PART I

Robotic Football Combine Drills

TITLE	POSITION	TESTS
60-Foot Shuttle	All	Speed and controllability
Three-Cone Drill	All	Agility, maneuverability
Strength Test	All	Strength and power
Speed test	All	Pure speed
QB Accuracy Test	QB (WR assist)	Throwing precision/accuracy
Kicker Strength & Accuracy Test	Kicker	Kicking distance & accuracy

The order of the drills may vary from that of this list depending on the number and kind of participants, and some may go on concurrently.

Drill: 60-foot Shuttle (Controllability Test)

Purpose: Measure the ability of the robot to shuttle (reverse direction) in a controlled but speedy manner.

Description: The drill consists of a start line and a finish line halfway in a rectangle 3 x 30 feet. (See Figure 1.) A straight line, marked by tape, is placed 15' from either end, marking the start and finish line. Starting from a standing stop, the robot must shuttle to one end, reverse direction, move to the other end, reverse direction again, and cross the finish line. The time to perform that action shall be measured in seconds. The timing official will measure the time and count the number of times the robot touches either side boundary line (called an infraction). One second shall be added for each infraction.

Measurement: The time taken to shuttle from the starting line to the finish line in the lane.

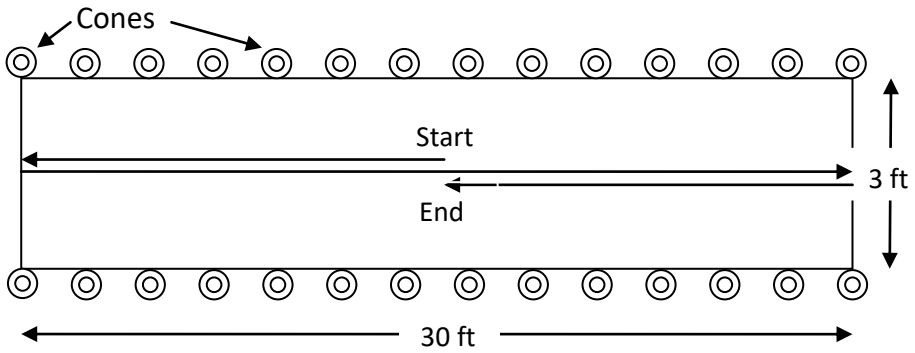


Figure 1. *Setup for the Controllability Test*

Record:

School/Trials	Robot #/Name	Time (secs)	Penalties +1 pt/cone hit	Score
1				
2				
3				
4				
5				

Drill: Three Cone Drill

Purpose: This drill tests the maneuverability and agility of the robot.

Description: As in an NFL combine, this drill consists of 3 cones in an L-shape and spaced 15 feet apart from each other. The robots start and finish on either side of cone #1. See figure 2 for the path around the cones (the path shown is illustrative and approximate). The robot will start from rest at cone #1 with its leading edge just before the start line. The path is timed from when the robot begins to cross the start line to when its leading edge crosses the finish line. A successful path is one that negotiates a nearly 360° turn (cone #2), a 180° turn (cone #3), and a roughly 90° turn (cone #2).

Measurement: The time required, in seconds, to travel from the start cone along the path in Figure 2 to the finish line, with one second added for each time the robot touches a cone with any part of its surface.

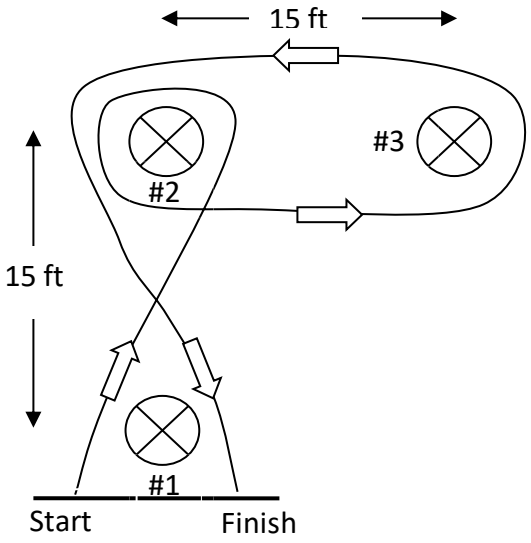


Figure 2. *Three-Cone Drill*

Record:

School/Trials	Robot #/Name	Time (secs)	Penalties +1 pt/cone hit	Score
1				
2				
3				
4				
5				

Drill: Strength Test

Purpose: This drill tests the overall strength of the robot, similar to a bench press.

Description: The robot will start from rest next to a 45-lb weight on a box with four free-wheeling casters. The robot must push the weight a distance of 10 feet. If the robot successfully completes the task, another 10 lbs. is added to the stack. This process is continued until the robot fails to move the stack across the finish line. The robot must start from rest barely touching the box to take momentum out of the test. See Figure 3 for a diagram. The robot does not have to follow a straight line, but the weights may or may not be symmetrical on the platform, so control is a factor.

Measurement: The highest weight in pounds that can be negotiated across the finish line.

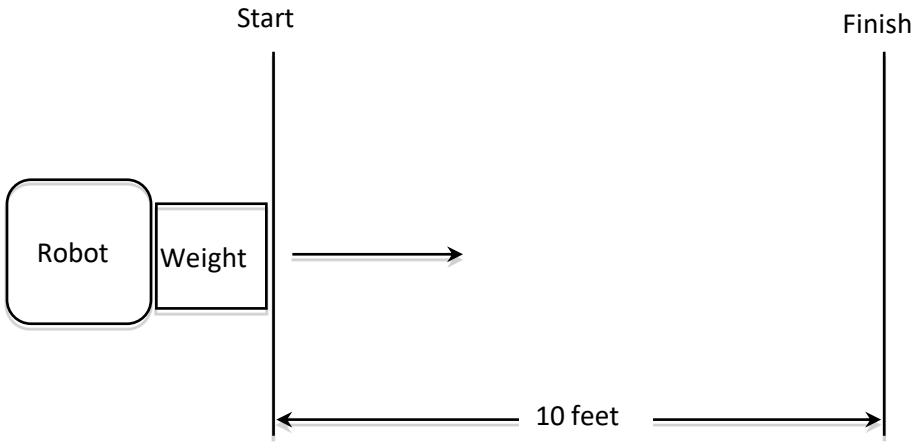


Figure 3. *Strength Test Setup*

Record:

School/Trials	Robot #/Name	Weight (lbs)
1		
2		
3		
4		
5		

Drill: QB Accuracy Test

Purpose: This drill tests how accurately the quarterback can throw to a specific location.

Description: A number of "X" marks are placed on the floor at distances of six, 12, and 18 feet and at angles from a line where the QB is stationed. The Center is on the other side of the line in position to make a handoff to the QB. The WR is maneuvered remotely so that it sits over an "X". The quarterback attempts passes to the wide receiver in the time allotted. If the football hits any part of the receiver but is not caught, the QB is awarded 1, 2, or 3 points for 6', 12', or 18', respectively. The score is doubled (2, 4, or 6 points, respectively) if the wide receiver truly catches the ball. No points are awarded for a miss. If the Center is inoperable, or missing, the scoring is halved. Once a catch or touch-catch is made, the WR must move to another "X" **and no "X" may be repeated until a non-zero score is achieved for each "X".** See Figure 5 for a diagram of the drill. If a completed pass is accomplished for each "X", the team may start again for additional points.

Measurement: The accumulated scores for completed passes in the time allotted.

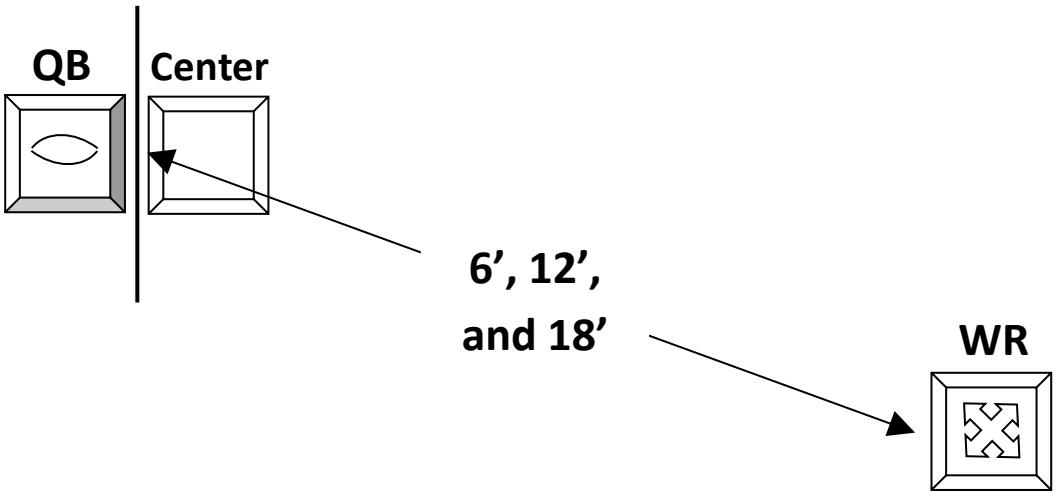


Figure 5. *Quarterback Passing Accuracy Test*

Record:

School/Trials	Robot #s/Names	Distance (Short, Med, Long)	Points	Penalties -3 for hand-feed	Score
1					
2					
3					
4					
5					

Drill: Speed Test

Purpose: This drill measures pure speed.

Description: A robot runs the length of a roughly 60-foot lane and is timed, starting from a dead stop. There is no penalty for deviating from the lane or a straight line, as the recorded time will necessarily reflect any departure from a straight line.

Measurement: The time in seconds taken to run the lane from start to finish.

Record:

School/Trials	Robot #/Name	Time (secs)
1		
2		
3		
4		
5		

Drill: Kicker Strength and Accuracy Test

Purpose: This drill tests the accuracy of the kicker to kick the ball in between two goal posts.

Description: The kicker has three tries to kick the ball through the uprights from distances of 30 feet (a point-after), and 50 feet (a field goal). The time it takes to perform the three attempts, from the first kick through the moment when the third and final ball hits the ground, is recorded to measure speed of preparing the kicker and the speed of the kicker itself to move from one location to the other.

Measurement: The summed score of successful attempts at each location less a time penalty. One point is awarded for each successful PAT; three points are awarded for each successful field goal. If a kicker makes all its kicks, its raw score would be 12 points. One point is subtracted for each 60 seconds (rounded to the nearest 30 seconds) of time required to complete the event. (Example: if the kicker completes 3 PATs and 3 FGs in four minutes, it would receive 12 – 4 = 8 points.) The team with the highest final score wins.

School/Trials	Kicker #/Name	Distance (feet)	Points (depends on distance)	Start time End time	Score = Total points less number of minutes
1		30 (1 pt)			
2		30 (1 pt)			
3		30 (1 pt)			
4		50 (3 pts)			
5		50 (3 pts)			
6		50 (3 pts)			

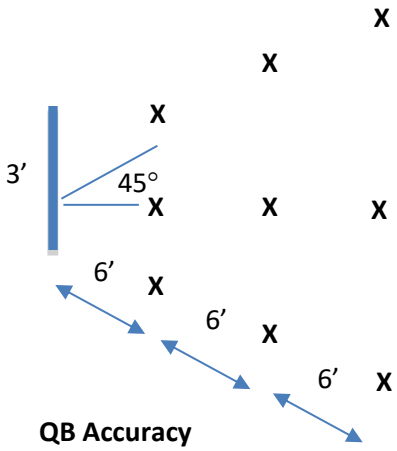
PART II

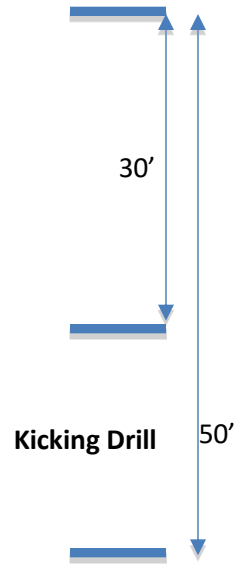
Scrimmage

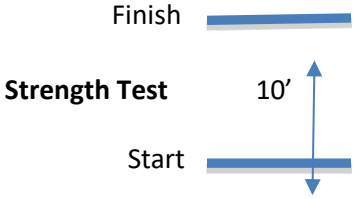
To provide participating teams with a real game experience, the teams attending will be matched up as best as possible in a scrimmage. If full or nearly full teams are present, or if the combine is part of the playoff, they will play each other according to their prior win/loss record. For partial teams, various school units will be asked to fill in so all may experience some game time.

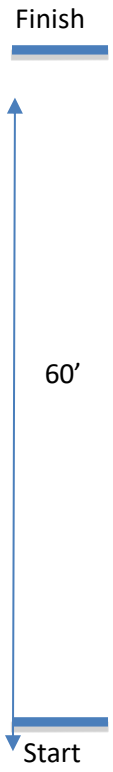
The game will be played on a hard-mat playing surface roughly the size of a basketball court. The exact dimensions and layout of the field can be found on the ND RFC Website. The rules are the same as NCAA rules for collegiate football except where noted in the rules on the website to accommodate the robotic nature of the players. Penalties and fouls will be called according to those rules, but anything involving robots that haven't been designed (kickers, for instance) will simply be dropped from the game. The length of the game(s) will be set at the time, taking into account the number of teams, robots participating, and time permitting.

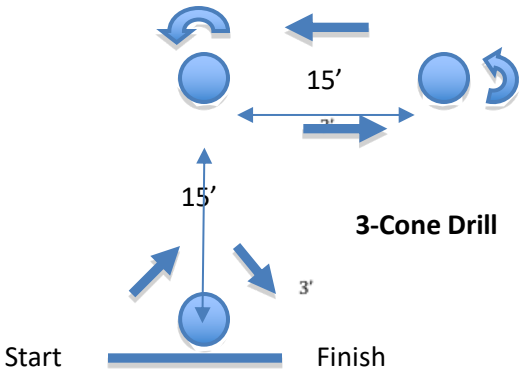
Overall Layout of Combine Events

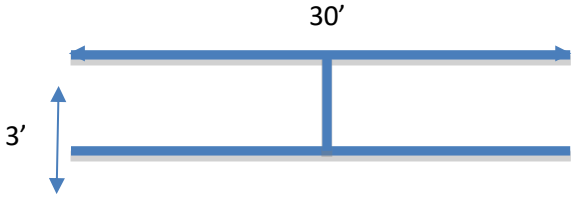












Shuttle

Place ~15 small cones on each side boundary