

The Rules of Collegiate Robotic Football AKA Mechatronic Football

This document sets forth rules of the game of Collegiate Robotic Football. These rules are subject to change in accordance with the evolution of the competition. Except as noted below, the competition follows all NCAA rules, including coin tosses, referee guidelines, unsportsmanlike conduct (by either machine or human), late hits, and so on. Referees shall treat the Players as humans for the purpose of application of the NCAA rules of collegiate football.

A. Players and Teams

1. The game is played by two opposing teams, each consisting of remotely controlled robots, referred to as Players.
2. No more than 8 Players from a Team are allowed on the playing field during a play, i.e. the game is 8-on-8. These rules also apply to games of 6-on-6 when there is space or other restrictions (see Figures at the end of this document for field dimensions). A delay of game penalty is assessed for having an excess of Players on the field at the beginning of a play, resulting in a 5' penalty marked from the line of scrimmage.
3. Humans are not allowed to intentionally touch any of the Players on the field of play with the following exceptions. One individual from the offensive team is allowed to:
 - i. Place the ball over the body of the center before an offensive play, and
 - ii. Place the ball on the kicking tee before a kicking play and prepare it to kick.
 - iii. This person must make a sincere effort to be off the field before the play starts. Once intentionally touched by a human, a Player is considered injured/damaged and cannot participate in the next play unless the team calls a time out. If the play starts with such a player on the field, a 5' delay of game penalty results.
4. Locomotion of Players must be DC powered, with a 24v maximum circuit voltage. Other stored energy sources can be used to power Player accessories as long as they are safely engineered. Any lead acid batteries must be sealed.
5. Players must have a kill-switch mounted externally on their top surface, easily reached. When activated, the switch should disconnect the main power to the system. Additional details are provided in the Technical Appendix.
6. Quarterbacks and Kickers can weigh no more than 45 pounds, and all other Players can weigh no more than 30 pounds.
7. All Players will be positioned on the field by remote control. Teams may not interfere with the signals broadcast from the opposing Team.

8. A specified digital accelerometer (tackle sensor) is required to sense if an upsetting event (knockdown, fall down, or tackle) has occurred. The code determining if an upsetting event has occurred, based on the accelerometer's output, will be provided. The sensor must be rigidly mounted in a horizontal orientation to a horizontal interior surface of each Player's base plate in a manner that enables a trainer to manually activate the reset button on the sensor within 10 seconds and a cable to be attached to reload the sensor software within 1 minute. The tackle sensor must also be mounted so that when the unit faces directly downfield, the tackle sensor is square to the end zone.
 - i. Only the quarterback, wide receivers, and running backs will be required to have tackle sensors. Other units do not require tackle sensors, but any unit that carries the ball will be required to have a tackle sensor regardless of that unit's functional designation. Any violation of this rule results in an "ineligible player" violation and a 5' penalty.
 - ii. Only Players with tackle sensors may advance the ball.
9. At least one single multi-color, high-intensity LED light, viewable from all directions, is to be used to indicate Player status. During normal play, each Player on the field will display a designated color for identification and status.
 - i. A player in "go" status shall have a GREEN light visible from all directions.
 - ii. A Player in possession of the ball is tackled when an upset-event has been detected by the tackle sensor and activates the RED light, which shall remain lit for 2-seconds minimum.
 - iii. Offensive Linemen must be clearly distinguished by a BLUE light visible from all directions so referees can determine eligibility. Offensive Linemen must be within 6 feet on either side of the ball and on the line of scrimmage at the snap.
10. A Player cannot take the field if it is judged by the referee to have a malfunctioning tackle sensor.
11. At their discretion, the referees may verify that any Player has a functioning upset-event sensor at any dead ball. If a ball carrier goes out of bounds or into the end zone and the referees determine immediately afterward that the upset-event sensor is not functioning properly, a 15' penalty and loss of down will be assessed and the Player will be removed from play until it is repaired. For non-ball carriers, the penalty will be just the 15' penalty without loss of down.
12. A Player's base plate must be solid and made of HDPE not thinner than ½ inch. A reasonable number of clearance holes for component mounts, component clearance, fasteners, wheels and wires are allowed. The outside of the base plate must be completely ringed with a bumper (specifications in the Technical

Appendix) that can be directly contacted from any horizontal direction by another Player's bumper-covered base plate. This requires that no fixed/permanent part of a Player may protrude beyond a vertical prism projected up and down from the base plate's bumper.

13. Stiff-arming is not allowed. Violation of this rule results in stoppage of play, loss of down and 15'. Stiff-arming is defined as the deployment of any material beyond the perimeter of the base plate that impedes the ability of an opponent to contact a Player's base plate and thus block or tackle a Player. If an appendage is deployed by a Player who is carrying the ball, upon simple contact by an opponent with the deployed appendage, the referee will call a touch-tackle and the play will be dead and the penalty enforced.
14. The centerline of a Player's base plate must be located 3.0 ± 1 inches above the playing surface and remain in that position at all times. This distance can be measured at any point during play by a referee, and if the Player is out of tolerance, the Player is no longer eligible to play.
15. There are no restrictions on the shape of a base plate or Player, but all Players, except the Center and the Kicker, must fit within a 16 inch square, 24 inch tall box at the beginning of any play (bumpers included from 2019 on). Only the Center may reach out from beyond this footprint before a play to deliver the ball to another Player. The Kicker may be rectangular and must fit within a 16 inch by 24 inch rectangle, and not be more than 24 inches tall.
16. Tires must be mounted on rigid, solid, wheels. Plastic is an acceptable material. Foam tires are allowed, but they can be no thicker than 1/2 inch and no softer than 20 Shore. Pneumatic tires are not allowed. Suspensions and shock absorbing systems are not permitted.
17. Players do not have to wear "jerseys," but must have numbers and must be readily identifiable from the sidelines as a member of their Team through the use of colors and have visible numbers.
18. Players, other than the center to which this rule does not apply, can have no more than 2 extensible arms consisting only of rotational joints.
19. The Kicker will perform a kick by striking the ball with a solid object. Stored mechanical energy may be used to power the device that kicks the ball. Punting and place-kicking (kickoff, field goal and point-after touchdown) are nominally identical. The kicking tee, upon which the ball can be manually placed, can elevate the lowest portion of the ball no more than 3 inches above the playing surface. The kicking tee may be an integral part of the Kicker.
20. When a Team elects to either punt or kick a field goal, it must verbally notify the referee and opponent which action it is taking prior to the placement of the ball on the Kicker/tee.

B. The Playing Field, Player and Ball Positioning

1. The game will be played on a field 90' long and 48' wide, as shown in Figure 1 (94' by 50' is acceptable if playing on a conventional NCAA basketball court). End zones extend 12' past the goal lines for a total area needed of 48' x 114' (10' past the goal lines on a 94' field). From end to end, the playing field is divided laterally into three equal sections. For a game of 6-on-6, the length of the field is unchanged, but the width is reduced to 42'. Hash marks are spaced 5' apart on either side of the center line for spotting the ball. The center of the field is marked with an "X" for the referees' benefit. The place at which a PAT is attempted is at the 10' line. There shall be a buffer between the sidelines and any spectators of at least 5 feet, along with any appropriate barrier.
2. The goal posts are to be nine (9) feet tall (8 feet is acceptable when justified by transportation requirements), six (6) feet apart from each other, and with a cross bar that is three (3) feet above the ground. The goal posts are toward the back of each end zone.
3. At the beginning of each half, after a touchdown, and after a field goal, the defending team kicks off to the receiving team from the one-third field mark of their own territory. The clock is started and play is initiated when the Kicker contacts the ball. The ball must be kicked from the centerline of the field. Since the receiving team is effectively the offense, three humans may be in or behind the receiving end zone as specified in rule B-13.
4. If the kicking team has an inoperable kicker, a QB may substitute and throw the ball to the opposing team. However, the throw must be made from the PAT line and cannot result in kicking team recovering the ball. The throw must result in change of possession.
5. A kick is caught by the first Player touching the kicked ball. If that Player can take possession of the ball before advancing it more than 10', before being tackled by an opponent, and before a second player touches the ball, the Player may advance the ball if it has a tackle sensor.
6. On a kick-off, the receiving team must line up behind the midfield line or marker. If the ball does not pass the midfield line or marker on the kick-off, only the receiving team may take possession of the kicked ball. During kick-off, if the ball passes the midfield line or marker, it will be considered live and may be recovered by either team.
7. If a ball is kicked out of bounds, the receiving team has the option to: (1) take possession of the ball from the point on the field where the out of bounds occurred, or (2) take possession of the ball at the one-third field mark of their territory. If a ball is kicked into or past the End Zone, the Receiving Team takes possession of the ball at the one-third field mark of their territory.

8. A first down is realized when a one-third span of the field is covered within 4 plays.
9. The referee initiates any kind of kicking play by blowing a whistle following an indication from the kicking team's coach that the Kicker is ready. To simulate the time it takes for a human to run up and kick the ball, the Kicker cannot kick the ball earlier than 2 seconds after the initiation of the play. The penalty is a replay of the down and a loss of 15'.
10. The Team receiving a punt will take possession at the point where one of its Players touches the ball. If that Player can take possession of the ball in accordance with the same standards as Rule B4, the ball may be advanced.
11. If the ball comes to rest in the End Zone, or if the ball is punted out of the End Zone, the Receiving Team takes possession of the ball at the one-third field mark of their territory. The Receiving Team has the option of taking possession of the ball up in the End Zone and advancing the ball.
12. Because its wheels are not easily viewed by the referees, a Player is considered out of bounds when any portion of its footprint crosses the inside of a sideline or endline.
13. Each Team will have a sideline area on one-half of the field. See Figure 1. The direction of play will remain the same for the entire game, with a team's sideline area being on their offensive side of the line of scrimmage. Humans controlling the Players and engineers providing service to Players are restricted to this area except as noted in Rules B-13 and B-14.
14. Offensive Player controllers can enter the playing field between plays to facilitate positioning their Players on the line of scrimmage prior to the snap of the ball. A referee will stand on the hash mark, 15' from the line of scrimmage on the offensive side of the line of scrimmage. The offensive team human controllers who are on the field cannot move any closer to the line of scrimmage than the imaginary line indicated by this referee – the Controller Boundary. Doing so is an off-sides penalty, assessed by a 5' penalty marked from the line of scrimmage.
15. Once the offensive Players are positioned, all but three of the offensive Player controllers must return to their sideline prior to the snap of the ball. Three offensive Player controllers may remain on the field during the play but must remain behind the Controller Boundary for the entire play. If the Player with the ball or the ball itself approaches their location, they must make an obvious effort to retreat or leave the playing surface.
16. Defensive Player controllers are restricted to their designated sideline areas at all times.
17. After each play, the referee spots the forward progress of the ball with a "toe-

spot", marking the new line of scrimmage. If yardage was gained in the previous play, the ball will be toe-spotted at the point of maximum forward progress of the ball. If yardage was lost, the ball will be toe-spotted at the point where the ball was located when the Player was tackled. The ball will be toe-spotted on the hash marks closest to the side of the field where the play ended. If the play clock had been stopped, it will restart when the referee has fully stretched out his/her arm with the football to hand it to the offense.

18. The center will line up with its leading edge on the line of scrimmage indicated by the referee's toe-spot.
19. A referee shall call a fumble if the ball carrier loses control of the ball without contact with another player. If impact from another player clearly causes the ball carrier to lose the ball to the ground, the referee shall call a fumble (if in doubt, no fumble shall be called). The team that first touches a fumbled ball gains possession. If the Player who touches the fumbled ball can take possession of it in accordance with the same standards in Rule B.5, that Player may advance the ball.

C. Game Timing

1. The game consists of two 20-minute halves and a brief halftime (5 or 10 minutes). The running clock only stops after touchdowns, field goals, or timeouts called by either team or the referee. During the final two minutes before the end of either half, the clock shall also stop at the end of each incompleteness, penalty, or first down (the clock starts again when the referee extends the ball to the offense).
2. The offense has 25 seconds, indicated by the play clock, from the time the referee toe-spots the ball to initiate a play. Failure to do so results in a delay of game penalty, assessed by a 5' "ineligible receiver" penalty marked from the line of scrimmage.
3. Other than kick-offs, punts and kicked PATs, a play is initiated the moment the Center releases the ball (not simply moves it).
4. Each Team is allowed 2 timeouts per half. A timeout can only be designated by the team coach forming a "T" with his/her hands. Each timeout lasts 1 minute. The 25-second play clock is started after the 1 minute has expired. A delay of game penalty results from a timeout called after all timeouts have been used, resulting in a 5' penalty marked from the line of scrimmage.
5. In case of a draw at the end of the game, NCAA rules for overtime are observed with each offense taking possession at the one-third line.

D. Scoring Rules

1. A kicked Point After Touchdown (PAT) is spotted at the 10' mark.
2. A PAT may also be run in, or passed in, and is then worth 2 points. If passed

- in, the completed pass has its own value as well. See pass scoring below.
3. All pass distances are measured perpendicular to the line of scrimmage.
 4. A long forward pass is defined as 10 feet or more and is worth 6 points if caught outright, 4 points if caught by touch.
 5. A short forward pass is defined as zero to 10 feet from the line of scrimmage and is worth 4 points if caught outright and 3 points if caught by touch.
 6. A screen pass is defined as a pass not beyond the line of scrimmage. There are no points awarded for a screen pass.
 7. All interceptions result in the defense taking possession of the ball. No extra points are awarded to the defense. If the defense intercepts by "touch," the ball is down at the point of interception. If a defensive player deflects the ball in the air on the offensive side of the line of scrimmage, it shall be ruled a deflection rather than an interception. If the defense intercepts by catching the ball outright, it may advance the ball.
 8. No team may earn more than 7 points from passing during a single possession. The maximum number of points that can be scored in a possession is 15 (7 for passing, 6 for a TD, and 2 PAT points).
 9. A ball downed in an offensive team's end zone results in a safety, with 2 points being awarded to the Defensive Team. The team charged with the safety punts the ball from the one-third field mark of their territory.
 10. Teams may elect to have the ball start on the quarterback. In this case, all scores are reduced by one half (rounding up). For example, a long pass completed with the ball starting the play on the Quarterback rather than the center is worth 3 points instead of 5.

E. Offense

1. The game is played using a miniature souvenir football. The ball may not be significantly modified and must be pressurized to a pressure within the range stated on the ball. Each offense may elect to use their own ball for their possessions. Referees may confirm that the ball is unaltered and properly inflated at any dead ball. Violations will result in a 15' penalty and loss of down. If any players (including the Kickers) damage the ball during play, a penalty is assessed by adding 3 points to the opponent's score.
2. All Players with tackle sensors are eligible to run down field and catch passes.
 - i. A Center or Offensive Lineman may not materially cross the line of scrimmage on a pass play until the ball has crossed the line of scrimmage,

- and a 5' penalty for doing so is assessed.
- ii. A Center or Offensive Lineman cannot be the first to touch a forward pass and the penalty for doing so is a 5' penalty.
 3. After each play, a referee must be able to remove the ball from any Player without touching that Player or lifting that Player off the ground so as to spot it for the start of the next play. This rule does not apply to quarterbacks unless the quarterback advances the ball by rushing past the line of scrimmage, and it does not apply to Kickers or defensive players who do not advance the ball following a turnover. If referee cannot freely access the ball, after one warning per half, that player will be ejected from that game only.
 4. A pass is caught/intercepted when any part of a Player contacts the ball before the ball touches the ground. If that Player retains possession of the ball and is equipped with a tackle sensor, the Player can advance the ball.
 5. A field goal or kicked PAT is scored when the kicked ball passes over the goal post crossbar and between the goal posts.
 6. If a field goal attempt outside the defending team's one-third field mark is missed, the defending team takes possession of the ball at the point of the field goal attempt. If a field goal attempt inside the defending team's one-third field mark is missed, the defending team takes possession of the ball at its one third field mark.

F. Defense

1. Exactly 3 defensive players must line up within 1' of the line of scrimmage, and all must be in close proximity to the spotted ball. The remaining 5 defensive players must be at least 10' back from the line of scrimmage until the play begins, at which time full rush is allowed. Violations will result in an "illegal formation" penalty, assessed by a 5' penalty marked from the line of scrimmage.
2. Passes contacting the 3 defensive players at the line of scrimmage will be considered deflected and not intercepted unless the player retains the football or has dropped back at least 5' from the line of scrimmage into pass coverage position.
3. No significant contact is allowed between the offensive pass receiver and a defender, where "significant" will be judged by the referees to mean anything that impedes the free movement of either Player. The Player initiating the significant contact will be charged with pass interference. Defensive pass interference results in an automatic first down and a 10' penalty marked from the spot of the foul. Offensive pass interference results in a loss of down and a 15' penalty marked from the original line of scrimmage. Pass interference penalties will only be called on plays in which the ball starts in or is transferred

to the quarterback, so run blocking that results in a tackle will not constitute an interference penalty.

4. "Forward progress" is called when a Player is considered tackled if it is in contact with other players and unable to move the ball in any direction within a 2 second period.

G. Offensive and Defensive Penalties

1. There is a 4" neutral zone on either side of the line of scrimmage. The only Player allowed in the neutral zone before a play is initiated is the Offensive Center. A Lineman is offside when it breaks the neutral zone prior to the snap, even if no contact is made with the opponent. The penalty is assessed by a 5' penalty marked from the line of scrimmage, and the down is replayed.
2. If human offensive player ventures into defensive side of the ball, thereby interfering with the defensive line, the referee shall first issue a warning. If after one warning, problem persists, the player shall be issued an unsportsmanlike penalty.
3. A "roughing" penalty called by a referee results in a 30' penalty. If the offended Player is damaged, it becomes the discretion of the referees to either disable an equivalent Player on the offending team or require the offending team to forfeit the game.
4. After the ball is released by the quarterback, there may be no significant contact between the defense and the quarterback as result of the motion of the defensive Player. The penalty is 30' for roughing the passer.
5. If the center retains the ball after the first attempt to pass it to the intended player, a 5' false start penalty shall be assessed.
6. The offense must have at least 4 Players within 1' of the line of scrimmage at the start of the play. The 4 Players can be anywhere on the field laterally. Violations will result in an "illegal formation" penalty, assessed by a 5' penalty marked from the line of scrimmage.
7. Taunting or verbal abuse by humans will not be tolerated. The first offense results in a warning to the individual. A second offense results in a 20' penalty for unsportsmanlike conduct. A third offense results in immediate ejection from the game.
8. If a unit has been driven at full speed into a barrier or wall, or if the referee determines that a unit has been operated without regard to safety, the referee will award a 15' penalty against that team. Intent or loss of control does not have to be established.
9. Kicker Ball Placement: The only contact allowed between a human and the kicker on the field is that needed for ball placement and to release any safety device.

Other prep work on the kicker must occur on the sidelines. The penalty for violation is delay of game.

10. To protect the human operators on the field, the following “unsportsmanlike” penalties will be adopted:
 - i. If the offensive human operator does not maintain a 10’ buffer between him/her and all offensive robots, the play will be whistled dead.
 - ii. If a defensive player gets closer than 5’ to a human offensive operator on the field, the referee will assess a 15’ penalty against the defense and the down will be replayed.

Figures: For all figures, red lines indicate a brightly colored tape to line the field. The depth of the team benches and stage are approximate. The goal posts are placed at the back of the end zones.

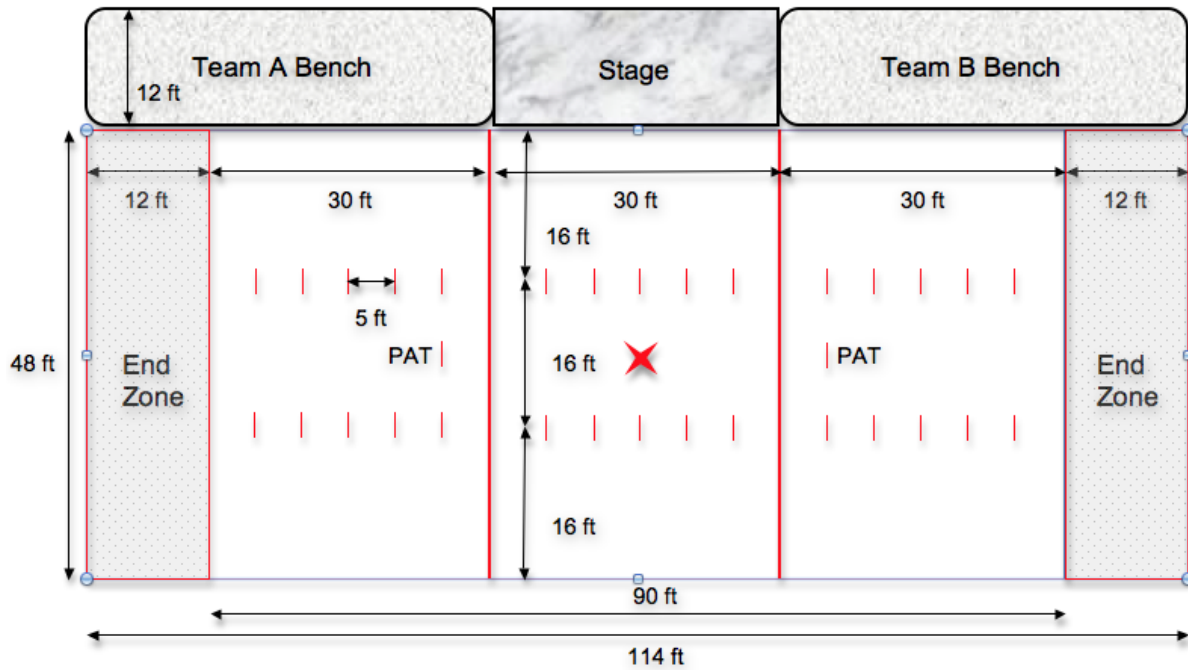


Figure 1: Standard Game: Playing Field Dimensions, 90' x 48'

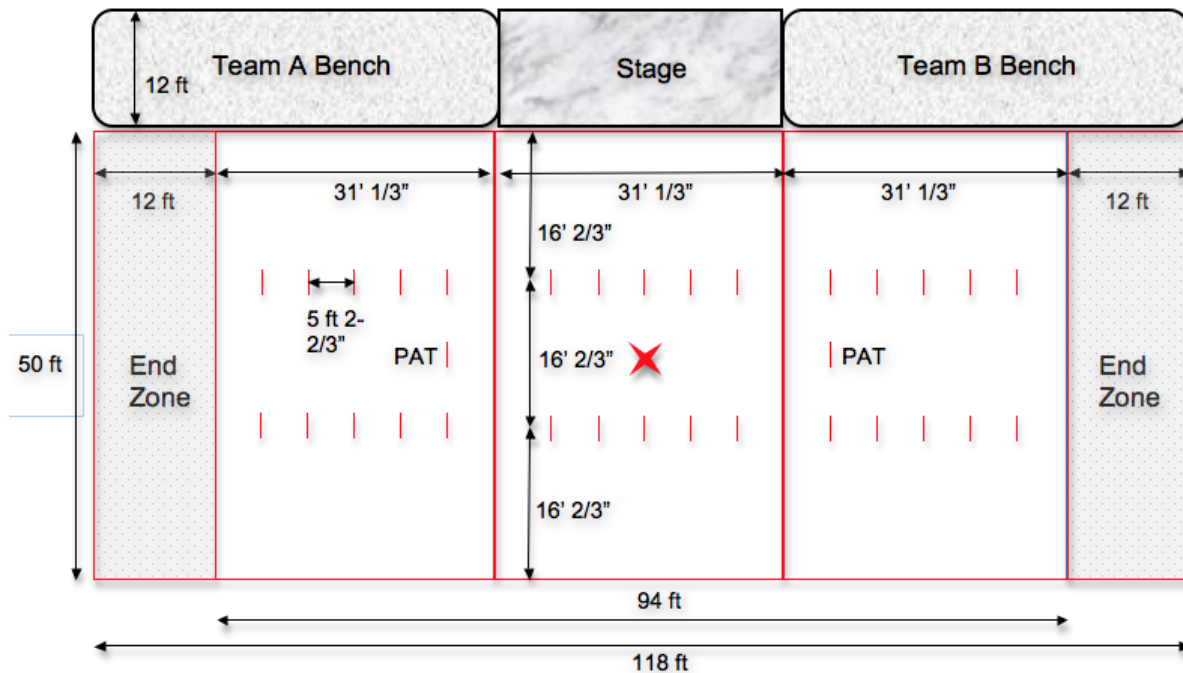


Figure 2: NCAA Basketball Court Playing Field Dimensions, 94' x 50'

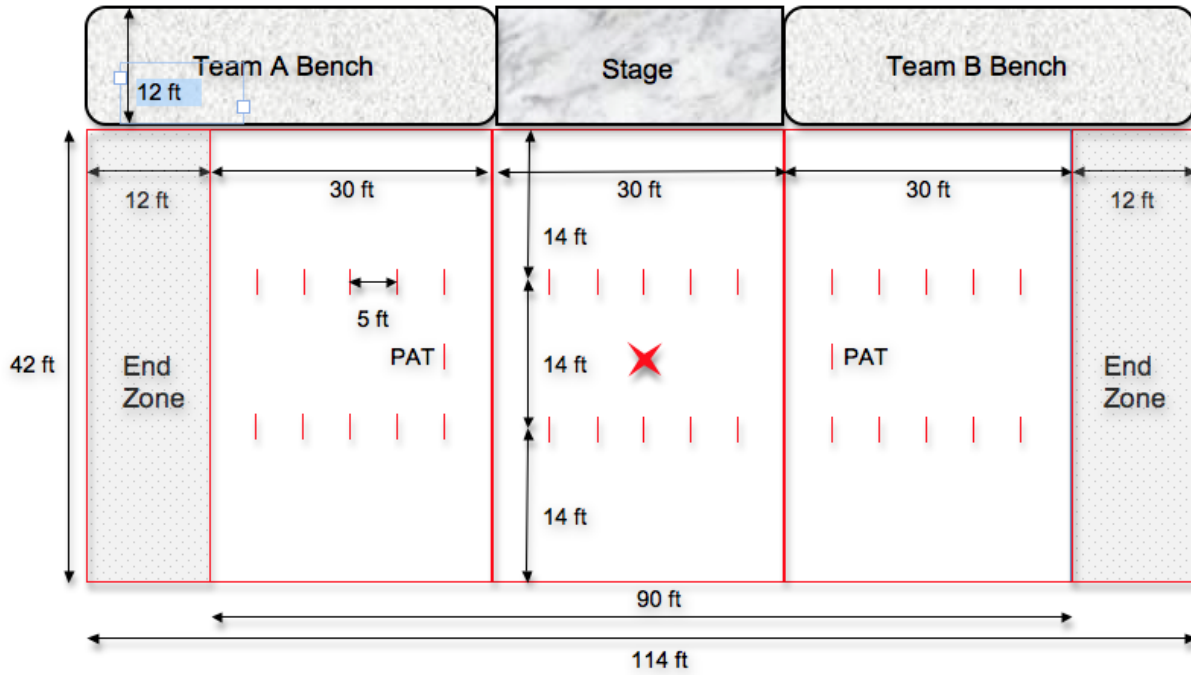


Figure 3: Six-on-Six Playing Field Dimensions, 90' x 42'

Pre-Game Activities

The order of the pre-game activities is:

1. Singing or playing of the national anthem (and any other rituals normally performed at college football venues associated with the anthem).
2. Coin toss involving the referees and at least one representative from each team.

Technical Appendix:

The following pieces of equipment are required items:

1 Kill switch:

a It is recommended that you use a lever type battery cut-off switch made for automotive applications. The kill-switch must be readily identifiable and colored red. A good example can be found at <http://www.pegasusautoracing.com/productdetails.asp?RecId=4913>.

b The switch cannot have a removable key, such as in the kill-switch found at <http://www.pegasusautoracing.com/productdetails.asp?RecID=1465>

2 Base-plate bumper material:

This will consist of a hollow bulb P-strip of extruded Ethylene Propylene Rubber (EPDM) acquired from Wefco Rubber Manufacturing Company, Inc. The part number is #4134, and the detailed dimensions can be found at http://wefcorubber.com/extrusions_industrial_pstrips.asp. The nominal stem thickness is 3/32 inch, and the nominal bulb diameter is 9/16 inch. The stem of the bumper must be bolted in a rigid fashion to the top or bottom of the base plate such that the hollow bulb is in direct contact with the 1/2-inch thick outside surface of the base plate. In this way, the hollow bulb will be the contact material for any contact with other Players. Bolts must be placed at least every 3.25 inches as measured along the perimeter of the base plate and may not be threaded directly into the base plate (thru holes and nuts must be used).