Section

6

THE ARENA

Table of Contents

6 THE ARENA 2

6.1 OVERVIEW 2
6.1.1 Dimensions and Tolerances 3

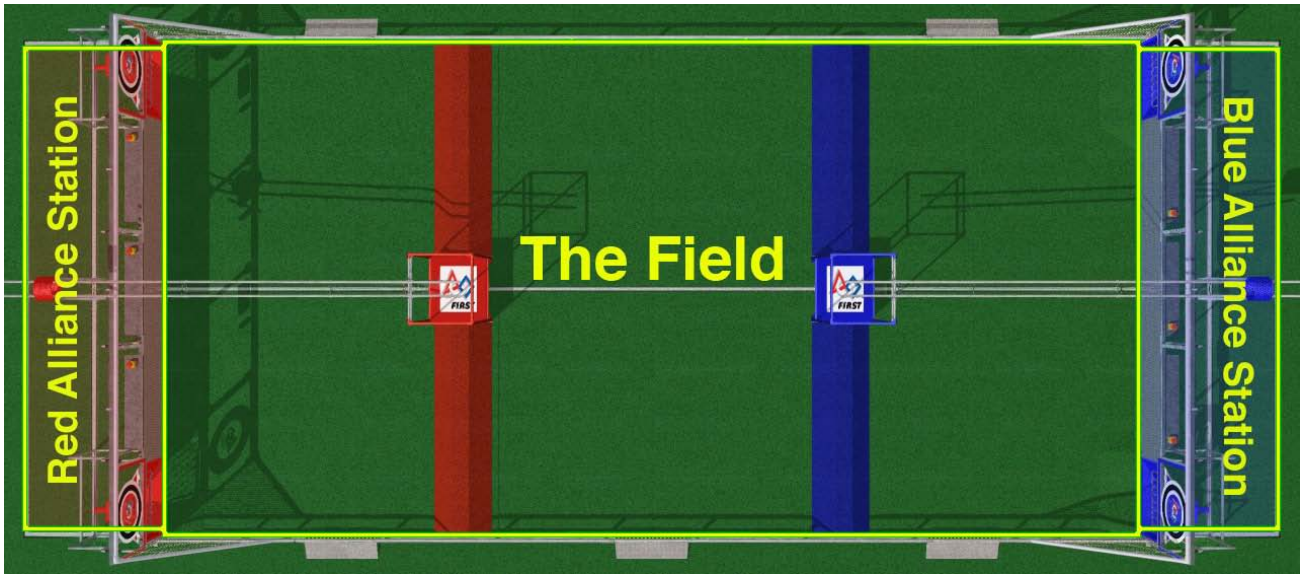
6.2 THE ARENA 4
6.2.1 The FIELD 4
6.2.2 The STARTING GRIDS 5
6.2.3 The BUMPS 5
6.2.4 The TOWERS 6
6.2.5 The GOALS 6
6.2.6 The VISION TARGETS 7
6.2.7 The CORRAL 7
6.2.8 The BALL RETURN 7
6.2.9 The ALLIANCE STATIONS 8
6.2.10 The PLAYER STATIONS 9

6.3 GAME PIECES 9
6.3.1 BALLS 9
6.3.2 TRIDENT 9

6 THE ARENA

6.1 OVERVIEW

The following sections of the manual describe the arena, game, robots and tournament structure used in the 2010 *FIRST* Robotics Competition. Please be sure to read and thoroughly understand Sections 6, 7, 8, and 9 to fully understand the game and ensure the best opportunity for success during the competition season.



Note: These illustrations are for a general visual understanding of the Breakaway ARENA only. Please refer to the official drawings for exact dimensions and construction details.

The ARENA includes all elements of the game infrastructure that are required to play *Breakaway*: the FIELD, the ALLIANCE STATIONS, the GOALS, the BALLS, and all supporting communications, arena control, and scorekeeping equipment.

ROBOTS play *Breakaway* on a 27 by 54-foot rectangular field known as the FIELD. The FIELD is bordered by a set of guardrails and ALLIANCE WALLS. During the game matches, the ROBOTS are controlled from ALLIANCE STATIONS located outside the ends of the FIELD. These rectangular zones consist of three team PLAYER STATIONS that provide connectivity between the controls used by the ROBOT operators and the ARENA. GOALS are located at the corners of the FIELD, and extend behind the ALLIANCE WALL and adjacent to the PLAYER STATIONS.

The specifications for the *Breakaway* ARENA used in competition are listed below in Section 6.1.1. The referenced specifications and construction details of the ARENA can be found on the *FIRST* web site at www.usfirst.org/frc/2010/fielddrawings.html . Note that the web site also contains drawings for low-cost versions of the important elements of the ARENA. Teams may choose to build these versions for their own use during the construction and testing of the ROBOT. These drawings can be found at www.usfirst.org/frc/2010/fielddrawings.html.

6.1.1 Dimensions and Tolerances

The exact dimensions and construction details of the ARENA are contained on the official arena drawings. The relevant drawings include:

2010 FRC DRAWINGS			
TITLE	**CATEGORY**	**DWG NO.**	**SHEET/S**
*2010 Arena Layout and Marking**	*Overall Arena Assembly*	*FE-00033**	*5 Sheets*
Floor Protection, Bump	2010 Game Specific	GE-10002	1 Sheet
Floor Protection, Tunnel	2010 Game Specific	GE-10003	1 Sheet
Trident, Assembly	2010 Game Specific	GE-10010	2 Sheets
Tunnel Assembly	2010 Game Specific	GE-10043	2 Sheets
Bump	2010 Game Specific	GE-10047	2 Sheets
Robot Retainer	2010 Game Specific	GE-10056	2 Sheets
*Ball Return, Assembly**	*2010 Game Specific*	*GE-10021**	*2 Sheets*
*Tower, Assembly**	*2010 Game Specific*	*GE-10027**	*1 Sheet*
*Goal, Assembly**	*2010 Game Specific*	*GE-10061**	*2 Sheets*
Top Rail	2009 Game Specific	GE-09031	1 Sheet
Plastic, Goal	2010 Game Specific	GE-10001	1 Sheets
Drivers Station Support	Generic Field Drawing	FE-00001	2 Sheets
Corner Supports, Left and Right	Generic Field Drawing	FE-00002	2 Sheets
Rail Pin Assembly	Generic Field Drawing	FE-00003	1 Sheet
End Panel	Generic Field Drawing	FE-00004	3 Sheets
Field Top Rail	Generic Field Drawing	FE-00007	1 Sheet
Field Plastic “A”	Generic Field Drawing	FE-00008	1 Sheet
Field Plastic “B”	Generic Field Drawing	FE-00009	1 Sheet
Field Plastic “C”	Generic Field Drawing	FE-00010	1 Sheet
Field Plastic “G”	Generic Field Drawing	FE-00011	1 Sheet
Drivers Station Acrylic	Generic Field Drawing	FE-00012	1 Sheet
Field Outrigger	Generic Field Drawing	FE-00013	1 Sheet
Field Entry Ramp	Generic Field Drawing	FE-00014	2 Sheets
Field Trip Guard	Generic Field Drawing	FE-00015	1 Sheet
Hanger, Plastic “G”	Generic Field Drawing	FE-00016	1 Sheet
*Field Rail Assembly - Middle**	*Generic Field Drawing*	*FE-00022**	*1 Sheet*
*Field Rail Assembly - End**	*Generic Field Drawing*	*FE-00023**	*1 Sheet*
*Field Rail Assembly – Gate**	*Generic Field Drawing*	*FE-00029**	*1 Sheet*

**Refer to drawing for all part numbers required to build assemblies.*

The competition ARENAS are modular constructions that are assembled, used, disassembled, and shipped many times during the competition season. They may undergo a significant amount of wear and tear. The ARENA is designed to withstand rigorous play and frequent shipping, and every effort is made to ensure that the ARENAS are as identical from event to event as possible. However, as the ARENAS are assembled in different venues by different event staff, some small variations do occur. Fit and tolerance on large assemblies (e.g. the TOWER) are ensured only to

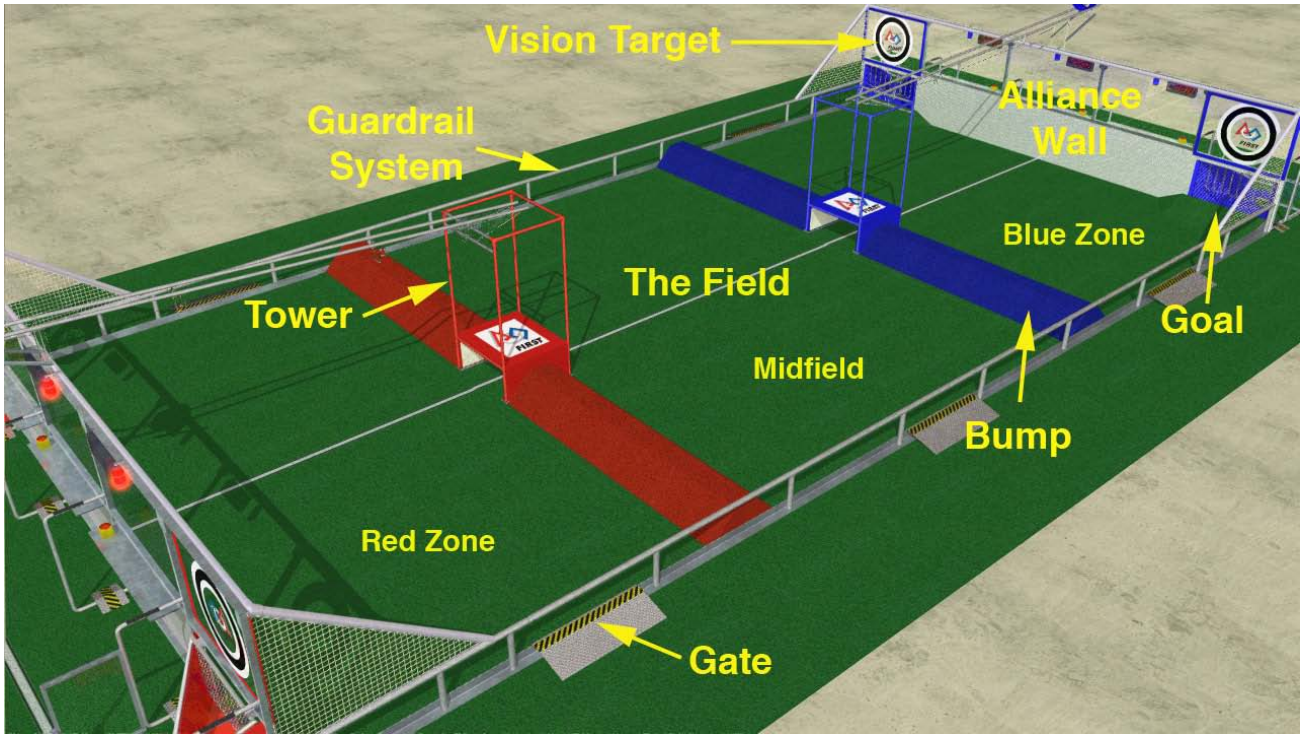
within ¼ inch. Overall gross dimensions of the entire field may vary up to 4 inches. Successful teams will design ROBOTS that are insensitive to these variations.

6.2 THE ARENA

Note: The official Breakaway ARENA description, layout, dimensions and parts list are contained in the "FE-00033 - 2010 Arena Layout and Marking" Drawing. Diagrams and dimensions below are for illustrative purposes only.

6.2.1 The FIELD

The playing FIELD for *Breakaway* is a 27-foot by 54-foot carpeted area, bounded by two ALLIANCE WALLS and a Guardrail System. The FIELD is covered with carpet (S&S Mills Sequoia-20 "scotch pine green," "polar express blue," and "capitol red"). The FIELD includes two BUMPS that divide the FIELD into three regions (the RED ZONE, the MIDFIELD, and the BLUE ZONE). A 2-inch wide white CENTER LINE runs down the center of the FIELD.



The ALLIANCE WALL is 6½ feet high, 27 feet wide, and defines the ends of the FIELD. The majority of the ALLIANCE WALL is composed of an 18-foot wide barrier protecting the PLAYER STATIONS. This barrier is composed of a three-foot high base of diamond plate aluminum topped with a 3½-foot high transparent acrylic panel. At each side of the Player Station barrier is a 4½-foot wide panel containing the GOAL and the VISION TARGET.

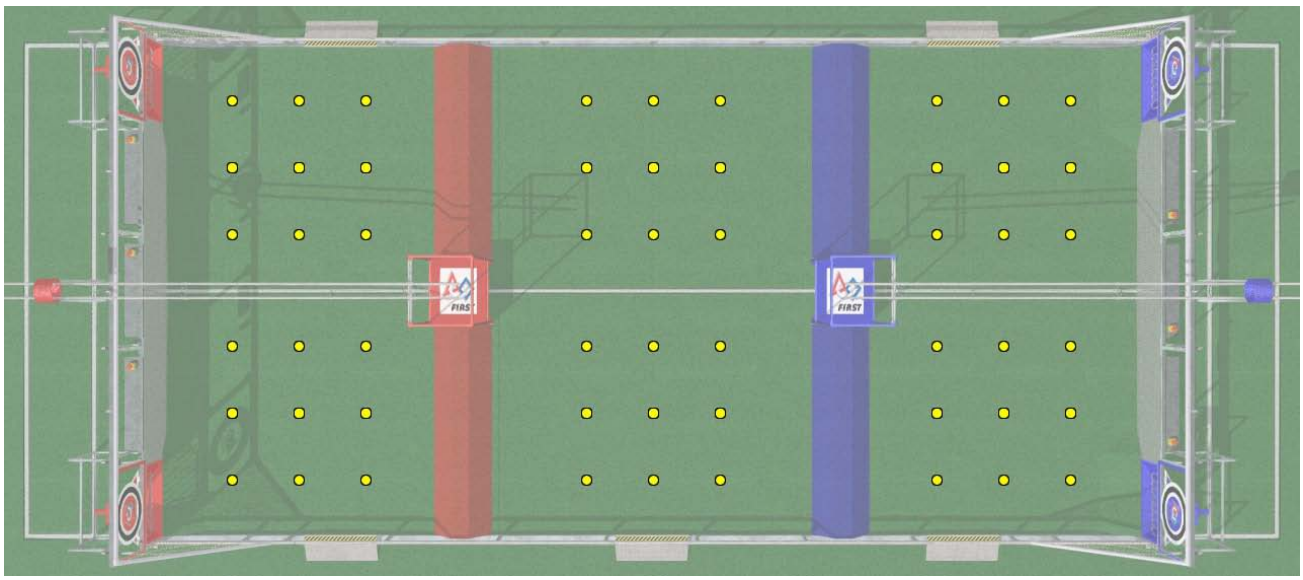
The Guardrail System is a horizontal pipe 20 inches above the floor, supported by vertical struts mounted on a three-inch aluminum angle. A shield is attached on the inside of the Guardrail System, extending from the floor to the top of the guardrail, and running the length of the guardrail. The shield is intended to help prevent ROBOTS, in whole or in part, from inadvertently exiting the

FIELD during a match. The Guardrail System defines the borders of the FIELD, except where it is bounded by the ALLIANCE WALL.

Five gates in the Guardrail System allow easy access to the FIELD for placement and removal of ROBOTS. The gates are four feet wide, and are closed and shielded during game play.

6.2.2 The STARTING GRIDS

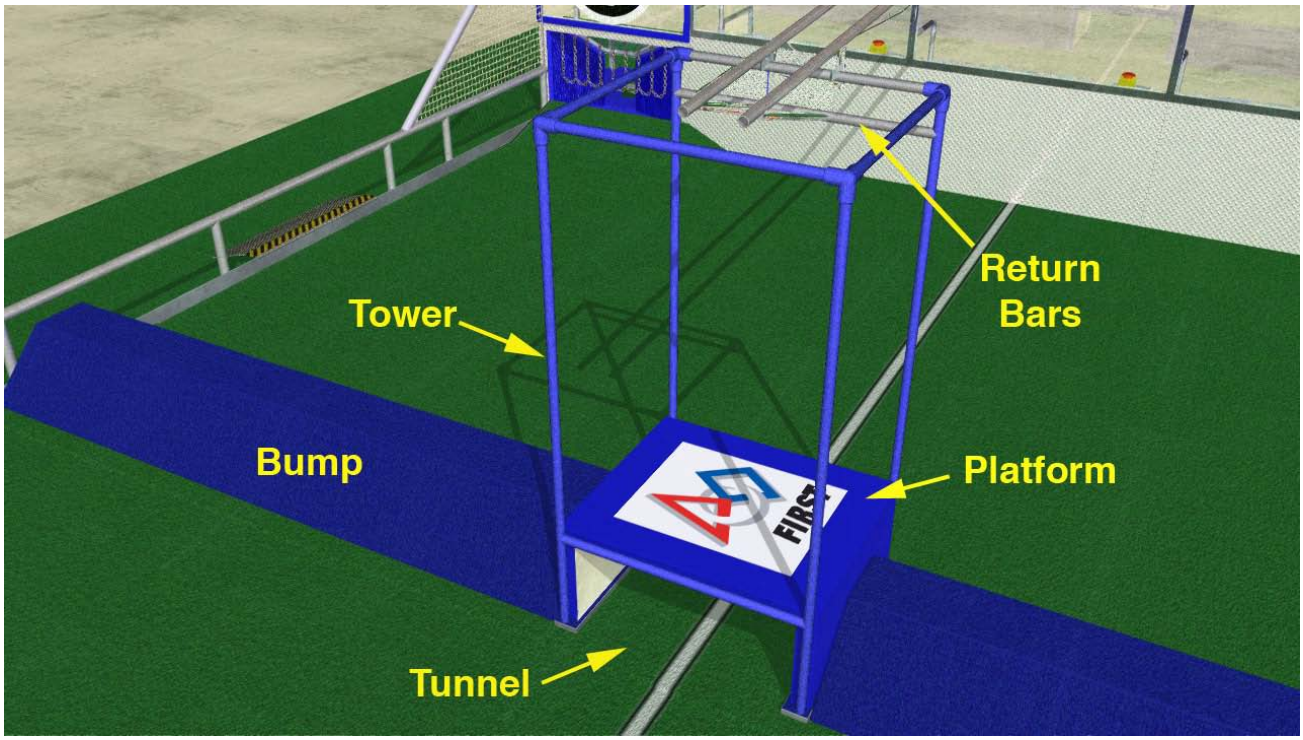
Each region of the FIELD (the RED ZONE, the MIDFIELD, and the BLUE ZONE) includes a STARTING GRID on each side of the CENTER LINE. The STARTING GRIDS are used to indicate locations where the BALLS may be located at the start of the MATCH. Each STARTING GRID is a series of nine dots lightly marked on the carpet, arranged in three rows of three. Each row/column of dots in the grid is spaced three feet apart, and the overall size of the grid is six feet by six feet. Each STARTING GRID is centered within its respective region, between the BUMPS and ALLIANCE WALL, and between the CENTER LINE and Guard Rail System. For detailed specifications for the STARTING GRID, please refer to *Drawing FE-00033, 2010 Arena Layout and Marking*.



STARTING GRID locations. Size and color of the STARTING GRID dots are exaggerated for clarity.

6.2.3 The BUMPS

Two BUMPS are located at approximately one-third of the length of the FIELD. Each BUMP is 12 inches high, 12 inches wide at the top, and extends across the spaces between the TOWER and the Guardrail System. The BUMPS are covered with the same carpet as the rest of the FIELD (although of different colors - red and blue). Each BUMP is colored red or blue, corresponding with the color of the nearest ALLIANCE STATION. The BUMPS are fixed to base plates that are secured to the carpet of the FIELD to keep them from moving. The base plates are covered with the same carpet as the FIELD. Note that this forms a small (approximately ½-inch tall) transition from the FIELD surface onto the base plates.

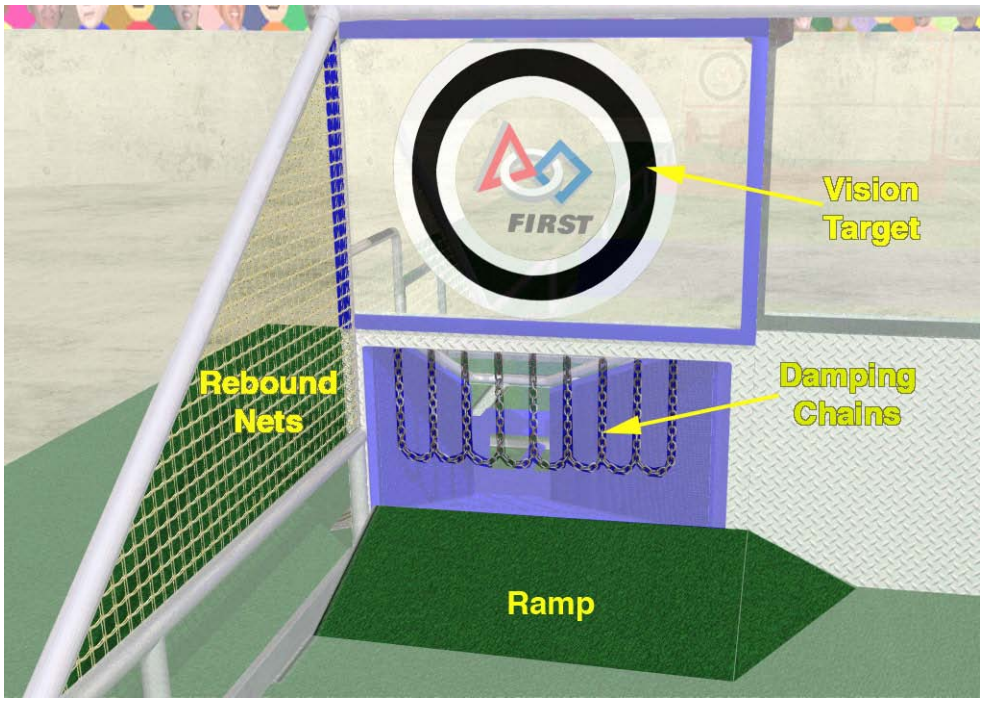


6.2.4 The TOWERS

A TOWER is located in the center of each BUMP. Each TOWER is composed of a base and a pipe superstructure. The PLATFORM is the horizontal surface of the base, and provides a solid surface to support ROBOTS during the game. The PLATFORM is 44 inches wide by 36 inches deep, and is at a height of 20 inches above the floor. A 36-inch wide by 18-inch tall TUNNEL under the PLATFORM, providing a passageway between the MIDFIELD and the adjacent end ZONES. The pipe superstructure is built of 1½-inch diameter steel pipe, and is 7 feet tall (at the top of the horizontal pipe elements). The TOWER is designed to support the weight of several ROBOTS. The RETURN BARS are the two horizontal bars at the top of the rear of the TOWER (the side nearest the ALLIANCE WALL). The RETURN BARS support the lower end of the BALL RETURN and are covered in black tape.

6.2.5 The GOALS

The GOALS are located at the corners between the ALLIANCE WALL and the Guardrail System. The GOAL is a 48-inch wide by 24-inch tall opening in the ALLIANCE WALL through which the BALLS can exit from the FIELD. A 6-inch tall dihedral ramp extends out in front of the GOAL opening. There is a 2-inch tall lip on the exterior edge at the top of the ramp. A set of chains hangs from the top of the opening down to 11 inches above the top of the ramp. The chains and the lip on the ramp help keep the BALLS from bouncing back onto the FIELD once they have passed through the opening in the ALLIANCE WALL. BALLS that have passed through the GOAL opening enter an asymmetric funnel that routes them to the BALL COUNTER. The BALL COUNTER contains quadrature-encoded photodetectors to automatically detect and score BALLS as they pass through. BALLS exit from the BALL COUNTER and come to rest in the CORRAL.



6.2.6 The VISION TARGETS

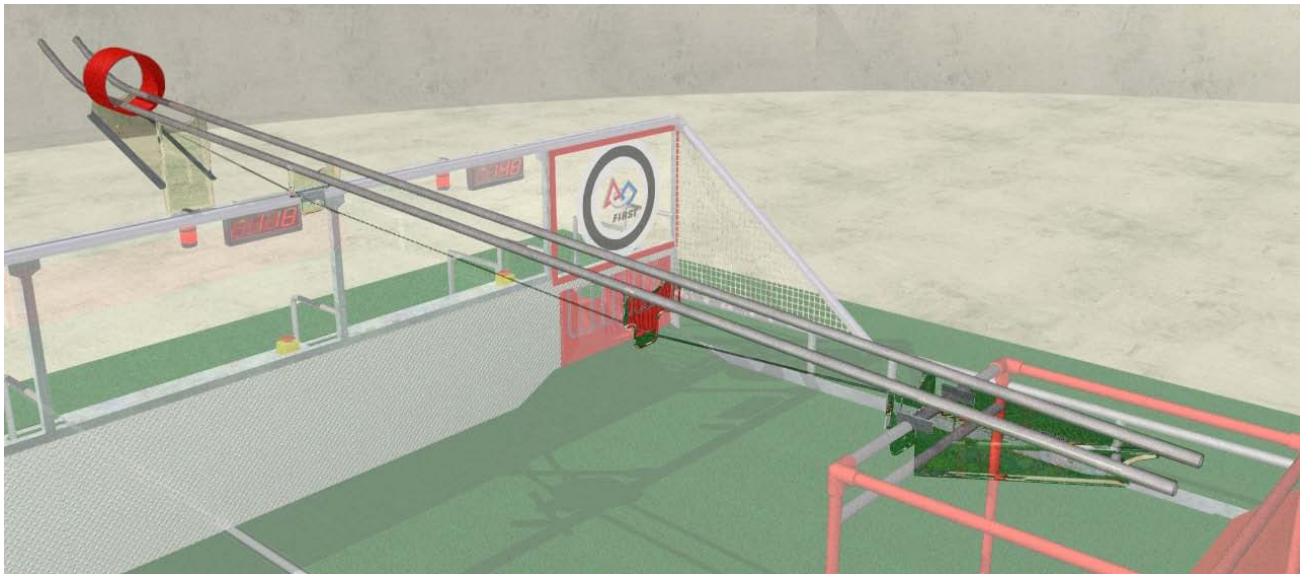
A VISION TARGET is mounted to the transparent portion of each ALLIANCE WALL, centered above each GOAL opening. The VISION TARGET can be used by on-board vision systems on the ROBOTS to determine the location of the GOAL openings. The VISION TARGET has been specifically designed for easy acquisition and targeting by edge-detection algorithms searching for high-contrast circles. Each VISION TARGET is composed of a set of three concentric white-black-white circles. The VISION TARGET has an outer diameter of 42 inches. Each circle in the target is 4 inches wide. A *FIRST* logo is placed in the center opening of the VISION TARGET for aesthetics. The logo is not formally considered part of the VISION TARGET.

6.2.7 The CORRAL

The CORRAL is a small, protected area immediately behind each GOAL assembly used to contain the BALLS after they exit from the BALL COUNTER. The CORRAL is bounded by the GOAL, the structural elements of the ALLIANCE WALL, and the CORRAL barrier. Team members remove BALLS from the CORRAL and re-enter them into play by using the TRIDENT to place them on the BALL RETURN.

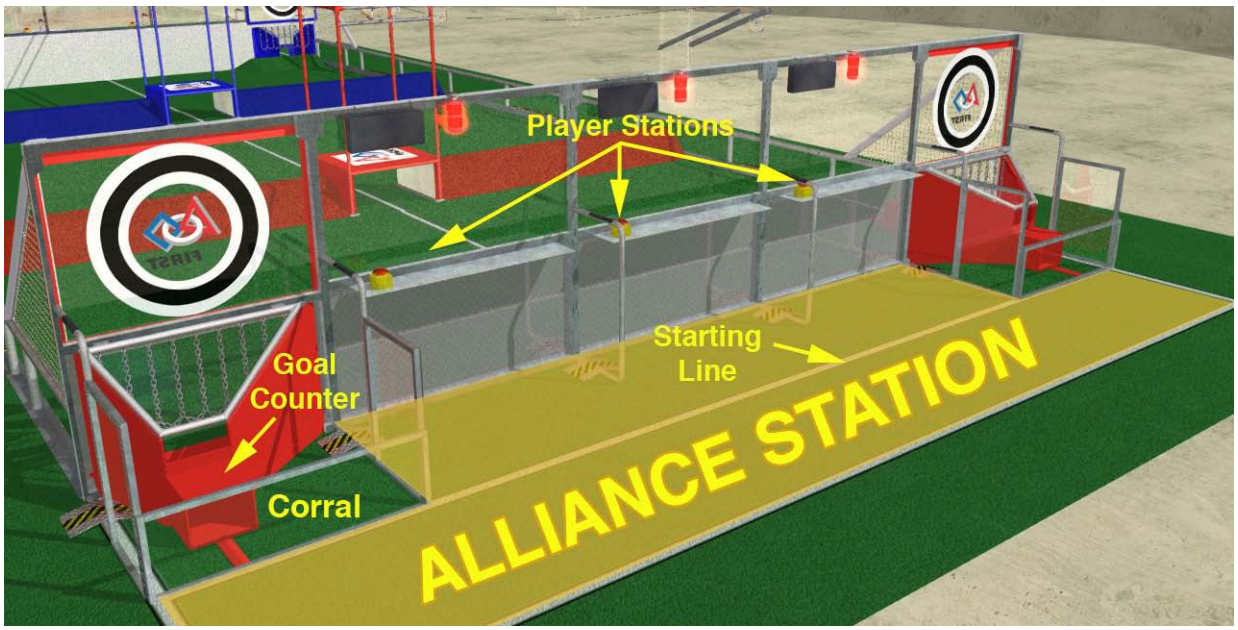
6.2.8 The BALL RETURN

Two parallel pipes extend from above the center of the ALLIANCE STATION to above the nearest TOWER. The pipes, and their associated supports and stiffeners, comprise the BALL RETURN that is used to return BALLS to the FIELD. The higher end of the BALL RETURN (above the ALLIANCE STATION) passes through a BALL RETURN COUNTER. The BALL RETURN COUNTER automatically detects BALLS as they return to the FIELD. The BALL RETURN is designed so that when a BALL is placed on the higher end (above the ALLIANCE STATION), it will roll down-slope through the BALL RETURN COUNTER, over the top of the TOWER, and then fall into the MIDFIELD.



6.2.9 The ALLIANCE STATIONS

The ALLIANCE STATIONS are located at either end of the ARENA, behind the ALLIANCE WALLS. All members of the competing TEAMS stand in their assigned ALLIANCE STATION during the MATCH, from where they operate their ROBOTS and play *Breakaway*.



The ALLIANCE STATION extends back eight feet from the ALLIANCE WALL, and across the entire 27-foot width of the wall. The ALLIANCE STATION includes the three identical PLAYER STATIONS, the back of the GOALS, and the CORRALS for the corresponding ALLIANCE. The STARTING LINE is marked on the floor four feet back from the ALLIANCE WALL, and extends across the width of the ALLIANCE STATION. The ALLIANCE STATION includes the area behind the STARTING LINE. All boundaries for the ALLIANCE STATIONS are marked on the carpet with white tape. The tape boundaries are considered “in” the bounded areas.

6.2.10 The PLAYER STATIONS

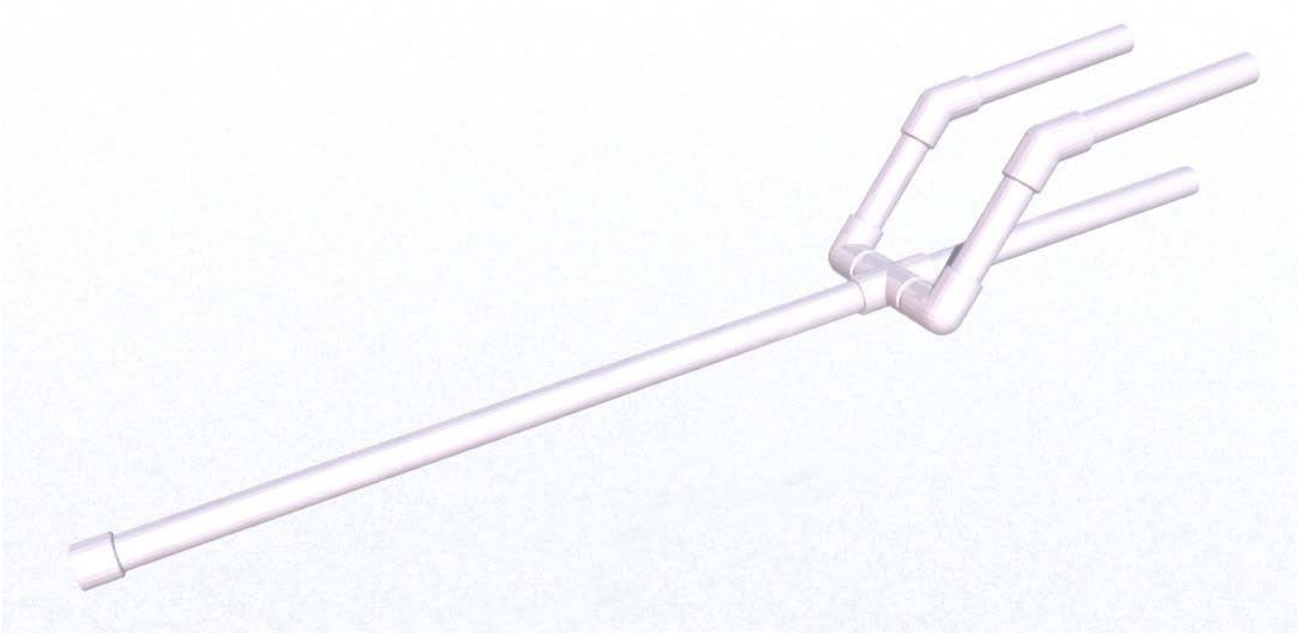
Attached to the ALLIANCE WALL are three aluminum shelves to support the OPERATOR CONSOLES for the three teams on the ALLIANCE. The support shelf measures approximately 60 inches wide by 12 inches deep. There is a 4½-foot long by two-inch wide strip of Velcro tape ("loop" side) along the center of the support shelf that may be used to secure the OPERATOR CONSOLES to controls the ROBOT. Each setup location includes a competition cable (to provide Ethernet connectivity) that attaches to the Ethernet port of the Classmate PC. The cable provides communications with the ROBOT. Emergency Stop (E-Stop) buttons for each team are located on the left end of each Player Station shelf. ARENA components (including team number displays, competition arena hardware, alliance lights, control hardware cabinets and clock displays) are also located above the PLAYER STATIONS and below the shelf.

6.3 GAME PIECES

6.3.1 BALLS

While playing *Breakaway,* ROBOTS manipulate BALLS to accomplish the objectives of the game. Each BALL is a standard Size 5 soccer ball. The BALL weighs between 14 and 16 ounces, has a circumference of 27 to 28 inches, and is inflated to a standard pressure of approximately 9psi. The specific ball that will be used in the official 2010 *Breakaway* competition events will be the "HS300, Size 5, Pearl White" ball from DSI Sports, Inc. (however, it is not a requirement that teams use this exact model for development or practice). Note that surface color and finish of BALLS may be different than the "normal" black and white patchwork pattern found on competition soccer balls.

6.3.2 TRIDENT

The TRIDENT is used to place BALLS on the BALL RETURN so they can be retuned to the FIELD and re-entered into play. The TRIDENT is a 6-foot long construction made of 1-inch PVC pipe.

The TRIDENT has three tines on one end that are spaced to allow the TRIDENT to firmly hold a BALL while it is lifted overhead.