

OCCRA 2016 RULES: “GO 4 IT!”

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 2016 Oakland County Competitive Robotics Association League Champions.

There will be a separate OCCRA VEX Tournament for Oakland County Middle Schools using the official VEX rules for the 2016-17 game but there will be no OCCRA High School VEX Tournament. The high school robots will continue to use the VEX control system.

General Game Rules:

Definitions:

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

BLUE FLAG: flag displayed by a referee that indicates a penalty is about to be called on the Blue ALLIANCE which could involve points being deducted from the blue ALLIANCE's score.

GOAL: A wood & metal pipe structure that is 72" high and consists of 7 columns and 6 rows of positions where 10" game balls may be placed to score points.

BALL: A 10" inflated, rubber ball, either blue or red, that scores 1 point when placed inside a GOAL.

DESCORING VIOLATION: Removing any ball from a goal during a match.

DRIVER STATION: The area where the robot drive teams and coaches for an alliance are located; it includes a 6-8 foot table and the carpeted area under and behind the table; students must stand or sit behind the table, which is positioned a foot away from the field perimeter.

GOAL SCORING: The positioning of a BALL in the GOAL structure so that the BALL is more than half inside and fully supported by the GOAL structure surface and not held in place by a robot of the same color.

GOALTENDING: Blocking the GOAL opening or any part of the goal structure's volume that prevents an opponent from scoring.

HANG: When a robot is suspended off the floor by the HANGING TOWER at the conclusion of a match and scores 2 or 4 points for its alliance.

HANGING TOWER: The metal pipe structure consisting of 4 horizontal bars that are 72" above the floor, 4 vertical pipes and additional support structure; robots may HANG off of these pipes to score additional points.

HERDING: When a robot pushes a ball along the floor with the effect of maintaining control of the ball's travel.

HERDING VIOLATION: When a robot HERDS one or more BALLS down the field; a 3-point penalty may be assessed.

HIGH HANG: Robot position in which the entire hanging robot is at least 18" above the floor at the conclusion of the match and scores 4 extra points for its alliance.

HOLD or HOLDING: Possession of any 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 2 GAME BALLS at a time; a 3-point penalty may be assessed.

HP: The Human Player; the high school student who puts BALLS into play during the game by loading them into ALLIANCE robots that are inside the 4 foot deep RESTRICTED ZONE..

LOW HANG: Robot position in which the entire hanging robot is above the floor but some part of the robot is less than 18" above the floor at the conclusion of the match; it scores 2 extra points for its alliance.

MATCH PERIOD: a 2-minute 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 3-point penalty is called.

PLACEBO: a league-supplied substitute robot.

RED FLAG: flag displayed by a referee that indicates a penalty is about to be called which could involve points being deducted from the red ALLIANCE's score.

RESTRICTED ZONE: 4' by 24' area at the opposite end of the field from the DRIVER STATIONS where robots must be positioned for loading balls from an HP. The tape that is used to mark the RESTRICTED ZONE is considered part of the RESTRICTED ZONE.

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

RUN: When 4 BALLS of an ALLIANCE are positioned consecutively in a row, column, or diagonal pattern; each RUN scores 2 additional points for that ALLIANCE.

STARTING POSITION: Designated location on the field where each robot must begin the match; part of each robot's chassis must be in contact with their end wall, touching it anywhere along the 8' section of wall that is in front of their DRIVER STATION.

THROWING VIOLATION: When an HP throws a ball and it travels across the field outside of their own ALLIANCE's RESTRICTED ZONE, a 3-point penalty may be assessed.

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 and E. 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 the PLACEBO (a league-supplied substitute robot). 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 score the most points by using robots to put balls into GOALS of the correct color and position themselves above the floor (HANG.) Scoring occurs at the end of the match. The total of all HANG points and BALL 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: There are 4 dozen game pieces and all are BALLS. There will be 24 red and 24 blue, heavy-duty, rubber, playground BALLS that are all approximately 10" in diameter. (Teams are cautioned that BALLS do not always remain spherical throughout the season, so robots should be designed to also handle egg-shaped BALLS!)

Ball Starting Placement: A total of 4 BALLS, one per robot, are placed onboard (or alongside and touching) each of the robots at the start of the match. 4 BALLS will be positioned on the floor of the field at the start of each match in front of the respective ALLIANCES' robots [See the BALL positioning in APPENDIX D and APPENDIX E and -- FIELD DIAGRAM LAYOUTS.] and another 4 BALLS (2 of each color) will be positioned along the line for the RESTRICTED ZONE. There will also be 32 BALLS, 16 for each ALLIANCE, in bins on the floor alongside the human player (HP) stations. [See Field Drawings in APPENDIX D and APPENDIX E.]

GR5 Game Structures: One GOAL (See the Diagrams in Appendices D and F) will be used. The GOAL will be a stationary structure positioned inside the playing field, between the ALLIANCES' DRIVER STATIONS, and running perpendicular to the wall starting approximately 4' from the perimeter wall.

The GOAL structure is built using 2x4's, ¾" Plywood and Electrical conduit. It is modular with a removable base, transportable in 2 large pieces. It is 72" tall, approximately 8' long, and holds a maximum of 42 balls. To score in the bottom row of the GOAL, BALLS enter through low openings on either side of the GOAL structure; all other scoring BALLS must enter through the top openings to score in the GOAL. BALLS in the bottom row are physically separated from the BALLS in the column above them. BALLS in a column are likewise physically separated from BALLS in adjoining columns. . [See Wood Cut Drawings in APPENDIX H]

The HANGING TOWER is a metal pipe structure consisting of 4 horizontal bars, each approximately 4' long, that are 72" above the floor, 4 vertical pipes and additional support structure. The tower is made from 1.25" schedule 40 pipe and Kee-Klump fittings. The HANGING TOWER mounts to the field perimeter. The total height of the HANGING TOWER structure is 84." Robots may HANG off of the pipes of the HANGING TOWER to score additional points, but NOT off of the field perimeter pipes. [See Goal Drawing in APPENDIX G]

Robots may not attach to any field structures (except the HANGING TOWER) throughout the match. Specifically, robots may not attach to the GOAL structures for positioning or scoring purposes. Some incidental contact with the GOALS is expected and will be tolerated. Intentional attaching by some part of a robot onto the GOAL structure, or other contact that could result in damage to the field structures, will result in a possible 3-point penalty for the offending alliance. Incidental contact with all field structures is expected during game play and will not be penalized.

Detailed drawings with dimensions will be made available to all teams on ChiefDelphi.com.

GR6 Human Players: There are two Human Players (HPs) on each ALLIANCE. (See the Field Diagram in Appendix E) The HPs are each positioned behind a line that is 2 feet from the field perimeter and extends around the corner of the field diagonally opposite to their DRIVER STATION. The HPs for each ALLIANCE start the game with 16 BALLS in plastic bins alongside their HP zone. BALLS that leave the field of play will NOT be returned to the HPs directly: they will be returned to the field at the nearest point to where they left the field that can be safely reached by the field reset volunteers. All HPs will wear safety glasses.

GR7 Human Player Actions: The HP may serve as field coaches for their drive teams, may pass BALLS to the other human player on their ALLIANCE, and may pass/load BALLS into an ALLIANCE robot that has *at least one wheel touching the floor* within their RESTRICTED ZONE (i.e. the entire chassis frame does NOT need to be in this RESTRICTED ZONE.

The HPs must stay within their own designated zones during the entire match. HPs may not throw BALLS outside of the RESTRICTED ZONE. **HPs must use great caution when passing balls to their partner HP: balls may not be tossed such that they leave the RESTRICTED ZONE without being possessed by an ALLIANCE robot. Refs will warn offenders and may issue a penalty of three (3) points which will be deducted from their ALLIANCE'S score.** Tossing balls with a high velocity so that their own kinetic energy carries them out of the RESTRICTED ZONE will *always* result in a 3-point penalty. If the toss does not have a high velocity and the refs feel that the intent of the throw was NOT to send the BALL beyond the RESTRICTED ZONE, no THROWING VIOLATION will be called. (i.e. BALLS that are obviously being tossed to one of their own ALLIANCE robots, but happen to bounce out of the robot and roll beyond the RESTRICTED ZONE, will not result in a THROWING VIOLATION.) This is a judgement call by the refs and not subject to appeal.

HPs will each start the match with a total of 16 BALLS in their two storage bins. Once the match starts, HPs may maintain possession of balls by holding them, placing them inside their plastic storage bin, or by setting them on the floor within their HP zone. If a ball leaves the zone or if an HP steps out of their zone to get a ball, the ball will be taken and returned to the field of play. HPs may NOT score BALLS into the GOAL.

HPs may not contact the robots or reach inside the field perimeter. Incidental contact with robots or incursions of the field space will be tolerated but deliberate violations are a safety concern and will not be tolerated by the refs.

GR8 BALL and HANG Scoring: The scoring of any BALL depends upon the color of BALL and where it is located at the end of the match-- not on how it got to that location. A blue BALL placed inside the GOAL scores 1 point for the blue ALLIANCE; a red BALL when placed inside a GOAL scores 1 point for the blue ALLIANCE. BALLs can be put into scoring position in goals **ONLY** by the action of a robot. How the robot gets the BALL into the goals does not affect the value.

For a BALL to be positioned for scoring the BALL must be more than 50% inside the space volume of the GOAL and the BALL must be fully supported by the GOAL structure at the end of the match; BALLs held in place by an alliance robot of the same color will not be scored. Only the 6 lowest BALLS in a column will be scored [i.e. stacking additional BALLS on top of the GOAL will not count for a score.]

When **4** BALLS of an ALLIANCE color are positioned consecutively in a row, column, or diagonal pattern, they form a RUN and will score 2 additional points for that ALLIANCE. There may be only one RUN bonus awarded per column, row or diagonal. [i.e. Five BALLS in a row still only earn one 2-point bonus.]

The refs will enter the field to score the match within **4** seconds of 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 supported by a robot from an ALLIANCE cannot score for that ALLIANCE.

When a robot is suspended off the floor by the HANGING TOWER at the conclusion of a match it will earn a bonus for making a HANG: it scores 2 or 4 points for its ALLIANCE. If the robot is positioned in such a way that the *entire* robot is above the floor but some part of the robot is less than 18" above the floor at the conclusion of the match, it has achieved a LOW HANG and it scores 2 extra points for its ALLIANCE. If the robot is positioned in such a way that the *entire* hanging robot is at least 18" above the floor at the conclusion of the match, it has achieved a HIGH HANG and scores 4 extra points for its ALLIANCE. The support for a HANG must come from the pipe structure of the HANGING TOWER. It does not matter which part of this metal tower supports the robot.

SCORING ACTION	POINTS
EACH BALL IN GOAL	1
4 CONSECUTIVE ALLIANCE BALLS IN A GOAL COLUMN	2
4 CONSECUTIVE ALLIANCE BALLS IN A GOAL ROW	2
4 CONSECUTIVE ALLIANCE BALLS ALONG A GOAL DIAGONAL	2
LOW HANG	2
HIGH HANG	4

GR9 Goaltending and Goal Intrusion: A robot may **not** attempt to block an opponent from putting BALLS into the GOAL by blocking the GOAL opening or any part of the GOAL structure's volume. These blocking or "goaltending" actions are illegal. **EXCEPTION: Teams attempting to score one of their own BALLS will NOT be called for Goaltending while they are in the act of scoring.** If it appears to the refs that a team is exploiting this exception by delaying their own scoring action (and only pretending to score so that they can prevent opponents from scoring), the refs can call a GOALTENDING violation. Robots may not detach any part of their structure for the purpose of covering a goal opening or obstructing the movement of BALLS inside the GOAL. The referees will issue a 3-point deduction if a robot's goaltending appears to be deliberate or is likely to interfere with an opponent's scoring chances.

GR10 The Restricted Zone Violation: The RESTRICTED ZONE is the 4' by 24' area on the end of the field where the HP stations are located. Robots may only be loaded with BALLS from an HP on their ALLIANCE when at least one of its wheels is touching the floor within the RESTRICTED ZONE. The tape that is used to

mark the RESTRICTED ZONE is considered part of the RESTRICTED ZONE. When an HP loads one of its ALLIANCE's robots that is not inside the RESTRICTED ZONE, or throws a ball and it travels across the field outside of their own ALLIANCE'S RESTRICTED ZONE, a 3-point penalty may be assessed. For the safety of the HPs, robots that are completely positioned inside the RESTRICTED ZONE and are being loaded by BALLS from an HP may not be rammed by robots of an opposing ALLIANCE. Minor, incidental contact may be overlooked by the refs but a 3-point penalty will be assessed for robot contact that the refs consider violates the rule's intent.

GR11 Descoring Violations: Robots are **not** allowed to remove BALLS from the GOAL during a match. Violators will be assessed a three (3) point penalty deduction **plus the referees will return the BALL(s) to the GOAL at the end of the match.**

GR12 Starting Positions: Each alliance must have their robots positioned with at least one point of their chassis touching the 8' wall section in front of their DRIVER STATION 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.

GR13 Match Scoring: The score for each ALLIANCE is calculated by adding the ALLIANCE'S BALL points (i.e. BALLS of their ALLIANCE color) inside the GOAL at the end of the match, plus their RUN bonuses, plus their HANG points, 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 points.** The losing teams will receive only their match points.

GR14 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.

GR15 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.

GR16 Field Dimensions: The playing field will be approximately 24' by 30'. There will be a 4' by 24' Restriction Zone on each end of the field (Consult the field layout diagrams in Appendix D and APPENDIX E).

GR17 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.

GR18 Restrictions on Robot Storage: Robots may not HOLD more than two BALLS at a time. If a robot inadvertently takes possession of an additional BALL, 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 GAME BALL(s) by the time the ref counts to three, a 3-point penalty will be assessed.

Robots may run into BALLS and it will not be penalized, but it is illegal for robots to intentionally "HERD" BALLS, regardless of whether they are carrying a BALL or not. [Herding occurs when a robot maintains continuous control of BALLS that the robot is moving along the floor.]

GR19 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 GOAL or field structures (except the HANG TOWER) at any time and may not intentionally contact the upper structure of the GOAL. Some contact with the GOAL's lower structure is expected and will not be restricted unless the refs feel there may be damage to the structure.

Robot interaction is allowed and expected anywhere on the field, except as specified in the RESTRICTED ZONE. 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 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.

BALLS may only be shot on goal if the entire robot is across the mid-field line and on the same end of the field as the GOAL. [Full-court shots on GOAL and strategic moves that intentionally send balls from the field are expressly forbidden as they pose a safety risk to DRIVERS and others near the field.]

OCCRA officials will return BALLs that unintentionally go out of bounds to the field at the nearest point to where the BALL went out. BALLs from an opposing ALLIANCE that enter an HP station will likewise be returned the field immediately.

GR20 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 scheduled alliance 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," donated by *The Robot Space*). 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.

GR21 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. If teams are scheduled to play more than 4 matches at a regional tournament, only their first 4 matches will count for tournament standings and for championship seeding purposes.

GR22 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 RED FLAG or BLUE FLAG waved by a referee indicates that an official warning has been given to a team and a potential loss of points or disqualification is imminent. Teams that get disqualified will not receive any points for that match, but their alliance partner may still earn points.

GR23 Time Outs: Alliances may not call time outs during seeding or local tournament matches (a.k.a. “regionals.”) 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.

GR24 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) 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 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 2016 OCCRA competition must be built **entirely** during the period of time starting at Kickoff 2016 and ending at the 2016 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 2016 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 2016, the VEX “Cortex” controller will be used. The electrical control system must still be enclosed inside a single, clear

plastic control box. Teams need to neatly lay out all of the electrical components and arrange key components so that their indicator lights are clearly visible to both inspectors and refs.)

You may not alter or remove the Cortex, fuse block, relays, speed controllers or fuses/circuit-breakers from the safety container(s). 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(s) 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(s) must be in position and secured when operating the robot. Teams that wish to buy a PWM splitter cable may do so. (This would allow a single control signal to run two Victors or two Spikes synchronously.)

RB3 The Power Supply: The Cortex controller must be powered by the 7.2V battery supplied in the Kit of Materials. ***Servos may be powered directly from the Cortex if powered by 7.2 Volts.*** A 12-Volt supply cannot be used without the risk of damage to the servos. **ALL TEAMS MUST USE A 9V BACK-UP BATTERY FOR THEIR CORTEX CONTROLLERS. This will be checked at inspection—no exceptions!**

RB4 General Wiring: Only the specified wire gauge and strand may be used. #14 wire is the minimum gage that may be used on all “non-signal” wire runs **with three exceptions:** #6 gage 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 Victor 884s (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.**

Main circuit-breakers may be either 80A or 120A [OCCRA will continue phasing out the 80A breakers this year.] Branch circuits must all be protected by breakers rated at 30A or lower. (No more 35A breakers may be used since they went out of stock and are no longer available to all teams!)

RB5 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(s) before they enter the box(s) 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.

RB6 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. Teams must all use the white, VEXnet 2.0 keys.

RB7 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 **132” perimeter footprint** and be no more than **44” in height at the start of the match.** [Remember teams: Robots must be able to fit through 30” doorways, so keep at least one dimension under 30 inches!] At the start of each match, no part of the robot can be extended outside of the vertical planes created by this perimeter “footprint.”

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 .75 inches of the floor! To protect people, robots and field structures, no protruding parts of the robot may have sharp edges.

NEW EXCEPTION FOR 2016: Some robot kit chasses have brackets that attach the wheels with a ground clearance of only 5/8"—we will allow this exception since they are not sharp and occur within the wheel well space and therefore pose almost no snag risk.

RB8 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 \$100 is not allowed.** If a team receives part donations or is able to buy components at a reduced price under \$100, **THE PARTS MAY NOT BE USED UNLESS THE PARTS ARE EQUALLY AVAILABLE TO ALL OCCRA TEAMS AT THE SAME PRICE.**

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!)

If a device or mechanism, such as a transmission, cannot be bought for less than \$100, but the *individual components* can all be readily bought by *any* team for a *total cost of less than \$100* and then assembled by the team, it is a legal device. If, however, the individual components add up to more than \$100, the transmission may NOT be used. Likewise, a chassis frame is considered a single device or mechanism. One (the C-Channel frame from AndyMark) is supplied to all teams by OCCRA in the Kit of parts. There are other, more expensive chassis frames on the market that could give teams an advantage but, unless the entire chassis frame can be bought by any team for less than \$100, it is not legal in OCCRA. The intent of this rule is to keep the playing field as level as possible. Continuing for 2016: OCCRA will allow two additional chassis frames to be used, since they are comparable to the AndyMark C-Channel frame supplied by the league in terms of price and functionality:

- 1) AndyMark - AM14U2 - \$209 (but on sale for \$159) - <http://www.andymark.com/AM14U2-p/am-2990.htm>
- 2) VEX Pro - 2014 Drive in a Day Chassis Kit - \$149 - <http://www.vexrobotics.com/vexpro/versaframe/drive-in-a-day/2014-drive-in-a-day.html>

If the companies that produce these chassis models replace them with another model and the Game and Kit Committee decides that the replacement chassis has a comparable price and functionality, it *may* allow teams to use the replacement chassis.

RB9 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.

RB10 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. If your robot is using the VEX 7.2 batteries, they should always be charged using the "Safe" setting on the VEX Smart Charger.***

Please Note: People with heightened sensitivities/allergies to **nickel and latex** need to be aware that many teams use parts containing these materials on their robots.

RB11 Operator Control Board: We recommend that each team create an operator control station or protected carrying structure 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 *should* have a control board to protect their joystick transmitters during transport to and from the field!** On the control board, teams should securely attach the two joystick controllers (Velcro is suggested for easy removal and reattachment). 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 new, white, VEXNET 2.0 USB key attached to its underside (to serve as modem/antenna) and will be attached to Joystick B via an RJ25 coiled cable. The VEXnet 2.0 keys are the only ones allowed in OCCRA this year (do not use the old, black, version 1.0 keys.) Extenders are available to raise the VEXNet keys above and away from the chassis—highly recommended since it separates the radios from motor noise and improves the radio's effective distance.

Teams will have to show the inspectors at each tournament that they have the most recent version of the firmware installed on their CORTEX, master JOYSTICK, and VEXNet 2.0 Keys.

All control board components should 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.

RB12 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!

RB13 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.

RB14 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).

RB15 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(s)
- Installation of fuses/circuit-breakers
- Location and fastening of battery and back-up Cortex battery
- Updated firmware on the CORTEX, master JOYSTICK, and VEXNet 2.0 Keys
- Communication between the CORTEX and the JOYSTICK Controllers
- Loose or dangling mechanisms
- Sharp objects that may damage the floor or other robots with a MINIMUM .75" clearance.
- 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 materials on the Additional Materials Restrictions list from APPENDIX B
- Usage of relief valve, regulator and pressure gage if pneumatic system is employed
- Overall safety
- Two-operator control
- Securing control system components
- Main circuit-breakers may be either 80A or 120A, branch circuits protected by 30A maximum breakers

RB16 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 are either the Thomas compressor or the VIAIR 00090 compressor supplied in the kit, and the only tubing sizes allowed is the 1/8" tubing supplied in the kit of materials or the 1/4" tubing (also used in FIRST.) To encourage more teams to use pneumatics, FESTO has made a large donation to OCCRA, so the league will be converting to 1/4" tubing over the next few years (but for now, either tubing size will be allowed.) 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 \$100, are equally available to all teams, 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 accumulator tank(s) and easily accessible.

RB17 Electric Motors: All 12V DC motors that are rated below 350 Watts and were supplied by OCCRA or are available on-line from BaneBot, AndyMark, the Robot Space and VEX are allowed in OCCRA for 2016. 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 **120 Amps** 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 current Kit of Materials. OCCRA provides an assortment of motors and transmissions that allow teams using the kit to build highly competitive robots.

RB18 Batteries: An 18 Amp-Hr. battery supplied by OCCRA or any functional equivalent may be used to power the robot. OCCRA does not allow power cables to be used so that the CORTEX can be powered by the same 12V battery that supplies the rest of the robot with energy. Teams should power their CORTEX with the standard 7.2 blue batteries (too many robots had their Cortex experience momentary power losses last year because source voltage dipped too low during large current draws from the 12V batteries.) Remember: ALL robots must have a 9V back-up battery attached to their CORTEX.

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.

Grinders and/or saws that create sparks or excessive noise are NOT to be used at competitions because of the safety threat they pose. Likewise, no painting or use of volatile liquids is allowed—even if there is no safety threat, they could potentially damage the venue flooring.

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. **Teams with very large tool boxes may be asked to locate their toolbox in an area adjacent to the team's dedicated pit area if the tool box is so large that it infringes on walkways or the space that other teams are entitled to.**

Teams have all been supplied with purple practice balls that match the game BALLS in every way except color. Teams should bring these purple balls-- not red or blue balls-- to the tournaments for practicing with their robot.

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. Again 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 seeding 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 zip ties or 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 students take over the entire repair process once it has gotten to the point where they have the necessary skill & knowledge to resume making the repair, 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 (including possible disqualification from the tournament.).

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) 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 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 time 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 be selected as a partner. The following chart shows the **restrictions**:

Roll 1 = Pick #10 or lower	Roll 5 = Pick #5 or lower
Roll 2 = Pick #9 or lower	Roll 6 = Pick #6 or lower
Roll 3 = Pick #3 or lower	Roll 7 = Pick #7 or lower
Roll 4 = Pick #4 or lower	Roll 8 = Pick #8 or lower

For example, if a "7" is tossed, (which will happen 12.5% of the time), **none of the top 6 teams may be selected** as an alliance partner since **the choice must be from teams that seeded at #7 or lower** [the #7 Seed, #8 Seed, #9 Seed,...etc.] 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 2016: LIST OF ALLOWED TOOLS

All teams will be limited to the standardized set of tools listed below for 2016; 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 standard¹ 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 saw² (hacksaw, coping saw, miter saw...etc.)
- Any common type of electric saw³ (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, 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

¹ 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!

² 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.)

³ 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 & 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 3D printers, mills, weld stations, lathes, laser-cutters...etc.) would create an unfair advantage for some teams and are expressly forbidden.

APPENDIX B

OCCRA 2016: 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, The Robot Space, 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 \$100 are allowed; OCCRA is continuing the process of switching over from 1/8" to 1/4" pneumatic tubing; thanks to the very generous donations from the FESTO Corporation, we plan to stock a full inventory of 1/4" components but *some* of the 1/8" components will still be available for the 2016 season; the only compressors that will be allowed are the ones supplied in the kit of parts.
- Any chain or links are allowed, within the cost constraint, but #35 roller chain & links are the only ones that will be stocked by OCCRA in the spare parts inventory.
- Any item that is not readily available to all teams is not allowed;
- Any single item that has a fair market retail value of over \$100 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 2016 : 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
Chassis:				
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
Motors and Transmissions:				
2.5 " CIM Motor (or DeWalt Drill)	5	25.00	AndyMark, Inc.	am-0255
PG27 Planetary Gearbox with 9015 Motor (or Keyang motor made for squared shaft or Keyang motor with integral shaft)	1	69.00	AndyMark, Inc	am-2542
BAG motor	1	25.00	VEX	217-3351
AM PG71 Gearmotor (or Globe motor)	1	75.00	AndyMark	am-0914
PG188 Gearmotor , (Encoder Ready) [or Denso, Bosch, or Valeo wiper motor/clutched liftgate motor/door motor]	1	79.00	AndyMark	am-2193a
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
Mechanical:				
Planetary GearMotor Bracket	3	9.00	AndyMark, Inc.	am-2197
PG71 Adapter Sleeve	3	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	2	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,	

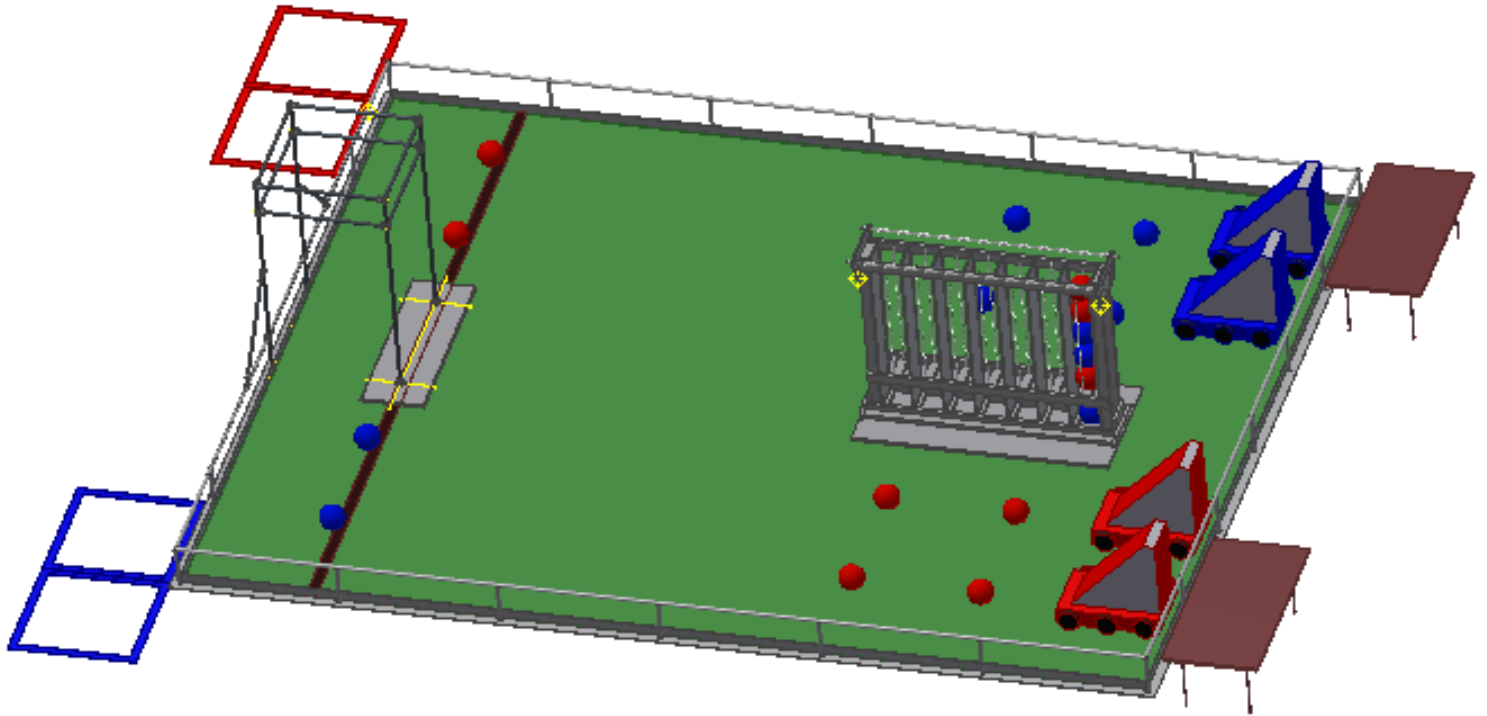
			Inc.	
Sprockets 30 tooth for H-Hub	2	28.00	Applied Industrial, Inc.	
Sprockets 45 tooth for H-Hub	1	36.00	Applied Industrial, Inc.	
Sprockets 60 tooth for H-Hub	1	52.00	Applied Industrial, Inc.	
G Split-taper hub, 3/8"ID	2	7.00	Applied Industrial, Inc.	
H Split-taper hub, 3/8" ID	4	7.00	Applied Industrial, 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	
Electrical:				
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 or KMart	
Battery charger with power cable	(1)	75.00		
Lead Acid Battery Charger, 3 Bank, 6 Amp, Dual Pro RS3 with SB-50A Connectors	1	194.00	AndyMark, Inc.	Am-2026
80-amp or 120-amp Circuit breaker	1	37.00	Terminal Supply	CB3-SM-80
Circuit-breaker/Fuse block w/common feed	1	21.51	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
Pneumatics Kit:				
Pressure Gage	1	10.00	SMC or Festo	42747777
Bosch Relay	1	6.59	Terminal Supply	TYR-042-1240
Socket for Relay	1	5.00	Terminal Supply	PT-BOS
Safety Air Relief Valve (lever arm)	1	7.38	SMC or Festo	VM 131-N01-01 or 153981
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
Pneumatic 1/4" polyurethane tubing	10m	donated	Festo	567948 (PUN-H-1/4BL-150-CB)
5/2 single solenoid 2-position DCV	2	33.38	SMC or Festo	SY5120-6L0Z-01T or 564212 (VUVG-L14-M52-AT-T14-5H2L)
5/2 double solenoid 2-POSITION DCV	2	34.00	SMC or Festo	SY5220-6L0Z-01T or

				564212 (VUVG-L14-B52-T-T14-5H2L)
5/2 double solenoid 3-position DCV (with center-stop)	1	49.90	SMC or Festo	SY5320-6L0Z-N7T or 564212 (VUVG-L14-P53C-T-T14-5H2LO)
Plug-in reducer fittings for center-stop DCV	2	.63	SMC	KQ2R01-07
1/8" or 1/4" plugs for ports, plastic	4	donated	SMC or Festo	?
Wire lead set (for SMC solenoids)	(8)	1.55	SMC	SY100-30-4A
Wire lead set (solenoid connection cables for Festo)	8	donated	Festo	566658 (NEB-H1G2-PO.5-N-LE2)
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 or Festo	NCGB40-UIA980035
60 psig variable regulator or Festo Air Regulator with Pressure Gage	1	18.05	SMC or Festo	AR20-N01G-Z or 173646
air regulator mounting bracket	1	donated	Festo	164936
Check valve	1	9.59	SMC or Festo	AK2000-N01 or 190843
Inline Flow (speed) control	2	8.38	SMC or Festo	AS1002F-07 or 534782 (GR-QB-1/4-U)
Branch tee 6-port manifold (6-way fitting-banjo)	(1)	10.00	SMC	KQ2ZT01-34S
Branch tee 6-port manifold with 1/8"NPT port	1	donated	Festo	190803 (QSLV6-1/8-1/4-U)
Union "Y"-fitting	(5)	3.00	SMC	KQ2U01-00
Union "Y"-fitting	5	donated	Festo	564774 (QBY-1/4T-U)
1/8 NPT to 1/8 tube fitting	(20)	1.250	SMC	KQ2H01-34S
1/8 NPT to 1/4 tube fitting	20	donated	Festo	533273 (QB-1/8-1/4-U)
Pressure switch	1	45.70	SMC	IS10-N01-LP
1/8" tube to metric (unifit) fitting	(4)	1.50	SMC	KQ2H01-U01
1/4" tube to 1/4" NPT fitting	4	donated	Festo	533276 (QB-1/4-1/4-U)
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
Plastic plug for 1/4" push to connect fittings	2	donated	Festo	564786 (QBC-1/4H-U)
MISCELLANEOUS				
1" x 6" x 20" board (for driver station)*	0	1.00	Any lumber supply	none
"How-To" manual	1	online	www.occra.net	Oakland Schools
OCCRA brochures	100	X	Terri Kroll	Oakland Schools
OCCRA posters	10	X	Terri Kroll	Oakland Schools
Rule book*	0	online	www.occra.net	Oakland Schools
Safety glasses*	0	3.75	BYO	Widely available
10" Rubber Playground ball by Voit	1	6.00	Wal-Mart	Widely available
VEX SYSTEM				
VEX Power Components				
Smart Charger V2	1	17.00	VEX Robotics or the Robot Space	276-2519
Battery Charger Power Cord N Amer. Type	1	2.00	VEX Robotics or the Robot Space	276-2520
VEXnet joystick power adapter (takes the place of AAA batteries)	2	13.00	VEX Robotics or the Robot Space	276-1701

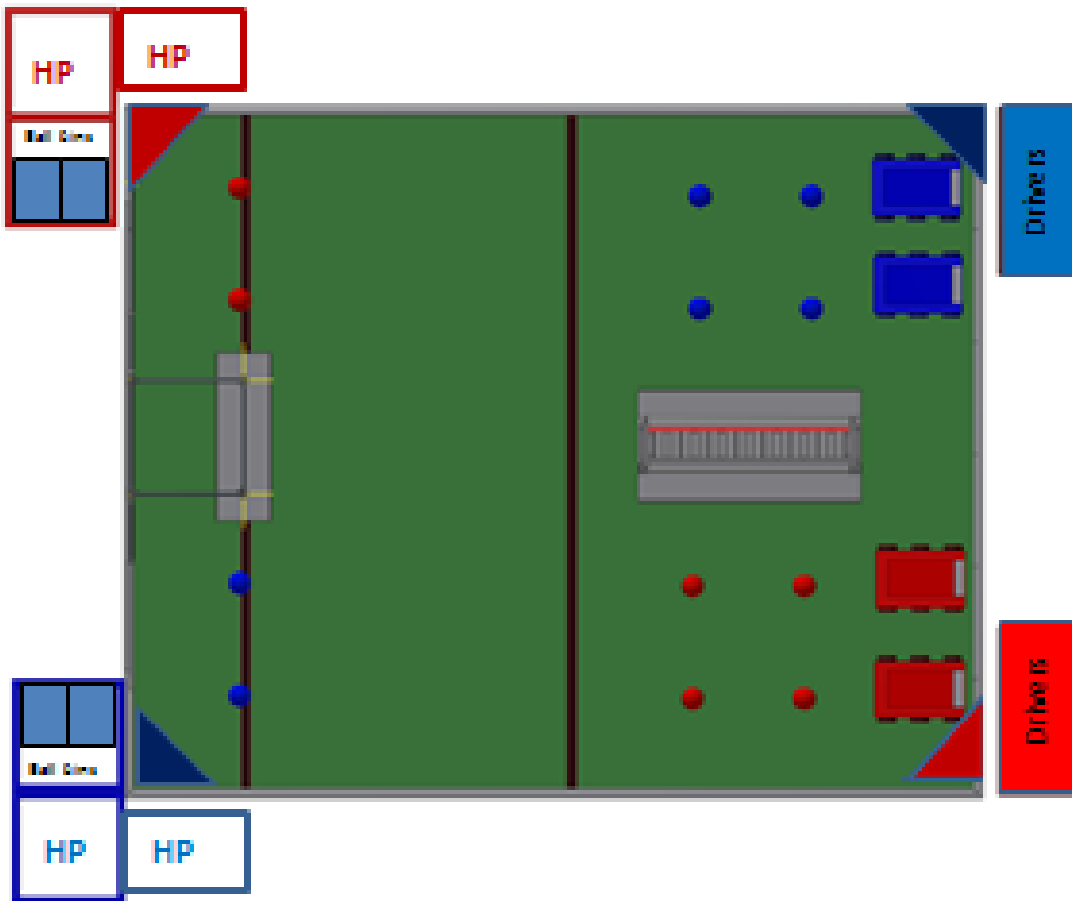
7.2V Battery-3000mAh (for Cortex)	2	30.00	VEX Robotics or the Robot Space	276-1491
8-Bay AA/AAA Smart Battery Charger	1	25.00	VEX Robotics or the Robot Space	276-1622
AAA NiMH Rechargeable Battery (6-pack)	3	13.00	VEX Robotics or the Robot Space	276-1696
VEX Control System:				
VEXnet System Bundle (includes Cortex, Joystick, 2 VEXnet USB Keys, back-up battery holder, USB A-A cable)	1*	400.00	VEX Robotics or the Robot Space	276-1604
(VEX Cortex Microcontroller)	(1)	(250.00)	VEX Robotics or the Robot Space	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 or the Robot Space	276-2192
(VEXnet 802.11 USB key [2 used at events plus 1 spare/team])	1 (2)	40.00 (40.00)	VEX Robotics or the Robot Space	276-2245
(VEXnet Backup Battery Holder)	(1)	(10.00)	VEX Robotics or the Robot Space	276-2243
(VEX USB cable 6ft.)	(1)	(10.00)	VEX Robotic or the Robot Space s	276-1403
(5' Ethernet cable (black))	(1)	(?)	VEX Robotic or the Robot Space	
3-pin orange jumper	2	.50	VEX Robotics or the Robot Space	276-1380
<u>Victor SP Motor Controller</u> or Talon SR Speed Controller	6	<u>60.00</u>	The Robot Space	<u>217-9090</u> or am-2505
Spike H-Bridge Relay	5	35.00	VEX PRO or the Robot Space	217-0220
2x3 Male to male pin array (4-pack adapter for PWM to Cortex)	4	8.00	VEX Rob or the Robot Space	276-1607
Partner Joystick	1	30.00	VEX Robot or the Robot Space	276-1891
ROBOTC for VEX Robotics 4.x [Classroom License] (Digital-License)	-	Free on-line download	VEX (Robomatter.com)	Perpetual Classroom License
VEX Programming				
	1	35.00		
VEX Programming Kit (includes a programming module, RJ14 6-pin cable & a 6' USB A-A cable)	1*	50.00	VEX Robotics	276-2186
VEX conductors:				
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

***Prices marked for pneumatic components supplied by Festo and SMC are for the SMC versions—all Festo components have been donated**

APPENDIX D
OCCRA 2016: FIELD VIEW



APPENDIX E OCCRA 2016: FIELD DIAGRAM LAYOUT



APPENDIX F
OCCRA 2016: GOAL STRUCTURE



APPENDIX G OCCRA 2016: HANG TOWER



OCCRA 2016 Tower Assembly

1-1/4" Schedule 40 iron pipe construction

Key Dimensions:

72" from floor to top of lower crossbar

95" total height

45" between uprights

1-5/8" Pipe Outer Diameter

Materials

4 pcs - 1-1/4" SCH 40 x 94" pipe (verticals)

8 pcs - 1-1/4" SCH 40 x 45" pipe (crossbars)

2 pcs - 1-1/4" SCH 40 x 36" pipe (diagonals)

1 pc - 24" x 72" x 3/4" plywood baseplate

1 pc - 3.5" x 54" x 3/4"

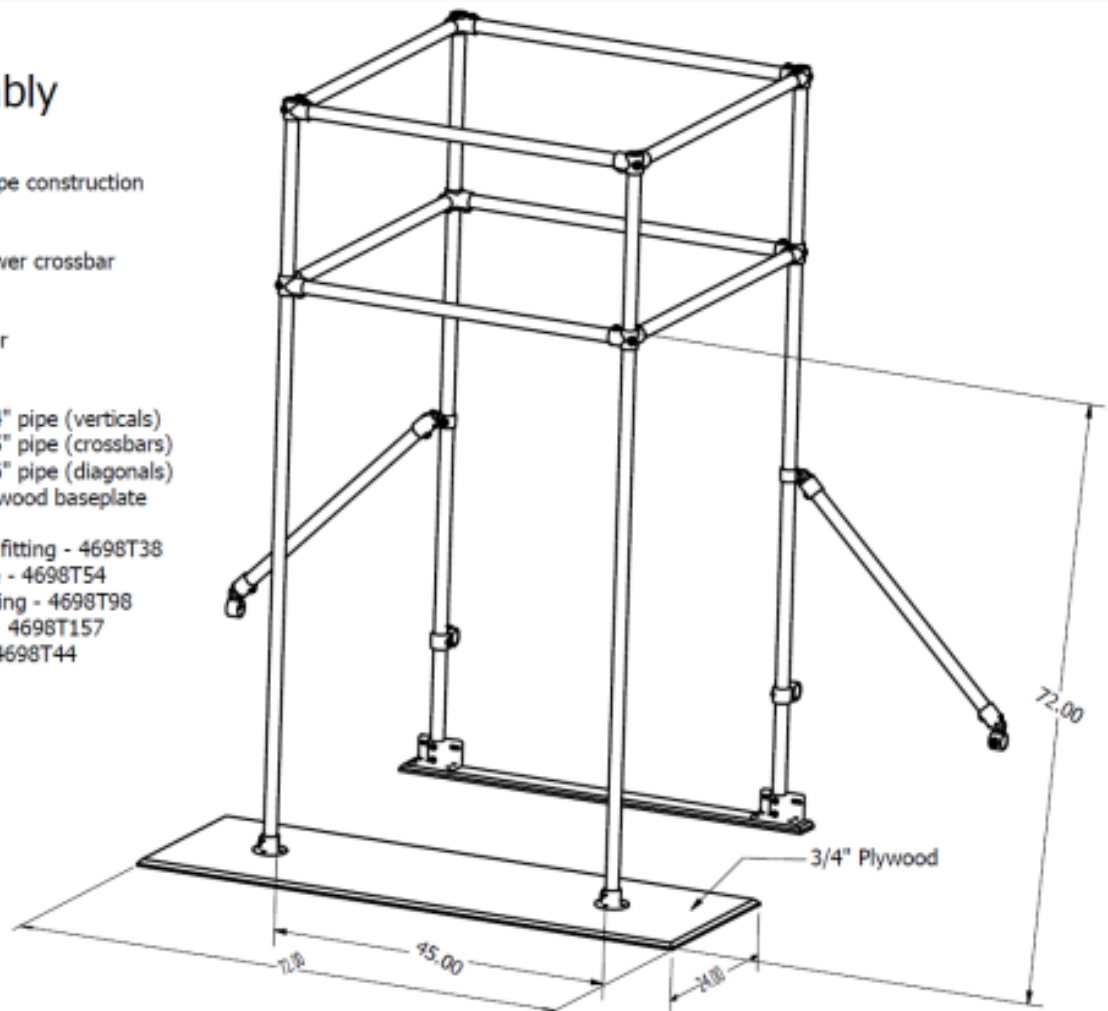
8 pcs - Kee-Klump corner fitting - 4698T38

2 pcs - Round Base Flange - 4698T54

4 pcs - Diagonal Swing fitting - 4698T98

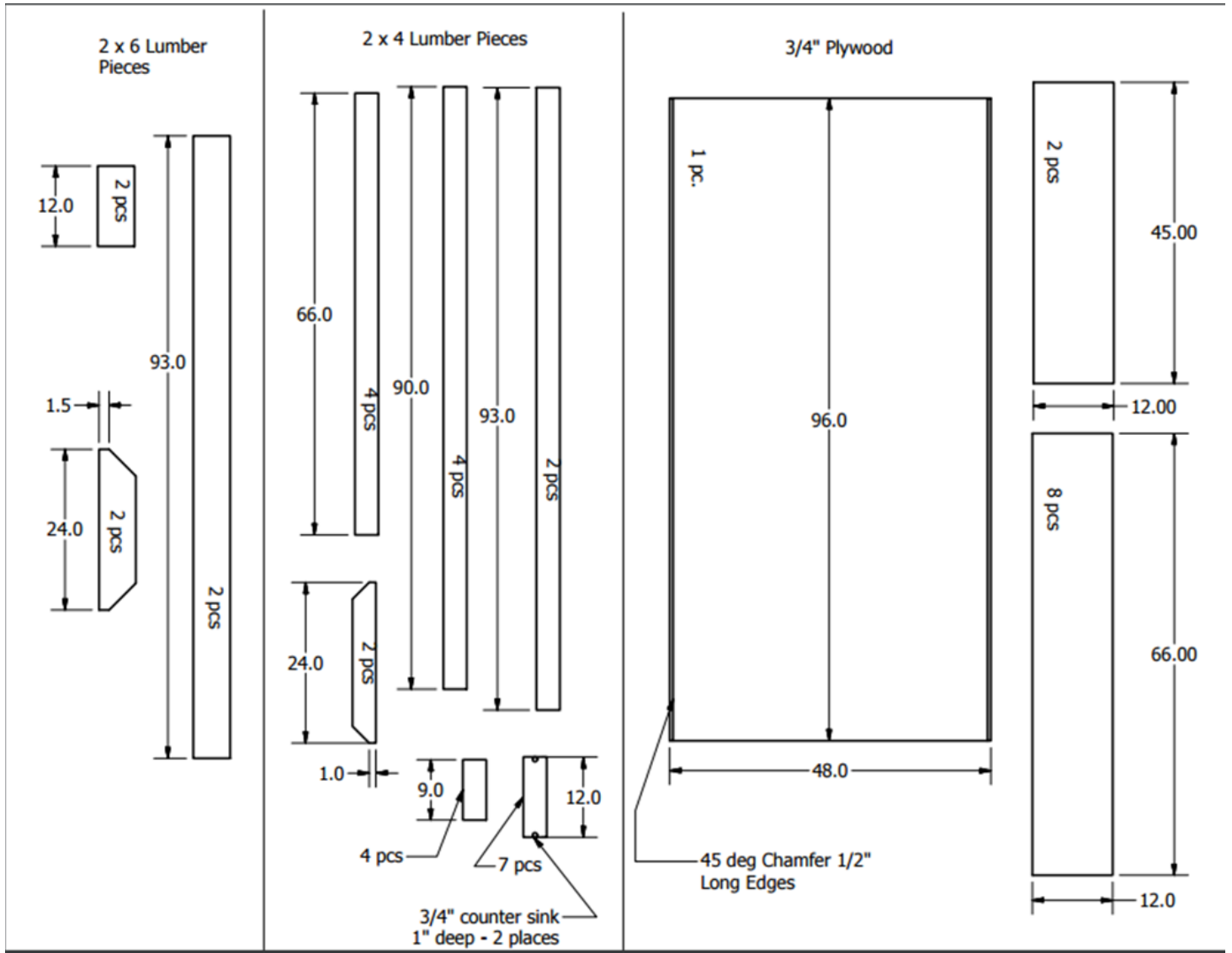
2 pcs - Toeboard Flange - 4698T157

2 pcs - crossover clamp - 4698T44



APPENDIX H

OCCRA 2016: LUMBER CUT PLAN



APPENDIX I

OCCRA 2016: ROBOT INSPECTION WORKSHEET

Mechanical:

- ☐ APPEND B - cost constraint parts (\$100 @) 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 .75" floor clearance except at wheels X _____

ALLOWED MOTORS (no limit) and their CONTROLLERS RB5

DeWalt Drill motors _____	Vic/Talon _____
CIM motors _____	Vic/Talon _____
Keyang motors _____	Vic _____ or Spike _____
Denso wiper motor or clutched lift-gate motor _____	Vic/Talon _____
Globe motor _____	Vic _____ or Spike _____
Pwr Sliding Motor may sub for Denso _____	Vic/Talon _____
PG27,71,188 AM Gearmotor _____	Vic _____ or Spike _____
BAG motor _____	Vic/Talon _____
Other Motors? If more than 20A rating, must use Victor or Talon _____	
And must be from BaneBot, Robot Space, AndyMark or VEX _____	
Compressor _____	Relay _____

Event # _____

RB7

- Max:Size 132" (perim.) x 44"(Height) In start position _____
- Entire robot within starting footprint _____
- Weight (less than 115) _____
- W/pneumatics (Less than 120) _____

Fairness Forms _____

Inspector X _____

Date _____

Electrical:

- ☐ RB5 - 1 Victor/Talon controller per CIM, Dewalt, BAG, Valeo/Denso/Sliding Door motor. X _____
- ☐ APPEND - Approved – batteries (18-A-Hr.rating) with approved chargers (2/4/6 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 _____
- ☐ RB4 - Correct gauge wire (14ga) or better for– motors – (6ga) battery – (22ga) sensors. X _____
- ☐ RB4 - Connectors properly installed/crimped/soldered (no bare/exposed wires). X _____
- ☐ RB2 - Control box mounted/**accessible**/secured w/cover, Cortex must be visible. X _____
- ☐ RB3 – Cortex powered by 7.2V battery; must have 9V back-up battery X _____
- ☐ RB5 - Wires strained relieved as they enter the control box using the eye bolt. X _____
- ☐ RB2 &5 – 1 control boxes; no alteration of electrical components mounted in the box(s). 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 _____
- ☐ RB4 – 80-Amp or 120Amp breaker supplied by OCCRA for main; 30A max. for branch circuits. X _____

Pneumatics:

- ☐ RB16 - Automotive relay to run the compressor – cannot be direct wired. X _____
- ☐ RB16- Only Thomas or the VIAIR 00090 compressor allowed X _____
- ☐ RB16 –Tubing must be 1/8" or 1/4" tubing X _____
- ☐ CURR - Air tubing, securely routed. X _____
- ☐ RB16 - Bleed off valve accessible for transport. X _____
- ☐ RB16 - Pressure gauge and regulator mounted and visible on output stream of system. X _____
- ☐ RB16 – Cylinders and pneumatics storage devices, no fabrication, no modification. X _____
- ☐ RB16 - Demonstration of 60 PSI max output. X _____

Miscellaneous:

- ☐ RB13 - Color Flag 1/2" PVC Pipe mount/clearly visible from all sides. X _____
- ☐ RB13 - Team Numbers (4"min.) – size and clearly visible from 3 sides. X _____
- ☐ RB7 - No contact surfaces on chassis at angles less than 60 degrees. X _____