

**1 OVERVIEW** The 2003 Game -**Stack Attack** -is played on a 54-foot long by 24-foot wide playing field. A 2-foot high platform that is 4-feet wide by 12-feet long is located across the center of the field. The platform is accessed from each of its long sides by ramps that are 8 feet long. Two alliances of two teams each compete in each match. Each team consists of a human player, two driver/operators, and a coach. A match consists of a 10-second Human Player Period, a 15-second Autonomous Control Period, and a 1 minute and 45 second Remote Control Period. The object of the game is to acquire and stack plastic storage containers that are initially located on the platform or placed on the playing field by human players. Each alliance must place containers in a scoring zone on its own side of the field to score points. The total number of points earned depends on the count of containers located in each alliance's scoring zone multiplied by the number of containers in their highest stack. Additional points are awarded for any robot that is positioned on the top of the platform at the end of the match.

## **2 THE PLATFORM AND RAMPS**

The platform and its ramps, as they will appear at the competitions, are shown in the 2003 FIRST Field Layout drawing. The 4-foot wide by 12-foot long by 2-foot high game platform is located across the center of the playing field. The horizontal surface of the platform is High Density Polyethylene (HDPE). Both platform approach ramps are 8 feet long by 12 feet wide (three 4' x 8' sections). They are sloped approximately 14 degrees from horizontal and are surfaced with open 1" by 1" welded wire steel mesh. The top wires of the steel mesh will be oriented so that they will run parallel to the 12-foot dimension of the top platform. The approach ramps and ramp platform have a 2-foot-high, ½" thick, transparent polycarbonate wall along their outside edges. These walls extend down to the surface of the playing field.

## **6 THE CONTAINERS**

Sterilite Corporation ([www.sterilite.com](http://www.sterilite.com)), Townsend, MA, manufactures the plastic storage containers used in this game. They are approximately 24-1/4" long x 17-1/4" wide x 15-3/4" high.

The tops of the containers will be fastened securely to the container bodies with plastic pop-rivets. Retro reflective tape will be applied to the human-player handled containers only.

## **7 THE GAME**

The object of the game is for each of the alliances to score points by acquiring and stacking plastic storage containers in their own end of the playing field. Additional points are awarded to alliances whose robots are positioned on the platform at the end of each match.

### **7.1 Initial Setup**

At the start of each match, 29 containers will be stacked in 5 tiers in a line across the top of the platform.

- The 1<sup>st</sup> (bottom), 2<sup>nd</sup>, and 3<sup>rd</sup> tiers will have 7 containers;
- The 4<sup>th</sup> tier will have 5 containers;
- The 5<sup>th</sup> (top) tier will have 3 containers.

Robots will initially be placed within the starting areas in the alleys at the sides of the platform/ramp structure. Each alliance's robots will start on the far side of the midfield barrier. Each alliance will have 2 human players (1 from each team) positioned outside each of the two gates at their end of the playing field. Each human player will have 4 containers stacked near him or her. The remaining 2 players and a coach from each team must stand in their driver station.

### **7.2 Human Player Period (10 Seconds)**

At a starting signal, all 4 human players will enter the field at the same time from separate gates at the sides of the field. They will have 10 seconds to place or stack their containers anywhere in their own Scoring Zone and exit the field. The human players will then stand on a pressure-sensitive mat located outside the playing field to positively indicate that they have cleared the field. The autonomous operation period of the game will automatically start

when the last human player leaves the field and all 4 pressure sensitive mats have been activated.

### **7.3 Autonomous Robot Control Period (15 seconds)**

As soon as the game starts, all robots will be under autonomous control (no human drivers) for a period of 15 seconds. During this time, the robots will operate and react only to sensor inputs and to commands programmed by their teams into the onboard robot control system.

During the autonomous robot control period, robots may use onboard sensors to detect features of the playing field surface (e.g., the white lines or colored areas of the carpet), the containers placed in the scoring zones by the human players (which have detectable strips of retro-reflective tape on the sides of the containers), structural elements of the play field (e.g., using proximity or contact sensors to detect edges of the field or parts of the ramp structure) and/or other robots. During the autonomous robot control period, the robots may move about the field and perform any activities that would be normally permissible when operated under human control.

### **7.4 Operator Control Period (1 minute and 45 seconds)**

Upon completion of the 15-second autonomous robot control period, the driver station controls will automatically be activated.

### **7.5 Game Play**

Robots try to acquire and stack (right-side up, upside down, on their side, etc.) as many containers as possible in their alliance's scoring zone. The "gray carpet" alleys at the side of the platform/ramp structure and the "gray carpet" areas directly in front of each end of the playing field are "No Score" areas, i.e., not in the scoring zone. See the 2003 FIRST Field Layout drawing for exact locations and dimensions of the scoring zones and the no score areas.

### **7.6 Scoring**

All containers within the alliance's scoring zone will be worth one point each **EXCEPT** the containers in the tallest stack. The total number of one-point containers will determine the base score for the alliance. The tallest stack of containers within the scoring zone is the "multiplier stack." Containers in the multiplier stack are worth zero points each (note that containers in other stacks of the same height are worth one point each). The total base score is then multiplied by the height in whole Stack Height Units (SHU) of the multiplier stack. More than one stack of the same height does not affect the multiplier.

An additional 25 points will be awarded to each robot that is touching only the top of the platform at the end of the match. Both teams in the losing alliance get their own alliance score in Qualifying Points (QP's). Both teams in the winning alliance get their own score plus twice the losing alliance's score in QP's. A tie awards the total of the match points to both alliances in QP's.

### **9.1 Safety Rules [ S ]**

**S1** The storage containers are the only projectiles that may be launched by a robot. **S14** Turn off the 120A main circuit breaker while making adjustments to your robot. Since the motors provided in the kit are quite powerful, it is important to keep all body parts away from all robot mechanisms while your robot is connected to the battery.

### **9.2 General Match Rules [ GM ]**

**GM1** Teams are allowed a maximum of 1 minute to set up their robots on the playing field and a maximum of 1 minute to remove all robot parts from the field following a match.

**GM2** During the setup for each match, robots must be placed totally within their designated starting areas. They must sit on the carpet unconstrained in the same position as when they were in the sizing box.

**GM3** At the start of each match, 29 containers will be stacked in a line across the top platform of the ramp structure in 5 tiers: the bottom 3 tiers will have 7 containers each; the 4th tier will have 5 containers; the 5th (top) tier will have 3 containers.

**GM4** At a starting signal, all 4 human players will enter the field at the same time from all 4 gates at the sides of the field. They will have 10 seconds to place or stack their containers within their own scoring zone.

**GM5** Human players may only travel in their own scoring zone. They are not allowed in the gray areas or on the ramps.

**GM7** During the first 15 seconds of a match, the robots are controlled autonomously by on board inputs and onboard-programmed control systems. Subsequent to this, robot control automatically switches to the driver

control stations. Matches end when control systems are disabled by the expiration of the match time unless the match is whistled dead by the referees.

**GM8** Any containers that leave the playing field during a match will not be returned to the playing field until the next match.

**GM9** Robots may not intentionally:

1. Detach Parts (no connection at all to a robot);
2. Remove the lids from the containers;
3. Damage another robot;
4. Tip over another robot;
5. Attach themselves to the ramp mesh or framing material;
6. Attach themselves to the railings/walls of any field structure.

**GM31** The outer field barriers are safety features of the playing field and robots should not be designed to react against them. Contact with all of the barriers is acceptable. Pushing a container against a barrier is acceptable if the forces applied are not sufficient to damage the barrier or otherwise deform the playing field. Minor forces associated with activating contact sensors carried by the robots or similar minimal-force contact methods to detect and locate the field barriers are permissible.

### **9.3 Scoring Rules [ SC ]**

**SC2** The “Scoring Zones” for containers are the RED and BLUE carpeted areas.

**SC3** The “Scoring Zone” for the robots is the top of the platform.

**SC4** The “No Scoring Zones” are the GRAY carpeted areas and the ramps.

**SC6** Final scoring begins when containers and robots come to rest, which should be within 10 seconds after the match ends or upon a referee’s decision.

**SC7** Scoring containers touching the Scoring Zone in front of the RED alliance that meet the conditions in SC8 and SC9, count for the RED alliance. Scoring containers touching the Scoring Zone in front of the BLUE alliance that meet the conditions in SC8 and SC9, count for the BLUE alliance.

**SC8** When determining the base score for the alliance, the referees will evaluate the containers with the following criteria: A container “in” a Scoring Zone is worth one point. A container will be determined to be “in” a scoring zone if at least some part of the container is touching the colored carpet that defines a scoring zone or is supported exclusively by

1. Other containers in that zone.
2. An opponent’s robot.

All containers in the tallest stack located in the scoring zone (the “multiplier stack”) are worth zero points. Containers in additional stacks of the same height will be scored normally;

1. If ANY part of your own alliance’s robots are in contact with ANY container in a stack (alone or in a multi-container stack), ALL containers in that stack will be worth zero points;
2. Opponent robots in contact with containers in the alliance scoring zone will not affect
3. the determination of the base score;
4. A container may touch the field border.

**SC9** When identifying the multiplier stack, the referees will base their evaluation on the following criteria:

1. Only stacks located “in” a scoring zone (as defined in SC8) are eligible to become multiplier stacks;
2. The tallest stack in the alliance scoring zone will be determined to be the multiplier stack. If ANY part of an alliance robot is in contact with ANY container in a stack, that stack will not be eligible to be the multiplier stack. In this event, the next-tallest stack will become the multiplier stack;
3. There will be only one multiplier stack. If there are multiple stacks of the same height, the redundant stacks will be scored normally as part of the alliance base score;
4. Opponent robot contact with a stack will not affect multiplier stack eligibility.

**SC10** The alliance match score is determined by multiplying the base score (as determined by SC8) by the height (measured in “whole Stack Height Units”) of the multiplier stack (as determined by SC9).

**SC11** Each robot touching only the top of the center platform at the end of the match is worth 25 points. You are

not fully on top of the platform if any part of a robot is touching any part of:

1. The ramp;
2. The field;
3. The top or outside of the platform/ramp structure sidewalls;
4. Both of the inside platform/ramp structure sidewalls at the same time.

**SC12** In the event that a robot is damaged to the point where parts become detached from the robot, the detached parts are not considered when determining whether or not the robot is “on” the platform or “in contact” with a container. In the event that large sections of the robot break apart, the section containing the Robot Controller is considered “the robot.” Any part that is still connected to the robot, no matter how loosely is considered part of the robot.

#### **SC14 Qualification Matches**

1. Each team in the losing alliance receives their match score in QP’s;
2. Each team in the winning alliance receives their own score plus double the number of match points of the losing alliance in QP’s;
3. If 1 team is disqualified, the match will be played as a 2 on 1 and scoring is as normal;
4. If an entire alliance is disqualified, the other alliance receives double their own score in QP’s;
5. Ties are allowed. In the event of a tie, all 4 teams get the total of the scores of both the RED and BLUE alliances;
6. At the conclusion of all of the qualification matches, teams are ranked by dropping their lowest QP score and averaging the rest. If teams must play an extra match to balance out the matches in a competition, the score of the extra match and their lowest score are dropped before averaging. Teams will be ranked using the following hierarchy of criteria (in order from most to least important):
  - a. Highest average qualifying point total;
  - b. Highest number of matches won during qualification matches;
  - c. Highest match score;
  - d. Flip of a coin.

### **9.5 Disabling Violations [ DA ]**

**DA1** If a robot/robot part goes out-of-bounds (outside of the playing field) to the point that it has to apply force to any out-of-bounds surface to rejoin play, its control system will be disabled. A machine should not be designed to react with an out-of-bounds surface for any reason.

**DA2** For safety reasons, no part of a robot may touch the team members. If this occurs, the robot may be disabled.

### **9.6 Disqualifying Violations [ DQ ]**

**DQ1** Strategies aimed solely at the destruction, damage, tipping over or entanglement of robots are not in the spirit of the FIRST Robotics Competition and are not allowed. Accidental tipping over of a robot is not considered damaging and may be allowed at the discretion of the referees. Intentional stabbing, cutting, etc., is illegal. If a breach of this rule occurs, the alliance will be disqualified for that match. Repeated offenses could result in a team being disqualified from the remainder of the regional competition and/or championship event.

**DQ4** Robot wheels, tank-type treads, etc., cannot contain any metal that contacts the carpet. Competing with this type of traction method will result in disablement and disqualification.

**DQ5** Deliberately damaging the playing field, controls or containers is strictly illegal and will result in disqualification of your alliance. Robot wheels must not, for example, damage the field carpet. This will be checked during robot inspection at registration on the first event day and throughout the competition. Bunching up or puckering the carpet is considered damage to the field.

**DQ9** A robot may not leave parts or any other items on the field during a match. It must remain whole. This includes elastic bands, Velcro, etc., that may be used to hold arms, etc., in place. If the referee determines that a robot has intentionally detached a part of itself (traumatic detachment caused by collision excluded), the robot will be disabled during the match and disqualified after the match ends.