during the game.

**MATCH PERIOD:** a 120-second period for the robots during which human beings are in direct radio control of the robot actions.

**PINNING:** preventing a robot from moving; if pinning lasts for more than three (3) seconds, a penalty is called.

**PLACEBO:** a league-supplied substitute robot.

**RAMP:** The plywood 12' by 8' sloped surface in the middle of the field that provides a passageway between the two halves of the field.

**RED CARD/FLAG :** card or flag displayed by a referee that indicates a penalty is being called which involves points being deducted from the offending alliance's score.

**ROBOT COLOR:** Either red or blue, it designates the alliance pairings.

**SAFE ZONE:** Triangular area in front of the HP station where robots may be safely loaded.

**STARTING POSITION:** Designated location on the field where each robot must begin the match.

**TOWER:** The vertical column that houses the balls scored in the BONUS GOAL.

**YELLOW CARD/FLAG:** card or flag displayed by a referee; it indicates a warning to an alliance that an infraction is occurring which will result in a penalty being called unless the offending action ceases.

**GR1 General Team and Match Structure:** Two alliances will play at a time on the court and there will be two teams in each alliance during the seeding matches. Specific locations for the players' stations, field structures and robots are shown in Appendix D. All teams must be staged and waiting so there are no delays in the start of matches. **Teams that have not checked in at the tournament by the end of the inspection period will not be allowed to participate at that tournament.** Teams not ready at the time the match is set to start will not be allowed to play. The remaining team in the alliance will play alone for that match or with the help of a league-supplied substitute robot (the "Placebo"). Each team in the alliance must be comprised of high school students and may consist of a maximum of four members: two 'bot drivers, a human player (HP), and a student coach. These students are the only ones allowed on the playing field or in the staging area.

**GR2 Game Objectives:** The object of the game is to use the robots to score the most points by suspending from the HANG BAR and/or placing balls into the GRID GOAL or BONUS GOAL of the correct color. Scoring occurs at the end of the match. The combination of these three scores, plus any penalties or bonuses, determines the alliances' match scores.

**GR3 Operating Period:** A MATCH PERIOD consists of a single, two-minute operating period of time during which robots will be radio-controlled by the driver(s) via radio signals.

**GR4 Game Pieces:** This year's game pieces are 8.5-inch inflated balls that look like tennis balls; they will be inflated to a 26.7" circumference, plus or minus 1" on the circumference.

Three GAME BALLS are placed alongside or onboard each of the robots at the start of the match. (See the Field Diagram in Appendix D). The human players (HPs) will each have twelve GAME BALLS in a tub in their HP zone at the start of the match; these may be loaded by HPs into their alliance's robots.

**GR5 Game Structures:** Two GRID GOALS (See the Field Diagrams in Appendices DE, and F) will be used. These goals will be stationary structures positioned outside of the playing field along the perimeter walls, one at each end of the field. These GRID GOALS will be color-coded (red or blue) and each will consist of 25 scoring compartments arranged in a 5 by 5 square matrix, approximately 6' by 6' in size and at a 30 degree angle to the floor.

Attached to each color-coded GRID GOALS will be a backboard. The backboard surface will be positioned vertical relative to the field. This backboard contains the BONUS GOAL of the opposing alliance's color. A 16" diameter hole in the center of the 2' by 6' backboard serves as the goal opening. Balls passing through the goal's opening will track down into a TOWER, where a maximum of 4 balls may be scored in a match.

Robots may not attach to any field structures (i.e. goals and field border materials) throughout the match and may not touch the GRID GOAL or BONUS GOAL structures for positioning or scoring purposes. Intentional contact by some part of a robot on the GRID GOAL or BONUS GOAL structure will result in a RED CARD (or a red flag thrown) and a 3-point penalty for the offending alliance. Incidental contact with field structures is expected during game play and will not be penalized.

Sloped, triangular wood panel wedges are mounted in all four interior corners of the field. These triangular CORNER PANELS serve three purposes: they isolate the HPs from robot contact, their color indicates which alliance field it is (blue or red), and the panels help prevent balls from getting jammed in the corners. Robots may not drive up on these panels in an attempt to push balls to their HPs. This activity could cause a safety issue with robots contacting players.

**GR6 Human Players:** There are two Human Players (HPs) on each alliance: one for each corner of the main field. (See the Field Diagram in Appendix D) The HPs are each positioned in a 4' by 4' zone. Each HP starts the game with a GAME BALL in his/her possession (hands) and 11 additional GAME BALLS in a bin in their zone. Balls that leave the field of play will be returned to the nearest Human Player. All HPs will wear safety glasses.

**GR7 Human Player Actions:** The HP may serve as field coaches for their drive teams, may pass/load balls into an alliance robot that is anywhere in their SAFE ZONE (defined as some part of the chassis above the SAFE ZONE), and may pass balls to the other human player on their alliance. The HP must stay entirely within their own designated zones during the entire match. HPs may not throw balls outside of the safe zone—this includes throwing balls at: spectators, the opponents' HP, drivers, coaches, or robots. **HPs must use great caution when passing balls to their partner HP: If an HP throws a ball that hits a member of their opponent's drive team, a red flag will be thrown and three (3) points will be deducted from their alliance's score.**

HPs will each start the match with 12 GAME BALLS in their possession. HPs may maintain possession of balls by holding them, by placing them inside their storage bin, or by setting them on the floor within their 4' by 4' zone. If a ball leaves the zone or if an HP steps out of their zone while a ball is in their possession, the ball will be taken and returned to the field of play.

**Human players may not throw balls out onto the playing field; this includes the GOALS.** This also includes rolling or bouncing the balls with enough velocity to violate any of the game rules. Balls may be tossed out to an alliance robot, provided it is in the alliance's own SAFE ZONE. Likewise, human players may not shoot a ball into a GRID GOAL or a BONUS GOAL by deflecting it off of a robot since the aim and energy for scoring the ball is coming from the human player. A ball may be thrown into a storage area of a robot for subsequent scoring into the goal *by the robot*. If (in a referee's opinion) an HP is intentionally violating a rule, it is considered a FOUL; their alliance will be penalized. A red flag will be thrown and three (3) points will be deducted from their alliance's score.

HPs may not contact the robots or reach inside the field perimeter.

**GR8 Ball Scoring:** The scoring of any ball depends upon where it is located at the end of the match. All GAME BALLS scored in the GRID GOAL are worth one point each. Only one ball may score inside each of the 25 GRID GOAL CELLS (squares.) GAME BALLS that are put into the BONUS GOAL will score 3 points each. The maximum number of balls that can be scored in the BONUS GOAL is 4 per match.

Balls can be put into scoring position in goals **ONLY** by the action of a robot. How the robot gets the ball into the BONUS and GRID GOALS does not affect the value.

GRID GOAL balls must be fully within the one-foot square CELL formed by the wood sides of the goal to be counted as 1-point scored. For a BONUS BALL to be counted as a 3-point score, it must have passed through the opening in the BONUS GOAL and be fully within the TOWER. (Only the first 4 balls scored in the TOWER will count for bonus points.

The match will be scored within ten seconds after the conclusion of the match when almost all motion of robots and balls has stopped. Adjustments may be made after the match at the referees' discretion (penalties, mistakes, etc.) Balls that are being touched by a robot from an alliance cannot score for that alliance.

OCCRA officials will return balls that unintentionally go out of bounds to the Human Player nearest to where the ball went out.

**GR9 Hanging Bonus** : Robots that are suspended from one of the 6' long horizontal bars mounted 30" above the floor on either side of the ramp along the center line of the field will score a three-point bonus added to an alliance's score. To get the HANGING BONUS, a robot's weight must be supported by the HANG BAR and the entire robot must be off the floor at the conclusion of a match. If another robot is in contact with a hanging robot at the end of a match it will have no effect on the bonus score.

**GR10 Descoring Violations**: Robots are **not** allowed to remove an opponent's GAME BALLs from the GRID GOAL during a match. Violators will be shown a red card/flag and have a three (3) point penalty deduction, **plus the referees will return the ball(s) to the goal at the end of the match.**

**GR11 Starting Positions**: Each alliance must have their robots positioned with at least one point of their chassis touching the wall in front of one of their SAFE ZONES at the start of the match. One of the blue robots must be in its starting position before the red robots are placed into final position. The other blue alliance robot has the option to be positioned last.

**GR12 Match Scoring**: The score for each alliance is calculated by adding the alliance's GRID GOAL points at the end of the match, plus BONUS GOAL points, plus HANGING BONUS points, plus the GRIDLOCK BONUS, minus any penalty points that were assessed. Zero is the lowest possible match score (there will be no negative scores.)

The alliance with the highest amount of points is the winner. **The winners of the match will each receive 10 bonus points plus their match score.** The losing teams will receive only their match points.

**GR13 Match Ties**: In case of a tie during the seeding matches, each team competing receives five (5) bonus points. In case of a tie during the elimination matches, the match is replayed. In the event that neither alliance's robots move from the start position during a match, neither of the alliances gets declared the winner and none of the teams get bonus points.

**GR14 Tournament Tiebreakers**: At the end of each regional tournament, the team that has the greatest amount of tournament points is declared the winner of the competition. In case of a tie, the following tiebreakers apply:

1. The team with the most matches won
2. The team with the most matches won in head-to-head competition
3. The team with the highest score in a single match
4. The team with the next highest score in a single match, etc.

**GR15 Field Dimensions**: The playing field will be approximately 24' by 30'. (Consult the field layout diagrams in Appendix D and E).

**GR16 Field Safety and the SAFE ZONE**: All student human players, drivers and coaches must wear safety glasses at all times during a match. Everybody must wear safety glasses in the pits. Any behaviors that are deemed unsafe by OCCRA officials will need to be remedied immediately and may result in exclusion from the event.

A diagonal line that is two feet out from the CORNER PANEL in front of each of the Human Player stations marks the SAFE ZONE for robot loading. A robot may **not** contact an opponent's robot while it is in this zone since they may place the Human Player at risk. This is a safety issue and will be closely watched. The first violation will result in a warning (yellow flag) and repeated violations will result in a disqualification for the match.

**GR17 Restrictions on Robot Storage:** Robots may not HOLD more than 3 balls at a time. If a robot inadvertently takes possession of an additional ball(s), it must release within three seconds or be penalized three (3) points. A ball inadvertently thrown into an opponent's robot should be released as soon as possible but will not be held to the three-second requirement. When a violation is noticed by a referee, they will begin to count off three seconds of HOLD warning. If the offending robot has not expelled the extra ball(s) by the time the ref counts to three, a red card/flag (3-point penalty) will be assessed.

Robots may freely push or plow balls regardless of how many they are carrying.

**GR18 Robot Actions and Interaction:** Robots may push opponents' robots but may not grab, hold or attach to them. Robots may not attach to any part of the GRID GOAL or BONUS GOAL structures at any time and may not intentionally contact the goals.

Robot interaction is allowed and expected anywhere on the field. This includes pushing, shoving, bumping, blocking, setting "picks" and fighting for position. However, robot action/contact intended to disable or damage the opponent is forbidden.

Pinning a robot for more than three (3) seconds and preventing them from moving is not allowed. This is a judgment call made by the refs: they will begin to count off the three seconds the moment they are sure that a robot is being prevented from moving in all directions. It is not considered a pin if a robot still has a direction that it can move. A red card/flag will be issued and a three-point deduction will be made to the offending robot's alliance if the offending robot has not backed away by the time the ref finishes their count.

Entangling or latching on to an opponent is not allowed as it is considered to be a form of pinning. Robots may push an opponent's robot but may not latch on or pull an opponent's robot. Blocking a robot's path is allowed; this allows for the interaction that happens as this occurs. Open-field, high speed ramming is not allowed. It is up to the referees to make a judgment call regarding whether the ramming speed was justified. Which contact is allowable is left to the referee's discretion and is not debatable.

A robot may not intentionally flip an opponent's robot over since that would likely result in serious damage. However, if two robots are pushing each other or fighting for position and one of the robots happens to topple over, no penalty will be called provided the referees feel that there was no intent to cause harm.

Robots may not contact the floor outside of the playing field perimeter.

**GR19 Goaltending and Goal Intrusion:** A robot may **not** attempt to block an opponent from putting balls into a goal by obstructing the opening. These blocking or "goaltending" actions are illegal. Robots may not, detach any part of their structure for the purpose of covering a goal opening. No part of a robot may be positioned inside or above a goal. Some incidental GOAL INTRUSION is expected to occur in the act of defending but the referees will issue a red card/flag (3-point deduction) if a robot's goal intrusion appears to be deliberate or is likely to interfere with an opponent's scoring chances.

No part of a robot may extend higher than 48 inches above the floor while the robot is on its own side of the field (the side where their own drive team is located.) Referees may overlook brief incidental violations of this rule but only if they do not think it had any effect on scoring by the opposing alliance.

**GR20 The "Gridlock" Bonus:** If, at any time during a match, all of the CELLS of a GRID GOAL become filled with balls, the goal will be declared "GRIDLOCKED"; the **first** alliance to achieve the "GRIDLOCK" will earn an additional 3 point bonus at the end of the match.

**GR21 The PLACEBO Robot:** If a team is unable to field its robot for a match they will not score any points for that match and they should notify their partner immediately so that their partner may get assistance for the match with the help of a league-supplied substitute robot (a.k.a. the “placebo”). The league will attempt to keep this PLACEBO operational throughout the season but cannot guarantee its availability for all matches (since the PLACEBO sometimes breaks down, too!) If using the PLACEBO, the team without a working partner must provide the other HP and must supply the battery and drivers for the substitute robot.

If each alliance has a team that is unable to field a robot for a match, neither alliance gets to use the PLACEBO.

**GR22 Match Schedules:** Matches are determined by a “semi-random” match list that is determined before each competition. A random number generator determines the order with alterations made to avoid back-to-back matches and other undesirable situations. Each team will be scheduled for the same number of matches at each tournament. Every team will not get to play every other team. If time constraints prevent every team from playing the same number of matches at an event, the average seeding score will be used to establish the final standings.

**GR23 Warnings and Penalties:** Referees may issue warnings of rule infractions to teams; if issued a warning, the teams are expected to stop the infraction or face possible power loss and/or disqualification. A yellow flag/card waved by a referee indicates that an official warning has been given to a team. A red flag/card waved by a referee indicates that an official penalty has been given to a team and their match score will be reduced by the 3 penalty points. An orange flag will be thrown to indicate that a team has been disqualified. Teams that get disqualified will not receive any points for that match, but their alliance partner may still earn points.

**GR24 Time Outs:** Alliances may not call time outs during seeding or local tournament matches. Each alliance will be allowed a single five (5) minute time out in the double elimination tournament at the county championships. This time out may not be divided into smaller segments for later use. The five-minute time out guarantees an alliance five minutes of extra time to ready their robots for competition. After the five minutes has elapsed, the teams should be ready to compete. The head referee may use his/her discretion to allow additional time if the referee feels that the team is almost ready to compete. If the referee does not feel that the team is very close to being ready, the referee will run the match without the robot(s) that are not ready. This is a judgment call by the referee and his/her decision is final. We hate to see a team unable to participate but we must keep the event moving at a reasonable pace for the sake of the spectators. Points do not automatically get awarded to an alliance if one of the robots from the opposing alliance is unable to take the field: the match still gets played.

**GR25 What You Don't Know CAN Hurt You!** It is each team's responsibility to read and review all rules and follow the clarifications and updates. This includes all requirements listed on the inspection sheets and rule updates that will be posted on the official web site ([www.chiefdelphi.com](http://www.chiefdelphi.com)) or passed out at the competitions. All disputes must be made to the referees at the time that they occur. The referees' decision is final. Any further disputes that may lead to future rule changes need to be made in writing to the board of directors for review. A written response will be made to all formal protests. The board/game & kit committee may modify the rules at any time. The rules however are not retroactive to any other competition or event. Be aware that these rules may be modified as needed to ensure fair, safe play for all teams. It is the responsibility of each team leader to see to it that their team members have read the rules regarding safety and robot building, and that all team members have agreed to abide by them.

**GR26 Safe Robot Transport:** Adults or other team members (non-drivers) may help students carry the robots onto and off of the field. Electrical power must be off on all robots while they are being transported. Robots using pneumatic power must have their pressure tanks empty while they are being transported and the 1/8<sup>th</sup> inch pneumatic line must be open downstream from the check valve (between the tanks and the check valve that is on the compressor.) This is a safety matter: we do not want unexpected movements of the robots while they are being carried to and from the playing field. Teams need to release whatever pressure is still stored after each match and disconnect the same line as before while the machine is carried off the field and back to the pits.

## Robot Build Rules:

**RB1 Building Objective and Timeframe:** The object is to build a robot to play the described game using the kit of parts and additional allowed materials. Except for the kit chassis, the robots for the 2013 OCCRA competition must be built ***entirely*** during the period of time starting at Kickoff 2013 and ending at the 2013 county championships. No parts on a robot are allowed if they were fabricated before this time period unless they were supplied to all teams by OCCRA. Parts such as sprockets, wheels, kit material including motors and fasteners are intended to be re-used in the design and building process. Structural material may also be re-used to save expenses. The intention is to have the students design and build a new robot for the 2013 season. Teachers and sponsors may answer questions, give instruction on scientific principles, help build practice field pieces, give instruction in tool usage and safety...etc.: ***students must do the actual designing and building.***

**RB2 The Control Box:** The control box has been pre-wired for your convenience. Again for 2013, the VEX "Cortex" controller will be used. The control box stays the same as last year. You may not alter or remove the Cortex, fuse block, relays, speed controllers or fuses/circuit-breakers from the safety container. OCCRA officials must have **visual** access to the Cortex microcontroller. Designing the robot so that the refs can see the electronic status of each Cortex expedites troubleshooting and makes the match schedule go much more smoothly, so use the clear lids provided and make sure the top of the control box is exposed. The container must be securely mounted to your robot. Care must be taken so that fasteners do not interfere with the inner parts or wires that may cause a short circuit. The top of the controls container must be in position and secured when operating the robot. Teams that wish to buy a PWM splitter cable may do so according to the additional materials list. (This would allow a single control signal to run two Victors or two Spikes synchronously.)

**RB3 General Wiring:** Only the specified wire gauge and strand may be used. #14 wire is the minimum gauge that may be used on all "non-signal" wire runs **with three exceptions:** #6 gauge wire must be used between the battery and the positive and negative distribution strips, #16 wire may be used to carry current from the Spikes to the pneumatic solenoids, and #20 or #22 gauge may power the fans on the Victors (this is smaller wire that they come with from VEX.) Extreme caution should be exercised when wiring components. Having a wire go to ground causes your robot to be a giant toaster. This is very dangerous and may cause burns or fires. Batteries may explode under certain conditions. **Safety glasses are strongly encouraged in the entire build process.**

**RB4 Wiring Control Devices:** You may use any number of relays (Spikes) or speed controllers, but speed controllers must be Victors or Talons. A single (1) automotive OCCRA-supplied relay must run the compressor. The usage of each is outlined in the curriculum materials provided. All wires routed from the motors and actuators must be secured to the strain relief bolt on the side of the control box before they enter the box and are attached to the Spikes and speed controllers. (This protects the connections inside the box from traumatic forces.) **Note: the CIM motors, the Dewalt drill motor, the BAG motor, and the Denso, Bosch or Valeo wiper motor and any other motor that draws more than 20A of current must each be run from a Victor or Talon, not a Spike.** Globe motors, Andymark Gearmotors and Keyang motors may be run by Spikes, Victors, or Talons.

**RB5 Electronic Modifications:** Teams are NOT allowed to modify or alter the joystick controllers, the control system, VEXnet keys, batteries, chargers, or motors in any way not specifically approved by OCCRA. If in doubt, please ask for a rules clarification.

**RB6 Physical Constraints:** Robot weight is limited to a maximum of 115 pounds, including the battery and all decorations. The entire robot must fit within a 28" by 38" footprint and be no more than 48" in height at the start of the match. Robots that are using a pneumatic system **with** compressor may weigh a maximum of 120 pounds. Robots that use pneumatics but do not have an on-board compressor are restricted to the 115 pound weight limit. Robot size may change after a match has started. No vertical perimeter surface of the robot may be at an angle of less than 60 degrees from the floor as this may cause other robots to be tipped over

(therefore, no “wedge” tipping devices are allowed). To protect the carpeting, **no part of the robot that is capable of snagging the carpet may be within one inch of the floor!**

**RB7 Material Sources:** All material on your robot must have either come from the supplied kit of materials or from the additional materials that are not on the exclusion list. Any single item that has a fair market retail value of over \$90 is not allowed.

Only professionally made pneumatic components, such as those included in the kit of materials, may be used to generate, store, or transmit compressed air or be powered by it. Any item or material whose sole purpose and function is to decorate or identify the robot may be used (subject to proof of NON-Function by the officials). All items must be “off-the-shelf” (available to all teams) and sold as an individual or quantity package. No special order items are allowed. Special order is defined as having an item custom made to your specifications. You may not use mechanisms or devices that are prohibited by this list, including those that have been removed from other machines and assembled products. (For example, you may not buy a riding mower so that you can use the wheels!)

**RB8 Building Constraints:** Precision machining is not allowed. This includes making parts out of raw stock with power tools that are not listed as allowed tools. Welding of any type is not allowed on any part used on the robot or the robot itself. Appendix A has the complete list of allowed tools: please check it before you begin fabrication! Team leaders are asked to make sure that all team members read and adhere to guidelines in Appendix B.

The Cortex controller should be run on the 7.2V battery supplied in the Kit of Materials (not the 12V power supply system that we have always used in OCCRA.) ***Servos may be powered directly from the Cortex if powered by 7.2 Volts but not if a 12 Volt supply is used.*** A 12-Volt supply cannot be used without the risk of damage to the servos. Teams wishing to use servos on the robot will need to use the 7.2V battery as their energy source for their Cortex.

**RB9 Safety First:** Safety is a major concern during the build phase and at the competitions. ***Safety glasses must be worn at appropriate times. This includes all people working in the pit area and the drive team and coaches when the match is being played. Each team will provide its own safety glasses. Individuals without safety glasses will NOT be allowed to compete.***

***The VEX 7.2 batteries should always be charged using the “Safe” setting on the VEX Smart Charger.***

**RB10 Operator Control Board:** Each team is to create an operator control station for their drive team. The 20” one-by-six pine board supplied in the Kit (or a comparable alternative) will serve as the support structure. Teams may use the same control board as last year, but **teams must have a control board to protect their joystick transmitters during transport to and from the field!** On the control board, teams must securely attach the two joystick controllers (Velcro is suggested for easy removal and reattachment) and the “VEX Competition Switch.” (Ironically, this switch will be used for controlling your robot at your school and while in the pits, but **not** during the actual matches of the competitions!) No tether will be needed to run your robot in the pits. The joystick controllers will be referred to as “A” and “B.” Joystick A will have the VEXNET USB 802.11g attached to its underside (to serve as modem/antenna) and will be attached to Joystick B via an RJ25 coiled cable.

**All control board components MUST be attached to the board securely.** Customization of the components is not allowed. Teams may replace the provided board with appropriate material (plastic, laminated wood, plywood...etc.) as long as the basic configuration remains. Wire traps, clips and holders may be added to secure the cables as needed and all parts must be securely attached to the board.

**RB11 Replacement for Kit Items:** Each team has been supplied with an additional VEX Joystick transmitter to serve as a spare. Teams need to contact VEX to get an RMA if one of their joysticks needs repairs by VEX. This should be done immediately upon discovery of a problem. The OCCRA league will not be able to replace damaged joysticks. If a second joystick gets damaged before the first one has been repaired, teams will need to borrow a spare from another team. Damaged Cortex microcontrollers must likewise be returned to VEX if

repairs are needed. Again, contact VEX and get an RMA before sending it in. OCCRA will stock a few “loaner” Cortex’s for teams awaiting repairs. If you damage other kit materials and need replacements, OCCRA will attempt to supply those replacements at cost. Each team automatically has a \$150 balance in their account at the start of the season (in other words, you can get \$150 worth of replacement parts before you start to owe any money). If you find that you are continually destroying the same part over and over again, you need to redesign your machine so that it stops happening!

**RB12 Flags and Team Numbers:** All robots must have their team flag (with the proper color) that contains their number correctly installed on a piece of ½” PVC pipe that extends upward from the robot at the highest stationary point and is clearly visible from all sides. Robots must also have a team number displayed that is written in digits that are at least 4 inches high and visible from at least 3 sides.

**RB13 Pre-inspection:** All robots must be Pre-Inspected using an OCCRA-supplied form before coming to the official inspection at the first event of the season. An adult mentor and at least one student team member must carry out this pre-inspection. The adult and student must certify with their signatures that all checklist items have been inspected for compliance. This form is required to be submitted at the Official check-in station (registration).

**RB14 Inspection:** Modifications to the robot may continue during the entire season so robots must pass inspection at each competition, prior to the robot’s first match. Inspectors will be looking for the following:

- Usage and routing of wires, including strain relief
- Installation of wire connectors (looking for bare or exposed wires)
- Location and fastening of control box
- Installation of fuses/circuit-breakers
- Location and fastening of battery
- Loose or dangling mechanisms
- Sharp objects that may damage the floor or other robots.
- Tire condition that may damage carpet or cut the floor.
- Modification of kit materials and parts (motors, pneumatics, control system...etc.) whose alteration is specifically prohibited by OCCRA
- Usage of additional materials not on the allowed list
- Usage of relief valve, regulator and pressure gage if pneumatic system is employed
- Overall safety
- Two-operator control
- Securing control system components

**RB15 Pneumatics:** All pneumatic components used in OCCRA must be professionally made and unaltered in any way that might compromise the integrity of the component. The only compressor allowed on a robot is either the Thomas compressor or the VIAIR 00090 compressor supplied in the kit, and the only tubing allowed is the 1/8” tubing supplied in the kit of materials. The pneumatic circuit must be controlled with a pressure switch and relay, and protected with a 120psi (or lower) relief valve, as described in the “How-To” manual. Teams may use pneumatic components that were not included in the kit of materials, provided they each cost less than \$90 and do not violate any other OCCRA rules. The pressure to all actuators must be controlled by regulator and may not exceed 60 psi. The gage on this regulator must be readily visible for ease of reading. For safety reasons, a valve to drain system pressure must be connected to the actuators and easily accessible.

**RB16 Electric Motors:** All 12V DC motors that are rated below 350 Watts and are available on-line from BaneBot, AndyMark and VEX are allowed in OCCRA for 2013. There are no restrictions on the quantity of any motor(s) but teams are encouraged to keep three other constraints in mind when designing their robots: (1) the maximum current used on a robot is limited to 80Amps by the main circuit-breaker, (2) there is a weight limit (either 115 or 120 pounds max.) placed on the robot, and (3) there are only 10 motor-control signal outputs on the Cortex. Also, teams are reminded that OCCRA will only stock reserve supplies of the motors that are provided in the Kit of Materials and will not be able to provide replacements for motors not found in the Kit of Materials. OCCRA provides an assortment of motors and transmissions that allow teams using the kit to build highly competitive robots.

## Events:

**E1 Electrical Availability and Safety:** At the events you will be designated a pit area for your team. There may not be electricity available within your pit area. Where electricity is available, teams must run their power lines using OCCRA-supplied cables and power-strips (it expedites the tear-down and clean-up at the end of tournaments if ALL cables and power-strips can be put in one storage bin!)

All batteries are your responsibility to keep charged. Bring fully charged batteries to the event. There will be a charging station available near your pit where you can plug in your charger and battery if needed. Please label your battery and charger with your school name and team #. ***The VEX 7.2 batteries should always be charged using the “Safe” setting on the VEX Smart Charger.***

**Safety glasses should always be worn when charging batteries and working on robots. All people in the pit area must also wear safety glasses!!!** Student drive team members will be required to wear safety glasses out on the field of competition.

To minimize the need for running electrical lines throughout the pit areas, the usage of portable power tools is encouraged. You should bring a box of tools and spare parts for your robot. The allowed tool list is in Appendix A.

**E2 Pit Etiquette:** The pits will be crowded and very busy. Please make an effort to reduce the pit personnel to only essential persons. There can be no horseplay or unsafe practices in the pit area. You are guests of a school so please be aware of your trash and the messes that you make. Teams are expected to leave the pit area clean at the end of the day. Use the provided trash containers. Food and drink is not allowed in most gym areas. Please respect the facilities.

**E3 Robot Debris:** Be aware of metal, wood or plastic shavings that fall to the floor while drilling, cutting or filing. These shavings could damage the floor or your robot (Always cover your control box while this kind of work is going on). Please watch damage to the floor by your hand tools and toolboxes.

**E4 Tardiness: Please arrive on time to the event: Teams that have not checked in at the tournament by the end of the inspection period will not be allowed to participate at that tournament. New this year: 2 students per team will begin the inspection of the robot during the field-building time while the rest of the team helps set-up the OCCRA fields.** In the event that the team vehicle has a flat tire, is stuck in traffic...etc. and the team cannot make it to the event before the end of the inspection period, the team leader must notify the Tournament Coordinator before the end of the inspection period so that they are scheduled for matches. Team leaders will be given the phone number of the Tournament Coordinator. OCCRA will not delay matches to wait for teams that are not ready. Teams not ready at the time the match is set to start will not be allowed to play. Your team will need a designated person to track your matches. If you miss a match it will not be made up and you lose an opportunity to score points.

**E5 Volunteers:** Each team that participates in a tournament is **required** to supply at least one person (parent, student, teacher, engineer...etc.) to serve as an impartial tournament worker; these people will wear the “OCCRA staff” shirts and will be unavailable to their teams for the entirety of the tournament.

**E6 Displays of Team Spirit:** School spirit and enthusiasm is encouraged at all times. School banners, signs, team shirts, hats, pompoms and noisemakers are all encouraged. Items that contact the bleachers or the floor to make noise are not allowed. Air horns can cause hearing damage and are not allowed. The use of tape on the walls to hang signs is also not allowed. Only rope type fasteners are allowed. **Individual teams may not display corporate names or logos on their robots, their team apparel, or anywhere at the events where an association with an individual school is apparent.**

**E7 Laser Pointers:** Lasers are distracting to the drivers and present a safety hazard. Use of these pointers may disqualify your team from competition.

**E8 Parking:** Park only in designated areas unless unloading the robot or tools. Do not park within 30 feet of the back of the OCCRA trailer: we need room to load and unload it!

**E9 Gracious Professionalism:** All members of all teams are reminded to exhibit gracious professionalism at all times. As Woodie Flowers has so often said: "Always act as though your grandmother is watching you!" Good sportsmanship and cooperation is *expected* of all OCCRA participants.

## **Fairness Guidelines:**

**FG1 Corporate Support:** All corporations that contribute human or financial resources to OCCRA in excess of 200 dollars are to be recognized by the league with a large banner at each event, by public address announcements at each event, by mentioning their help in all brochures and with a thank-you in all tournament programs. Individual teams, however, shall not display corporate names or logos on their robots, their team apparel, or anywhere at the events where an association with an individual school is apparent.

**FG2 Legal Tools:** All tools used in the construction of your robot must be found on the list of allowed tools (see Appendix A); these tools are available to all teams. These tools will be the *only* tools allowed in the fabrication and repair of robots during the season and at all events. Teams must attempt to secure all of the tools that they anticipate needing through their own resources (school funds, corporate loans, parent donations...etc.), but any team not able to afford some of the tools can make special arrangements with the League to obtain the tools they need.

**FG3 Student Designed and Built:** Students must do the physical construction of the robots. For example, adults may show students how to drill a hole on a piece of scrap metal so that they learn the correct techniques of center-punching and drilling, but *none* of the hundreds of holes on the finished robot may be drilled by adults. Any change to materials from their "legal stock form" is a fabrication and must be made by students. All team leaders will need to sign a form at each tournament to verify that the robot was designed and built by students. This form is a **required** part of the inspection process, the same as the safety check and weigh-in. There are four situations where a legal exemption to this rule may be made:

a) If an adult coach or sponsor does not want to have their students make cuts with an electric saw, that adult can make the cuts for the student. This exception is made for safety reasons: we still expect the student to measure and mark the material to be cut, fasten the cut material, etc.

b) If an adult is purchasing stock material for the team and needs to cut it down in size for ease in transporting it, this is allowed as long as students are making the finished cuts to size.

c) If an adult sees an immediate safety concern they should do whatever short-term action is needed to protect the students. For example, if a teacher sees that a student has shorted a wire and is about to turn the robot into a toaster, they do not have to get a student to change the wiring, they can jump right in and unhook it themselves. They should then explain the problem to the student(s) and instruct the students on the safe way to affect the wiring plan. Adults must not use an event like this as the open door to helping build the robot: students are to resume full ownership of the build once the safety crisis is resolved.

d) If repairs are needed at a tournament, there may be the need for adult intervention according to the provisions in FG4.

**FG4 Mentor Help with Repairs:** Repairs that need to be made at tournaments may, in some cases, be made with direct, "hands-on" adult involvement. Since broken robots need to be fixed under tight time constraints at tournaments, and since we want healthy machines and a successful experience for all students, there is a procedure by which adults may help students make timely repairs. A team experiencing a repair crisis should be able to approach an OCCRA Pit Official and request a waiver of the "100% student-built" rule provided these conditions are met:

a) The repair is not one that students on their own are likely to be able to fix before their robot's next match,

b) The repair is needed to rectify a damaged or nonfunctioning part of the robot, not simply to improve an existing design or gain some competitive advantage,

c) Students do as much of the repair as is possible, and

d) A Pit Official issues a temporary permit that must be clearly displayed in the team's pit while the repair is being made. No work on the robot can be done without a waiver permit being present.

**FG5 Student-Built Authentication:** All team members (students and adults) must read the official robot-building policy statement; the student captain and the adult team leader will be required to sign an "Authentication Document" that is to be submitted to the inspectors at the start of each tournament as part of the inspection process. In this document, the team leaders attest to the fact that the official rules of robot building were, to the best of their knowledge, followed in the construction of their team's machine.

**FG6 Sanctions:** If anyone on one of the teams is found to be in violation of any of the fairness rules by one of the OCCRA Officials, the team's leader and the Tournament Coordinator will be notified that the team is in violation of the fairness policy; the transgression will be explained to the team leader, the team will be placed "on warning", and the activity must immediately stop; a second (or continued) violation of the same policy at the tournament will, at the discretion of the Tournament Coordinator, result in the forfeiture of the team's next match, or other sanctions deemed appropriate.

**FG7 Technical Support:** A pool of technical support for the entire league is available so that all teams have access to the expertise of engineers, educators, designers, etc. during the OCCRA season. The expertise of these adults is available through an interactive OCCRA web site ([www.chiefdelphi.com](http://www.chiefdelphi.com)) monitored by knowledgeable adults, and through a mentorship program where site visits by experienced adults can be set up at the school of any team needing more involved support.

**FG8 The Adult Role:** Robots are to be made from student designs. Adults are permitted to do the following: coordinate the design process, facilitate the brainstorming process, help organize sub teams, teach relevant physics and programming concepts, answer student questions (other than "What should we do?"), discuss possible applications...etc., but they must not suggest or dictate to students how the robot is to be built. Adult supporters are to be mentors and resources, not designers. Should an adult see a *safety issue* with a student design they are allowed (encouraged!) to *intervene at any time* with their expertise to resolve the safety issue. If a mentoring adult sees students going down a design path that they know will result in failure and a significant waste of build-time, they may point out the problem that they see and explain the nature and cause of the problem. They should not just give the students the design solution. This will be a tricky area and is totally unenforceable, but we must ask all adults to exhibit gracious professionalism and abide by the spirit of the guidelines.

**FG9 The Design Review:** **Once each week, for one hour**, students and adult mentors may have a design review meeting during which students can present their designs, prototypes and fabrications for inspection by a panel of adults. During that time, students may ask directed questions to mentors about their designs. Adults may offer opinions, insights and critiques that are not allowed during the rest of the OCCRA build season. This design review clause is meant to provide a learning opportunity for students, not to give adults an open door to take over the design process. Students are not bound by any of the adults' suggestions, and **adult mentors must not insist that students act on any of the opinions, insights and critiques that are given**. Again, we ask all adults to exhibit gracious professionalism and abide by the spirit of the design review meeting. OCCRA will provide adult technical support for any team wishing help in assembling a design review panel.

**FG10: Alliance Selection:** A number of the top-seeded teams will not be allowed to select each other during the selection process at the county championship event. This number will be determined by a random process using the roll of an 8-sided die before the start of the elimination matches at the championships. The top team will toss the die and the number that comes up will determine the number of top teams that may **not** be selected as a partner. The following chart shows the restrictions:

Roll 1 = Pick #10 or lower

Roll 2 = Pick #9 or lower

Roll 3 = Pick #3 or lower

Roll 4 = Pick #4 or lower

Roll 5 = Pick #5 or lower

Roll 6 = Pick #6 or lower

Roll 7 = Pick #7 or lower

Roll 8 = Pick #8 or lower

For example, if a “7” is tossed, (which will happen 12.5% of the time), the top 6 teams may **not** be selected as an alliance partner since the choice must be from teams that seeded at #7 or lower. OCCRA has instituted this procedure to discourage teams from losing matches on purpose (in the hopes of getting a “better” partner in the alliance selection process.) When teams lose matches intentionally, it hurts the ranking of their alliance partner, makes the matches less exciting for the audience, and runs contrary to the ethic of “gracious professionalism” that we strive to maintain in OCCRA. The randomness of the toss is used by OCCRA to encourage fair play by all teams.

## **APPENDIX A**

### **OCCRA 2013: LIST OF ALLOWED TOOLS**

All teams will be limited to the standardized set of tools listed below for 2013; If you need a tool that is listed here and your team lacks the resources to get it on their own, let Mike McIntyre know at 248.209.2039.

- Any standard<sup>1</sup> screwdriver (Phillips, flathead, Torx-head...etc.)
- Any standard type of pliers (linesman, diagonal-cutting, slip-joint, long-nose, electrician's 6-in-1 tool, crimper...etc.)
- Chain breaker/chain puller, pry bar or press (must be manual)
- Any common type of hand saw<sup>2</sup> (hacksaw, coping saw, miter saw...etc.)
- Any common type of electric saw<sup>3</sup> (saber saws, jigsaws, bandsaw, circular saws...etc.)
- Any electric drill & bit set, including a drill press (but not precision machines like mills and lathes).
- Hole saw bits
- Rotary tool (Dremel-type) and the assorted bits they use
- Reamers and any type of standard deburring tool
- Any common type of wrench (hex, adjustable, box, socket wrench sets, torque wrench, vice-grips...etc.)
- Any standard type of hammer (carpenter, ball peen...etc.)
- Any type of punch (center punch, hole punch...etc.)
- Any common measuring tool (multimeter, ruler, level, feeler gauges, tape measure, caliper, square...etc.)
- Any standard vice or clamp
- Any standard kind of file (flat, half-round, rat-tail...etc.)
- Taps and dies
- Any common type of sander, chisel or grinder
- Soldering gun/iron (and solder) and propane torch
- Pop rivet tool, stapler and staple gun – manual, pneumatic, or electric
- Any standard type of scribe, razor or “Exacto/utility” knife
- Tin snips, scissors, sheet metal nibbler or sheet metal scissors
- Sewing machine
- Paper hole punch – Hand type
- Hairdryer/ hair blower or heat gun

<sup>1</sup> The terms “standard” and “common” refer to tools that are readily available in any normal hardware store. Our intent is not to force you to go out and buy new tools unnecessarily; for example, if you buy a wheel to use on your robot and it uses Torx-head screws, you will need to get a Torx-head screwdriver (or bit) or borrow ours; if nothing you are using has Torx-head screws on it, you obviously do not need a Torx-head screwdriver and do not need to borrow one of ours!

<sup>2</sup> Listing only certain kinds of handsaws may have presented a problem to teams that already had different kinds of handsaws. Once again, do not feel that you need to buy or borrow every type of handsaw that is

made. We offer these as examples of the common types of handsaws available: you need to make sure that you have something that can cut metal (bolts, angle aluminum...etc.) and nonmetals (wood, plastic...etc.)

<sup>3</sup> These are the most dangerous items on the list; we have been asked by a couple of teams to add them to the list, but we **strongly** urge all team leaders to closely watch all cutting while it's being done with electric saws. Even the cordless electric saws are dangerous if not used properly. This is the one area of robot building where adults are allowed to provide hands-on assistance: any adult who does not want their students using electric saws may make those cuts for them. Teams should rely on handsaws for the bulk of their cutting. ***Safety glasses need to be worn by all students using power tools and anybody else who is in the vicinity!***

There are no restrictions placed on miscellaneous materials that are used in the course of fabricating the robot but that do not alter or form the materials in any way. (For example: flashlights, marking pens, calculators, extension cords...etc.) There are no "precision-machining tools" on this list; the use of machines used in industry but not commonly found in high schools (such as mills, weld stations, lathes, laser-cutters...etc.) would create an unfair advantage for some teams and are expressly forbidden.

## **APPENDIX B**

### **OCCRA 2013: Additional Materials Restrictions**

- All motors supplied in the kit of parts are allowed plus all 12V DC motors that are rated below 350 Watts and are available on-line from BaneBot, AndyMark and VEX are allowed in OCCRA. These motors may be used in any number the team wants—there is no limit. Note: Electric servos, such as HD322 Hi-Tech Servo or equivalent (available from servohut.com and most hobby shops) are *not* classified as motors for OCCRA and may also be used in any number but will not be part of the Kit of Materials.
- All pneumatic components that are under \$90 are allowed, except any pneumatic tubing or compressor not supplied in the kit of parts is not allowed.
- Any chain or links other than #35 roller chain & links are not allowed.
- Any single item that has a fair market retail value of over \$90 is not allowed.
- Any electronic control system not supplied in the kit of parts is not allowed.
- Any battery or electrical energy storage device not supplied in the kit of parts are not allowed, except batteries rated at 18Amp-Hours and used in FIRST are considered identical replacements for OCCRA supplied batteries and are allowed.
- Any items that are not "off-the-shelf" and are not sold as an individual or quantity package are not allowed. This means that you may not use mechanisms or devices that have been removed from other machines and assembled products. (For example, you may not buy a riding mower so that you can use the wheels!)
- Special order items are not allowed.
- Items that are inherently dangerous (highly flammable, explosive, toxic, etc.) are not allowed.

**Internet sources like McMaster Carr, VEX, Banebots, AndyMark, MSC, and Northern Tool offer great prices on casters, wheels and raw stock and supplies. As long as the item is not found on the additional materials restrictions list they may be purchased from Internet sources like these.**

The "spirit of the competition" requires that we all promote fairness; all teams must have equal accessibility to the supplies that are used to build the robots. Please make this your guiding principle when you go looking for building materials.

## APPENDIX C

### OCCRA 2013 : KIT OF MATERIALS WITH PRICES

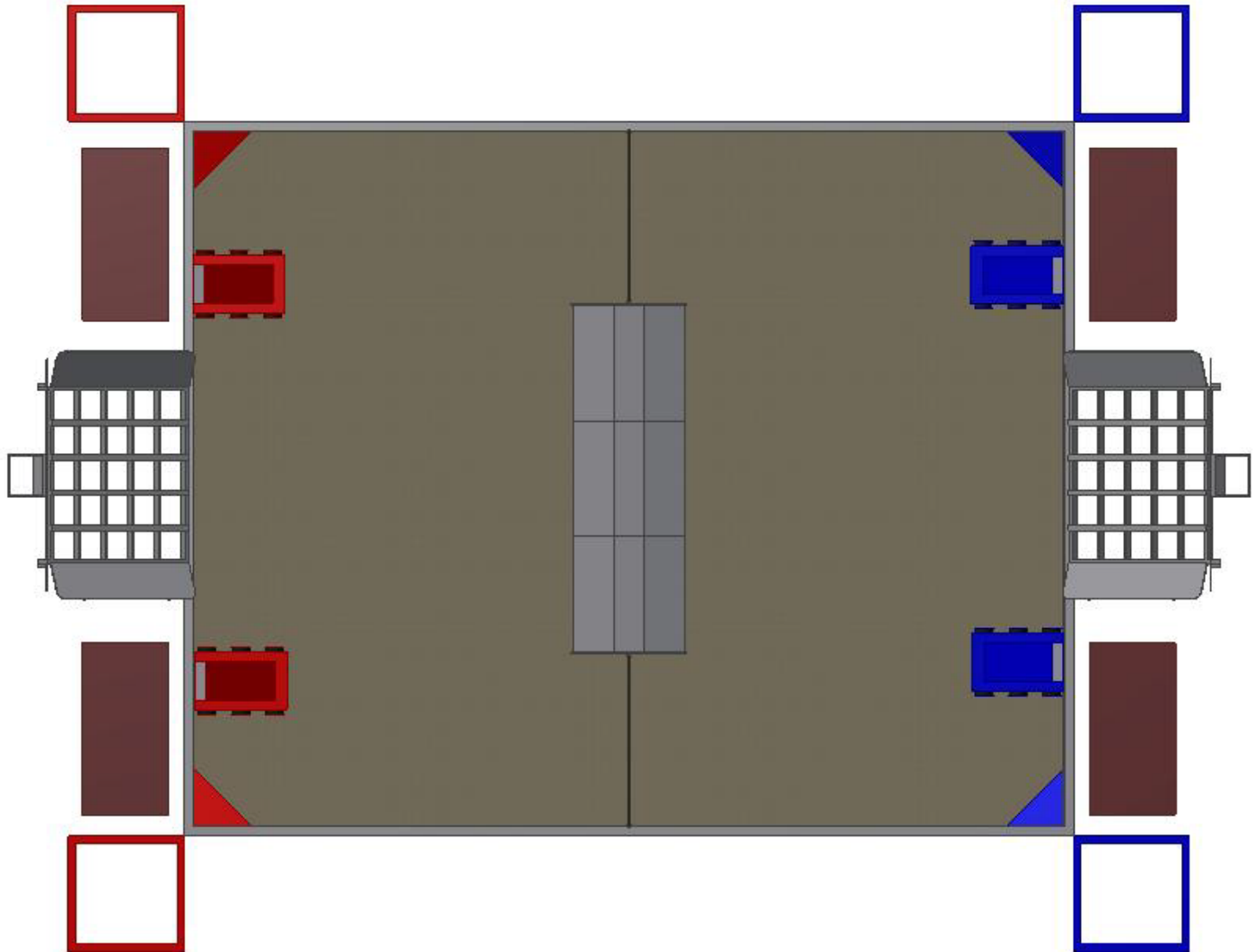
ITEM (*these items are kits that include the parts itemized below them in parentheses)	TEAM QTY	ITEM COST	SUPPLIER	PART NUMBER
<b>Chassis:</b>				
C-Base Chassis kit frame	1*	155.00	AndyMark, Inc.	am-0952
(30" C-Channel)	(6)	(18.00)	AndyMark, Inc	am-2222
(C-Base Corner Connects)	(8)	(4.00)	AndyMark, Inc	am-0212
(3/8-16 x 6 Hex Head Bolts)	(6)	(1.00)	AndyMark, Inc	am-1268
(3/8-16 Nylock Nut)	(6)	(.15)	AndyMark, Inc	am-1054
(1/4-20 x 1-3/4" SHCS, 50pack)	(1)	(12.00)	AndyMark, Inc	am-1206
(1/4-20 Nylock Nut, 100-pack)	(1)	(3.00)	AndyMark, Inc	am-1160
2008 FIRST kit wheel	4	7.00	AndyMark, Inc.	am-0144
S35-24 aluminum sprocket	4	11.00	AndyMark, Inc.	am-0119
3/8 id, 1-1/8" od, flanged ball bearing	8	3.00	AndyMark, Inc.	am-0573
#10-32 socket head cap screw, steel, zinc plated	24	.15	AndyMark, Inc.	am-1165
ToughBox to C-Base Chassis Mounting Kit	1*	26.00	AndyMark, Inc.	am-0953
(T Brace for 2010 C-Base)	(2)	(7.00)	AndyMark, Inc.	am-0443
(Angle Bracket for 2010 C-Base)	(2)	(6.00)	AndyMark, Inc.	am-0442
(1/4-20 x 5/8" SHCS, 10-pack)	(1)	(1.25)	AndyMark, Inc.	am-1203
(1/4-20 Nylock Nut, 100-pack)	(1)	(3.00)	AndyMark, Inc.	am-1160
(1/4" Flat Washer, 100-pack)	(1)	(2.00)	AndyMark, Inc.	am-1069
500 Cross Hex Tube 19.25"	1	3.00	AndyMark, Inc.	am-2241
Clamping u-bolt zinc-plated steel, 5/16"-18 thread, for 1-3/4" OD	1	1.51	McMaster Carr	3042T86
<b>Motors and Transmissions:</b>				
2.5 " <b>CIM Motor</b> (or DeWalt Drill)	<b>5</b>	25.00	AndyMark, Inc.	am-0255
<b>Keyang motor</b> made for squared shaft	<b>1</b>	0	n/a	Donation
<b>BAG motor</b>	<b>1</b>	25.00	VEX	217-3351
<b>Keyang motor</b> (integral shaft)	<b>1</b>	0	n/a	Donation
***AM PG71 <b>Gearmotor</b> (or Globe motor)	<b>1</b>	75.00	AndyMark	am-0914
Denso, Bosch, or Valeo <b>wiper motor</b> /clutched liftgate motor/door motor	<b>1</b>	0	n/a	Donation
VersaPlanetary Single Stage 4:1 Transmission (for BAG motor)	1	35.00	VEX	217-2725
Toughbox Transmission (with CIM attachment hardware)	3	66.00	AndyMark	am-0145
Toughbox nano-long key transmission for CIM (with pinion gear and hardware kit)	1*	80.00	AndyMark	am-0553
<b>Mechanical:</b>				
Planetary GearMotor Bracket	1	9.00	AndyMark, Inc.	am-2197
PG71 Adapter Sleeve	1	4.00	AndyMark, Inc.	am-0996
Squared shaft for Keyang motor	1	0	n/a	Donation
CIM Gear, 14 Tooth (for Toughbox connect.)	4	8.00	AndyMark, Inc.	am-0034
(Hardware Kit for attaching CIM and Toughbox Nano)	(1)	(9.00)	AndyMark, Inc.	am-0850
500 Key Hub	1	10.00	AndyMark, Inc.	am-0077
1/8x1/8x0400 Machine Key, steel	5	.50	AndyMark, Inc.	am-1018
Sprocket 12-tooth aluminum, keyed, .5"ID	4	13.00	AndyMark	am-0166
Sprockets 15 tooth, for G-Hub	2	15.00	Applied Industrial, Inc.	
Sprockets 30 tooth for H-Hub	2	28.00	Applied Industrial, Inc.	

Sprockets 45 tooth for H-Hub	2	36.00	Applied Industrial, Inc.	
Sprockets 60 tooth for H-Hub	1	52.00	Applied Industrial, Inc.	
G Split-taper hub, 3/8" ID	2	7.00	Applied Industrial, Inc.	
H Split-taper hub, 3/8" ID	5	7.00	Applied Industrial, Inc.	
Shaft collar, 3/8" ID	8	1.38	McMaster-Carr	6166K23
#35 Connecting Link for Roller Chain	6	.75	AndyMark, Inc.	am-0368
#35 Single Strand-Riveted Roller Chain, 10-ft	15ft	1.00/ft.	AndyMark, Inc.	am-0367
Shaft Couplings, rigid steel, 3/8" ID	2	5.39	McMaster-Carr	6412K13
Bronze bearing (bushing) 3/8" ID	8	.79	McMaster-Carr	6391K172
Strain relief I-bolt	1	1.75	Any Hardware store	
<b>Electrical:</b>				
Limit switch	1	8.00	Applied	
Battery	2	50.00	Battery World	ES18-12 #5660543CZ
#6 Gauge wire, black	5'	2.00		
#6 Gauge wire, red	5'	2.00		
Control box with lid (clear plastic)	1	6.00	Meijer	
Battery charger with power cable	1	75.00		
80-amp Circuit breaker	1	37.00	Terminal Supply	CB3-SM-80
Circuit-breaker/Fuse block	1	19.00	Terminal Supply	ATO-FB10CF
20A Fuses (on Spike Relays)	7	.35	Terminal Supply	
Terminal Splitters	2	.50	?	?
#14 Female terminals (large)	20	.10	Home Depot	
#14 Female terminals (small)	6	.05	Home Depot	
#14 Ring terminals (small)	10	.05	Home Depot	
#6 Ring Terminals (large, for battery)	7	?	Terminal Supply	
Battery connector	2	4.75	Terminal Supply	SY6331G1
Terminal block for negative (ground)	1	11.00	RacerParts Wholesale	FAS-406-211
Slow-blow 30A circuit breakers	4*	4.50	Terminal Supply	211-30
35A Slow-blow Circuit breakers	5	4.00	Snap Actions, Inc.	VB3-A35-F57
#14 Gauge Wire, red	20'	.20/ft	Terminal Supply	14 GXL – 100 – red
#14 Gauge Wire, black	20'	.20/ft	Terminal Supply	14 GXL - 100 – black
<b>Pneumatics Kit:</b>				
Pressure Gage	1	10.00	SMC	42747777
Bosch Relay	1	6.00	Terminal Supply	332 209 159
Socket for Relay	1	5.00	Terminal Supply	PT-BOS
Limit switch (mechanical valve)	1	6.25	SMC	VM 131-N01-01
Thomas Compressor	1	125.00	Rietschle Thomas	Model 405ADC38/12H
[or VIAIR 00090 compressor]	(1)	64.00	Andymark	Am-2005
Pneumatic 1/8" polyurethane tubing	10m	4.75	SMC	TIUB01C-20
5/2 single solenoid DCV	2	24.00	SMC	SY5120-6L0Z-01T
5/2 double solenoid DCV	2	34.00	SMC	SY5220-6L0Z-01T
5/2 double solenoid DCV with center-stop	1	40.84	SMC	SY5320-6L0Z-N7T
Plug-in reducer fittings for center-stop DCV	2	.63	SMC	KQ2R01-07
1/8" plugs for ports, plastic	4	?	SMC	?
Wire lead set for solenoids	8	2.50	SMC	SY100-30-4A
2" bore x 10" stroke cylinder	2	51.50	SMC	NCDGBN50-1000
1.5" bore x 4" spring retract cylinder	2	26.00	SMC	NCME150-0400 S
1" bore x 2" stroke double-acting cylinder	1	20.00	SMC	CDM2B32-50
18 cu. in., 40mm x 8" volume accumulator tank	2	22.00	SMC	NCGB40-UIA980035
60 psig variable regulator	1	9.10	SMC	AR20-N01G-Z
Check valve	1	8.00	SMC	NAK2000-N01
Flow (speed) control	2	7.00	SMC	NAS1001F-01
6-port manifold (6-way fitting-banjo)	1	10.00	SMC	KQ2ZT01-34S
Union "Y"-fitting	5	3.00	SMC	KQ2U01-00
1/8 NPT to 1/8 tube fitting	20	1.250	SMC	KQ2H01-34S

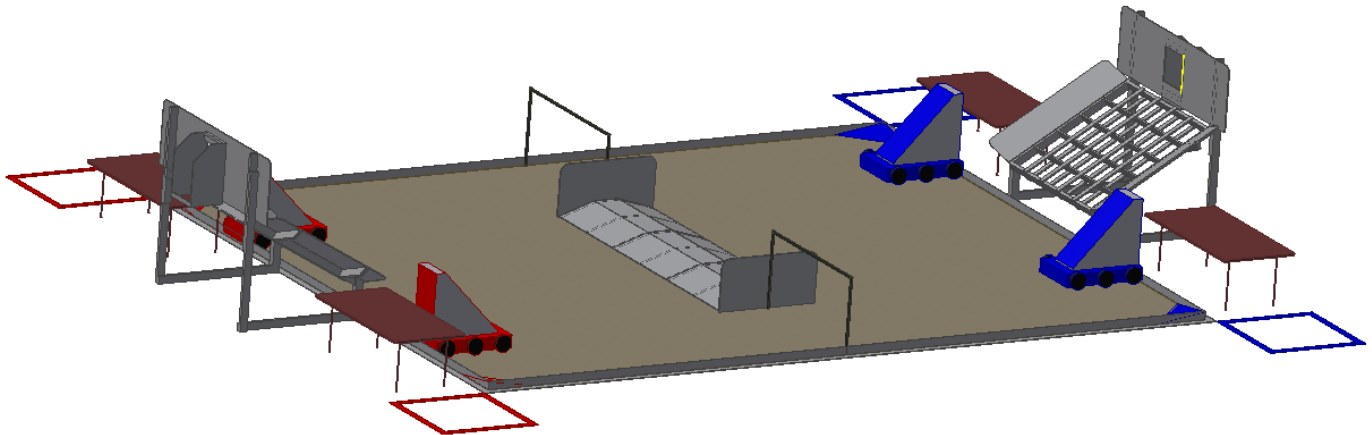
Pressure switch	1	18.00	SMC	IS1000-N01-X201
1/8" tube to metric (unifit) fitting	4	1.50	SMC	KQ2H01-U01
Relief valve 1/4M 125 psi (for compressor) with 1/8 NPT thread size	1	?	Midwest Press.Sys.	1004V25
1/4NPT to 1/8 tube fitting	4	1.00	SMC	KQ2H01-35S
<b>MISCELLANEOUS</b>				
1" x 6" x 20" board (for driver station)	0	1.00	Any lumber supply	none
"How-To" promotional video	0	0	Terri Kroll	Oakland Schools
"How-To" manual	1	online	Terri Kroll	Oakland Schools
OCCRA brochures	100	X	Terri Kroll	Oakland Schools
OCCRA posters	10	X	Terri Kroll	Oakland Schools
Rule book	0	online	Terri Kroll	Oakland Schools
Safety glasses	0	3.75	BYO	Widely available
8.5" inflatable tennis ball (a.k.a. "Giant Tennis balls")	1	5.50-6.00	Five-Below, Toys-R-Us, and others	varies
<b>VEX SYSTEM</b>				
<b>VEX Power Components</b>				
Smart Charger V2	1	17.00	VEX Robotics	276-2519
Battery Charger Power Cord N Amer. Type	1	2.00	VEX Robotics	276-2520
VEXnet joystick power adapter (takes the place of AAA batteries)	2	13.00	VEX Robotics	276-1701
7.2V Battery-3000mAh (for Cortex)	2	30.00	VEX Robotics	276-1491
8-Bay AA/AAA Smart Battery Charger	1	25.00	VEX Robotics	276-1622
AAA NiMH Rechargeable Battery (6-pack)	3	13.00	VEX Robotics	276-1696
<b>VEX Control System:</b>				
VEXnet System Bundle (includes Cortex, Joystick, 2 VEXnet USB Keys, back-up battery holder, USB A-A cable)	1*	400.00	VEX Robotics	276-1604
(VEX Cortex Microcontroller)	(1)	(250.00)	VEX Robotics	276-2170
VEXNET Joystick transmitter (2 used at events plus 1 spare/team; one may be "partner" type)	1 (1)	150.00 (150.00)	VEX Robotics	276-2192
(VEXnet 802.11 USB key [2 used at events plus 1 spare/team])	1 (2)	40.00 (40.00)	VEX Robotics	276-2245
(VEXnet Backup Battery Holder)	(1)	(10.00)	VEX Robotics	276-2243
(VEX USB cable 6ft.)	(1)	(10.00)	VEX Robotics	276-1403
VEXnet competition Switch (includes 5' Ethernet cable for practicing competition modes)	1	20.00	VEX Robotics	276-2335
(5' Ethernet cable (black))	(1)	(?)	VEX Robotics	
3-pin orange jumper	2	.50	VEX Robotics	276-1380
Victor 888 Motor Controller or Talon SR Speed Controller	7	70.00 Or 59.00	VEX PRO or AndyMark, Inc.	217-2769 or am-2505
Spike H-Bridge Relay	7	35.00	VEX PRO	217-0220
2x3 Male to male pin array (4-pack adapter for PWM to Cortex)	6	8.00	VEX Robotics	276-1607

Partner Joystick	1	30.00	VEX Robotics	276-1891
<b>VEX Programming</b>				
EasyC V4 for Cortex full version (20 seats)	1	35.00	Intellitek/VEX Rob.	63-2060-4040
VEX Programming Kit (includes a programming module, RJ14 6-pin cable & a 6' USB A-A cable)	1*	50.00	VEX Robotics	276-2186
<b>VEX conductors:</b>				
3-wire PWM cables 12"	8	5.00	VEX Robotics	276-1426
3-wire PWM cables 24"	4	5.00	VEX Robotics	276-1425
3-wire PWM cables 36"	2	5.00	VEX Robotics	276-1976
PWM Y-Cable 6"	1	7.50	VEX Robotics	276-1423
Coiled Handset Cable '	1	7.00	VEX Robotics	276-1602

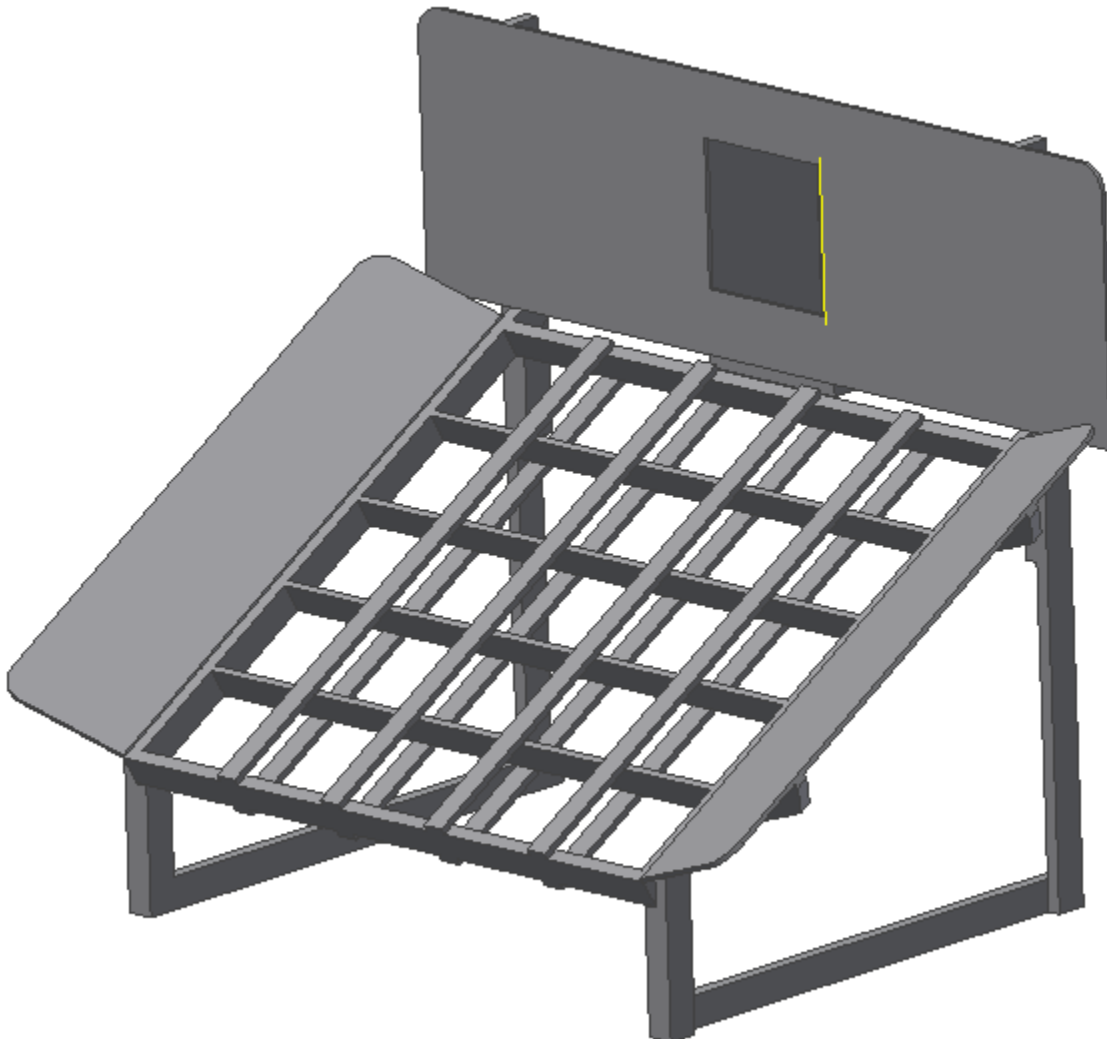
## APPENDIX D OCCRA 2013: FIELD DIAGRAM LAYOUT



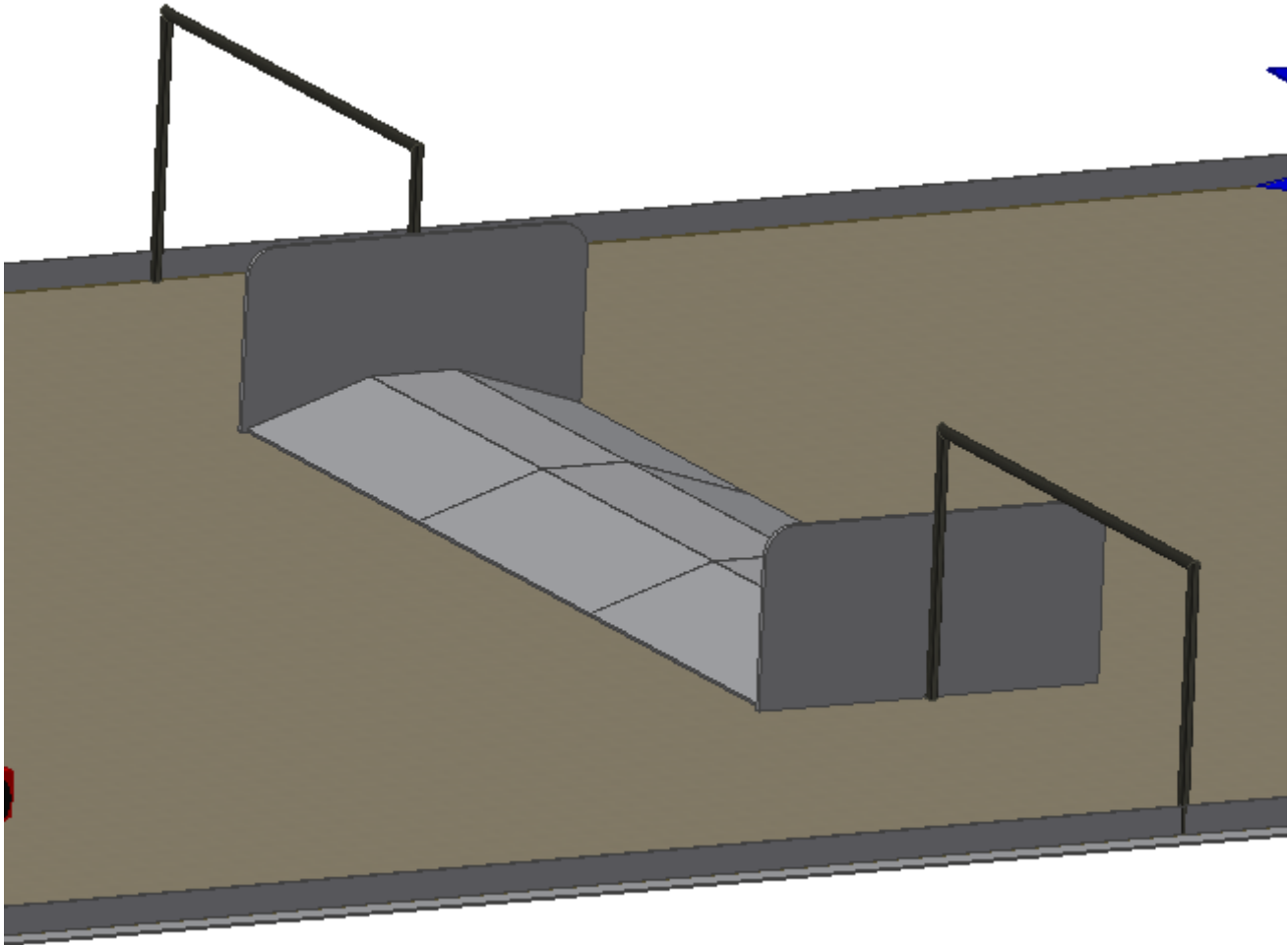
**APPENDIX E**  
**OCCRA 2013: FIELD DIAGRAM ISOMETRIC VIEW**



**APPENDIX F**  
**OCCRA 2013: FIELD, GRID GOAL**



**APPENDIX G**  
**OCCRA 2013: RAMP AND HANGING BAR**



# APPENDIX H

## OCCRA 2013: ROBOT INSPECTION WORKSHEET

### Mechanical:

- ☐ APPEND B - cost constraint parts (\$90 @) X \_\_\_\_\_
- ☐ APPEND B - additional materials X \_\_\_\_\_
- ☐ RB14 - Sharp edges and corners removed X \_\_\_\_\_
- ☐ RB8 - No precision machining X \_\_\_\_\_
- ☐ RB8 - No welding X \_\_\_\_\_
- ☐ APPEND C - Allowed motors (list power source) \_\_\_\_\_.
- ☐ RB6 – Min. of 1" floor clearance from potential snags X \_\_\_\_\_

Event # \_\_\_\_\_

RB 6

Max:Size 28(Base) x 38(Base)x 48(Height)  
In starting position \_\_\_\_\_

Weight (less than 115) \_\_\_\_\_  
W/pneumatics (Less than 120) \_\_\_\_\_

Fairness Forms \_\_\_\_\_

Inspector X \_\_\_\_\_

Date \_\_\_\_\_

### ALLOWED MOTORS (no limit) and their CONTROLLERS

DeWalt Drill motors _____	Vic/Talon _____
CIM motors _____	Vic/Talon _____
Keyang motors _____	Vic _____ or Spike _____
Denso wiper motor or clutched liftgate motor _____	Vic _____
Globe motor _____	Vic _____ or Spike _____
Pwr Sliding Motor may sub for Denso _____	Vic _____
PG71 AM Gearmotor _____	Vic _____ or Spike _____
BAG motor _____	Vic/Talon _____
Other Motors? If more than 20A rating, must use Victor or Talon _____	
Other motors must be from BaneBot, AndyMark or VEX _____	
Compressor _____	Relay _____

### Electrical:

- ☐ RB4 - 1 Victor/Talon controller per CIM, Dewalt, BAG, Valeo/Denso/Sliding Door motor. X \_\_\_\_\_
- ☐ APPEND - Approved – batteries (18-A-Hr.rating) with approved chargers (4 amp). X \_\_\_\_\_
- ☐ RB3 - Battery terminals insulated/protected on all batteries. X \_\_\_\_\_
- ☐ CURR - Battery hold down strap or device. X \_\_\_\_\_
- ☐ CURR - Loose wires secured/risk of entanglement reduced. X \_\_\_\_\_
- ☐ RB3 - Correct gauge wire (14ga) or better for– motors – (6ga) battery – (22ga) sensors. X \_\_\_\_\_
- ☐ RB3 - Connectors properly installed/crimped/soldered (no bare/exposed wires). X \_\_\_\_\_
- ☐ RB2 - Control box mounted/**accessible**/secured w/cover, Cortex must be visible. X \_\_\_\_\_
- ☐ RB8 – Cortex powered by 7.2V battery (fresh) X \_\_\_\_\_
- ☐ RB4 - Wires strained relieved as they enter the control box using the eye bolt. X \_\_\_\_\_
- ☐ RB5 - No alteration of electrical components mounted in the robot control box. X \_\_\_\_\_
- ☐ CURR - All circuits must be fused/breaker protect. – no wire attach.on battery side of fuse block. X \_\_\_\_\_
- ☐ RB5 - no modifications /controller or joysticks. X \_\_\_\_\_
- ☐ APPEND B - No electric components other than approved or provided. X \_\_\_\_\_
- ☐ RB3 - No grounding to chassis. Test w/meter from ground to frame. X \_\_\_\_\_
- ☐ RB2 – Only the 80-Amp breaker supplied by OCCRA being used. X \_\_\_\_\_

### Pneumatics:

- ☐ RB4 - Automotive relay to run the compressor – cannot be direct wired. X \_\_\_\_\_
- ☐ RB15- Only Thomas or the VIAIR 00090 compressor allowed X \_\_\_\_\_
- ☐ CURR –Tubing must be 1/8 tubing X \_\_\_\_\_
- ☐ CURR - Air tubing, securely routed. X \_\_\_\_\_
- ☐ CURR - Bleed off valve accessible for transport. X \_\_\_\_\_
- ☐ CURR - Pressure gauge and regulator mounted and visible on output stream of system. X \_\_\_\_\_
- ☐ CURR – Cylinders and pneumatics storage devices, no fabrication, no modification. X \_\_\_\_\_
- ☐ CURR - Demonstration of 60 PSI max output. X \_\_\_\_\_

### Miscellaneous:

- ☐ RB12 - Color Flag ½" PVC Pipe mount/clearly visible from all sides. X \_\_\_\_\_
- ☐ RB12 - Team Numbers (4"min.) – size and visible from 3 sides. X \_\_\_\_\_