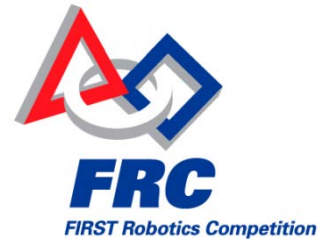


Section  
0

# INTRODUCTION



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## 0 INTRODUCTION

### 0.1 WHAT IS THE *FIRST* ROBOTICS COMPETITION® (aka FRC)?

**Take dedicated, enthusiastic students, teachers, engineers and other professionals, add six (6) weeks for design and fabrication and you get a wide range of amazing machines that are competition ready.**

The *FIRST* Robotics Competition (FRC) is an exciting program that assimilates teams, sponsors, colleges and technical professionals with high school students to develop their solution to a prescribed engineering challenge in a competitive game environment. The competitions, also known as Coopertition™(s), combine the practical application of science and technology with the fun, intense energy and excitement of a championship-sporting event. The program results in life-changing, career molding experiences for its participants and is a lot of fun.

In 2010, FRC will reach nearly 48,000 students representing approximately 1,800 teams. FRC teams come from every state in the United States, as well as from Brazil, Canada, the United Kingdom, Mexico, Chile, Germany, Israel, Turkey, Australia and The Netherlands. FRC has become an international program and is continuously growing. FRC teams will participate in 43 Regional Competitions, 7 Michigan District Events and approximately 300+ deserving teams will qualify to go to the *FIRST* Championship at The Georgia Dome in Atlanta, Georgia.

This year's challenge will be presented at the 2010 FRC Kickoff on Saturday, January 9, 2010. At the Kickoff event, all teams:

- see the 2010 game field for the first time;
- learn about the 2010 game rules and regulations; and
- receive a Kit of Parts (KOP). The KOP includes, but is certainly not limited to, motors, sensors, chassis hardware, transmissions, software packages, control systems and batteries. The intent of the kit is to provide a level starting point for all teams.

### 0.2 GRACIOUS PROFESSIONALISM™, A *FIRST* CREDO

Dr. Woodie Flowers, *FIRST* National Advisor and co-founder of FRC, asks:

*"Why do FIRST folks talk so much about that phrase?"*

Dr. Flowers elaborates on the significance of Gracious Professionalism™ in *FIRST*, at work and in life, below.

*"FIRST does not celebrate being an incompetent jerk. FIRST does celebrate high-quality, well-informed work done in a manner that leaves everyone feeling valued. Gracious Professionalism™ seems to be a good descriptor for a big part of the ethos of FIRST. It is one of the things that makes FIRST different and wonderful.*

Gracious Professionalism™ has purposefully been left somewhat undefined because it can and should mean different things to each of us. We can, however, outline some of its possible meanings. Gracious attitudes and behaviors are win-win. Gracious folks respect others and let that respect show in their actions. Professionals possess special knowledge and are trusted by society to use that knowledge responsibly. Thus, gracious professionals make a valued contribution in a manner pleasing to others and to themselves.

In *FIRST*, one of the most straightforward interpretations of Gracious Professionalism™ is that we learn and compete like crazy, but treat one another with respect and kindness in the

process. We try to avoid leaving anyone feeling like they have lost. No chest-thumping barbarian tough talk, but no sticky sweet platitudes either. Knowledge, pride and empathy comfortably blended.

Understanding that Gracious Professionalism™ works is NOT rocket science. It is, however, missing in too many activities. At *FIRST*, it is alive and well. Please help us take care of it.

In the long run, Gracious Professionalism™ is part of pursuing a meaningful life. If one becomes a professional, and uses knowledge in a gracious manner, everyone wins. One can add to society and enjoy the satisfaction of knowing that he or she has acted with integrity and sensitivity. That's good stuff!"

## 0.3 PROMINENT FRC AWARDS

*FIRST* recognizes both on-field and off-field team performance that promotes *FIRST*'s mission to change culture. Several awards celebrate team competencies including, but not limited to, technical expertise, community involvement, and safety practices. The two most prominent FRC awards are described below (however, for a complete list and description of awards available to teams, please reference Section 5).

### 0.3.1 The Chairman's Award

Every year, veteran FRC Teams have the opportunity to compete for *FIRST*'s most prestigious award; i.e., the Chairman's Award. This Award was created to maintain focus on changing culture in ways that would inspire greater levels of respect and honor for science and technology, as well as encourage more of today's youth to become scientists, engineers and technologists. It represents the spirit of *FIRST*. The Chairman's Award honors the team that best embodies the goals and purpose of *FIRST* and is a model for other teams to emulate.

One team is chosen at each regional to receive this award; these teams go on to be considered for the Chairman's Award at the Championship. Teams who have won the Chairman's Award at the Championship are entered into the *FIRST* Hall of Fame. Past Hall of Fame inductees are listed below.

Year	Team	Official Team Name
2009	236	Dominion Millstone Power Station & Lyme-Old Lyme (CT) High School
2008	842	Honeywell / Arthur M. Blank Foundation / Science Foundation Arizona / Intel / Vegas Fuel / Wells-Fargo & Carl Hayden High School
2007	365	DuPont Engineering/DuPont CCRE/First State Robotics & MOE Robotics Group
2006	111	Motorola & Rolling Meadows High School & Wheeling High School
2005	67	General Motors Milford Proving Ground and Huron Valley Schools
2004	254	NASA Ames Research Center/Laron Incorporated/Unity Care Group/Line-X of San Jose/PK Selective Metal Plating, Inc. & Bellermino College Preparatory
2003	103	NASA/Amplifier Research/Custom Finishers/Lutron Electronics/BAE Systems & Palisades High School
2002	175	Hamilton Sundstrand Space Systems International/The New England Air Museum/Techni-Products/Veritech Media & Enrico Fermi High School
2001	22	NASAJPL/Boeing/Rocketdyne/FADL Engineering/Decker Machine & Chatsworth High School
2000	16	Baxter Healthcare Corporation & Mountain Home High School

Year	Team	Official Team Name
1999	120	NASA Lewis Research Center/TRW, Inc./Battelle Memorial Institute & East Technical High School
1998	23	Boston Edison & Plymouth North High School
1997	47	Delphi Corporation & Pontiac Central High School
1996	144	Procter & Gamble & Walnut Hills High School
1995	151	Lockheed Sanders & Nashua High School
1994	191	Xerox Corporation & JC Wilson Magnet High School
1993	7	AT&T Bell Labs & Science High School
1992	191	Xerox Corporation & JC Wilson Magnet High School

### 0.3.2 The Woodie Flowers Award

The Woodie Flowers Award celebrates mentors who lead, inspire and empower their team. Woodie Flowers Award winners demonstrate effective communication in the art and science of engineering and design. Founded in 1996 by Dr. William Murphy, the Woodie Flowers Award is presented to an outstanding engineer or teacher participating in FRC who lead, inspire, and empower using excellent communication skills.

Students submit an essay that nominates one mentor from their team for consideration. Past winners of this award are listed below.

Year	Name	Title
2009	Mr. John Novak	Engineer, Baxter Healthcare Corporation
2008	Mr. Mark Breadner	Vice Principal, Toronto District School Board
2007	Mr. Dan Green	Director, New Technology Business Operations, Motorola
2006	Mr. Rob Mainieri	Teacher, The Preuss School at UCSD
2005	Mr. Paul Copioli	Staff Engineer, FANUC Robotics America
2004	Mr. David Kelso	Teacher, Central High School
2003	Mr. Andy Baker	President, AndyMark, Inc.
2002	Mr. David Verbrugge	Engineer, GM Proving Ground
2001	Mr. William Beatty	Beatty Machine & Manufacturing Company
2000	Ms. Kyle Hughes	Teacher, OSMTech Academy
1999	Mr. Ken Patton	Engineer, GM Powertrain
1998	Mr. Michael Bastoni	Teacher, Plymouth North High School
1997	Ms. Elizabeth Calef	Teacher, Bridgewater-Raynham Regional High School

## 0.4 SAFETY: A *FIRST* CULTURE

Safety is critical within FIRST and must be observed continuously by all participants. As a part of the Safety Awareness and Recognition Program, teams are observed and evaluated at many different levels and by many individuals at the event.

“Safety Advisors” evaluate team safety behavior and practices at Regional Competitions.

“Referees” observe safety on the playing field as well as adherence to the game rules.

“Judges” evaluate how teams have integrated safety into their robot designs when considering the team for technical awards.

Safe practices at the competitions are required. Teams are urged to adopt safe habits throughout the entire competition season including during travel to and from events and while working in their shops at home, etc...

# COMMUNICATION

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# 1 COMMUNICATION

## 1.1 OVERVIEW

This section provides teams with necessary information for contacting *FIRST*® staff and other key people during the season. This section also contains help regarding the use of the *FIRST* logo, finding materials on the *website*, the Team Information Management System (TIMS) and tips on reserving hotels.

## 1.2 FIRST HEADQUARTERS- CONTACT INFORMATION

You can reach *FIRST* via mail, email, phone, and fax, or get information from our *website* at [www.usFIRST.org](http://www.usFIRST.org). The office is open Monday through Friday from 8:30 AM to 5:00 PM, EST. Refer to the sections below for the appropriate help resource.

***Be sure to provide your Team Number on all communications!***

Mailing Address	200 Bedford St, Manchester, NH 03101
Email Address	<a href="mailto:frcteams@usFIRST.org">frcteams@usFIRST.org</a>
Phone Numbers	(603) 666-3906 (800) 871-8326
Fax Numbers	(603) 666-3907 (Main) (603) 647-5772 (Finance)

## 1.3 TEAM SUPPORT

The Operations (Team Support) Group is ready to answer program-related questions regarding registration, team record maintenance, the Kickoff, shipping and drayage, etc. All are ready and eager to help your team. You may contact them via email or telephone.

### 1.3.1 Emails and Subject Lines

Our program requires that many requests must be in writing, so email may be your best communication tool and the best way to get a quick answer or solution to your problem. Emails save money, time, prevent phone tag and provide information for a researched, more accurate answer. To facilitate a quick reply, include your **Team Number** and reference in the subject line.

### 1.3.2 Please Do Not Duplicate Efforts

We ask that you do not contact or copy multiple persons about the same problem. Being a small group, we must work efficiently and avoid having more than one person working on the same item. We can usually answer questions or requests within one working day.

## 1.4 CONTROL SYSTEM SUPPORT

Please refer to the “Where To Get Help” section of the Control System website at:

<http://www.usFIRST.org/roboticsprograms/frc/content.aspx?id=14532>

## National Instruments Hardware/Software

If you haven't received help via *FIRST* forums in a reasonable amount of time and you have questions about your cRIO, its modules, or LabVIEW, contact National Instruments. Remember to provide your *FIRST* Team Number in the subject line.

**Tech Support Phone:**

(866) 511-6285

**Website:**

[www.ni.com/FIRST](http://www.ni.com/FIRST)

## C/C++ Programming

For assistance with WindRiver C/C++ programming environment, please visit the *FIRST* Forums at <http://forums.usFIRST.org/forumdisplay.php?f=23>.

## Java Programming

For assistance with Sun Microsystems Java programming environment, please visit the *FIRST* Forums at <http://forums.usFIRST.org/forumdisplay.php?f=23>

## 1.5 SOFTWARE CONTACT INFORMATION

### Autodesk

Please go to [www.autodesk.com/FIRST](http://www.autodesk.com/FIRST) and join the Community to download Autodesk software products. Visit the Community often to check on new information and resources; to get your 2010 Kit of Parts modeled in Autodesk Inventor Professional 2010 at Kickoff; and to submit your questions and requests for technical support.

### PTC Software

Please visit [www.ptc.com/go/FIRSTgettingstarted](http://www.ptc.com/go/FIRSTgettingstarted) for information on the available software downloads and training. If you *cannot* find answers to your questions from the above *website*, please contact [FIRSTsupport@ptc.com](mailto:FIRSTsupport@ptc.com) with any questions.

## 1.6 FIRST ROBOTICS COMPETITION WEBSITE

Visit the *FIRST* Robotics Competition area on [usfirst.org](http://usfirst.org) where you can find answers to administrative concerns and link to other areas of support.

- Check deadlines and dates for the Team Information Management System (TIMS), entries, grants, registration and payments, robot shipment, and awards submissions. <http://www.usFIRST.org/roboticsprograms/frc/content.aspx?id=454>
- Find links to the new "Consent and Release Form", the "Email Blast Archive", "FRC Q&A Forum", the "2010 Robot Shipping" page, "FRC Team Manual" sections, events and a list of the "Regional Contacts" at: <http://www.usFIRST.org/roboticsprograms/frc/default.aspx?id=966>
- Find fundraising support materials such as the photo gallery, video clips, and program information. <http://www.usFIRST.org/roboticsprograms/resourcecenter.aspx?id=952>

### 1.6.1 Getting Answers To Your Competition Questions

**Manual and Updates:** The *FIRST* Robotics Competition (FRC) Manual is available on the *FIRST Website* at <http://www.usFIRST.org/roboticsprograms/frc/content.aspx?id=452>.

Sections relating to the game will be posted at Kickoff. Updates to the Manual, event details, etc... will be published per the "Team Updates" section below.

**Updates and additions to the manual, should they be necessary, will be posted in this area of the website. Please be sure to check this area often during the build season to ensure that you have the latest information.**



**FRC Q&A Forum:** Shortly after Kickoff, *FIRST* provides an on-line forum for questions and answers (Q & A). It is accessible at <http://forums.usfirst.org> for each section of the Competition Manual, such as "The Game," "The Robot," etc. Anyone can view questions and replies on this system. Only those team contacts with a special team username and password can post questions to this system. This username and password have been sent to the team's Main Contact. Teams may post directly to the moderators of the forum. Until a moderator accepts, and answers, the questions, others cannot see them.

### 1.6.2 Email Blasts

Email blasts are important communications that *FIRST* sends to the Main and Alternate contacts for all FRC teams identified in TIMS. An e-mail blast is a message sent to all FRC teams via e-mail. *FIRST* archives the email blasts on the *FIRST* website at <http://www.usFIRST.org/roboticsprograms/frc/content.aspx?id=6616>.

*FIRST* will send out one email blast on the Thursday of each week. It will highlight items that have been added to the "2009-2010 News and Email Blasts" webpage since the previous week's email blast. News that must be shared with all teams at the same time will be introduced to teams in the weekly email blast and then be posted to the news page where team members may refer to it again.

Team members are encouraged to visit the "2009-2010 News and Email Blasts" webpage regularly. Here, Teams can refer back to their contents. This system will provide team members and mentors easy access to information *FIRST* provides to, and requests from, teams. This feature is especially helpful for teams that register later in the season. We suggest that you have several team members in charge of updating and informing relevant persons on the team.

### 1.6.3 Team Updates

After the Kickoff, Team Updates provide rules updates, important information about parts and administrative reminders/deadlines. These documents are posted on the *FIRST Website*. Our Team Updates schedule is Tuesday by 5:00 PM and Friday by 5:00 PM.

- Unexpected circumstances may, on occasion, delay this publication;
- Additional updates may be released, if necessary; and
- Occasionally, *FIRST* will publish revisions to manual sections.

Teams often ask one person to read all *Team Updates* and make sure the right team members are informed about their contents. After the Kickoff, you will find the updates on [the website](#). [Go to the FRC Home page, click on "Game and Season Info" on the left hand side, then click "Team Updates"](#)

You can find information on the *FIRST website* to enhance your team's recruitment efforts. Find PowerPoint® presentations, video clips and statements about the Impact of *FIRST*, our Vision, testimonials, and *FIRST* financial information at: <http://www.usFIRST.org/roboticsprograms/resourcecenter.aspx?id=952>

## 1.7 THE TIMS - SUPPLYING INFORMATION TO *FIRST*

### (Team Information Management System)

The TIMS is the on-line system used to register your team and provide information to *FIRST* as the season progresses. For details about using the TIMS, please reference Section 2.3. Refer to the "Calendar of Important Deadlines" to check program deadlines on the website at: <http://www.usFIRST.org/roboticsprograms/frc/content.aspx?id=454>. When teams use the system properly, the TIMS provides *FIRST* with necessary, up-to-date information including:

- 1) Team Names: Official, Nickname;

- 2) Team Contact information for important, team messages, shipments, and *FIRST* email blasts;
- 3) Team Partner (Sponsor) information;
- 4) Event attendance information for each team;
- 5) Team's FedEx, UPS, or USPS shipping account number; and
- 6) Team Judges' Information Page.

Additionally, the TIMS "Team Information" provides options for:

- Teams willing to mentor other teams;
- Teams wanting mentoring; and
- Entering team *website* address/link.

## 1.8 JUDGES' INFORMATION

**The Judges' Information page is crucial and a great opportunity to communicate your team's strengths to the competition judges. Please take advantage of this opportunity and provide this important information.**

The Judges' Information is a team overview page. It is your team's opportunity to share valuable information and statistics with *FIRST* and the judges at the events. These data are very valuable for planning events and very helpful in our efforts to procure funding. *FIRST* may use the robot photos you submit in the Awards Ceremonies. Enter the information under the "Judges' Information" section in TIMS.

The purpose of the Judges' Information page is to provide:

- a common starting point for judging each team;
- insight for judges into team's workings, history, goals, strengths, and robot; and
- team data for *FIRST* and its archives.

Please refer to the team manual, Section 5 – The Awards, for more information.

## 1.9 EVENT-SPECIFIC INFORMATION

The *FIRST* Robotics *website* includes important information about specific events. We advise that you print and keep copies of the "Site Info," "Shipping / Drayage," and any information you receive regarding all shipping related (including the FedEx donated shipping) processes for the events you will attend.

You will be able to download the below information for the events, and you can find this information on the *FIRST* Robotics page by clicking on "Events", then "Regional Events", then clicking on the name of your event. You will then be taken to a page with additional information.. Provide the information to appropriate team members and mentors.

- The 2010 Consent and Release Form is the only acceptable version of the form for the 2010 Kickoff and events. Bring completed copies in case the originals are lost or the person carrying them is delayed. These are due at registration of your initial competition event.
- Site Maps;
- Shipping and drayage information and labels;
- Copies of pre-ordered lunch forms;
- Team social events; and
- Be sure to include your FedEx information and instructions.

## 1.10 REGIONAL EVENTS HOTEL SEARCH INFORMATION

*FIRST* will not be offering hotel reservation services for the regional event season. Here are some recommendations for *FIRST* team mentors regarding placing team hotel reservations.

**We suggest that you use the following tips to help with your hotel search.**

- 1) Pick out 3 or 4 hotels within close proximity (typically, within 3-5 miles of the venue) of your regional event to obtain approximate pricing for the marketplace. You can find a complete list of venue addresses for the Regionals on the *FIRST Website*.
- 2) Use web based online driving direction services to confirm the distance to the venue.
- 3) Once you make your choices, contact the hotels reservation personnel and ask your questions directly. The following are examples of what features you will want your hotel to have:
  - 24 hour security;
  - Free parking, or at least secure parking if it is in a city environment;
  - Interior entrance rooms - rooms that have exterior entrances are the ones that have inherent security risks. Also, any team member can wander off at any time;
  - Hotels that have been renovated within the past 4 years; and
  - Hotels that will disclose if they have groups in house that are not consistent with or are in direct opposition to *FIRST* values or any other groups that tend to stay up late and can affect your sleep.

Other items to consider are:

- Will your room block be together on the same floor/area;
  - Is there a complimentary breakfast;
  - Is there free Internet access (about 50 percent of all hotels have it); and remember that
  - Cheapest should not be the only qualifier. If the quality or location is poor, it can lead to an overall bad regional experience. Without the proper sleep, you will wish that you had paid a little more for a better quality hotel.
- 4) Call and make your reservations as soon as possible. Rates that you may find available now may not stay the same as the event date approaches, when the hotel is close to its capacity.

## 1.11 CHAMPIONSHIP HOTEL INFORMATION

*FIRST* is pleased to announce that Steele Meetings, Inc. will be handling the hotel reservation system in Atlanta for the 2010 *FIRST* Championship. The information for 2010 will be in place by December 3rd, 2009 at noon EST. *FIRST* will send out an email blast so teams are able to make hotel reservations for the 2010 *FIRST* Championship. To contact Steele Meetings at any time, please email: [FIRST@steelem meetings.com](mailto:FIRST@steelem meetings.com).

## 1.12 FIRST LOGOS

You have numerous creative opportunities for designing your own team identity. Every year we see great examples of how teams "brand" their efforts with *websites*, incredible team logos on robots, T-shirts, hats, banners, fliers, and giveaways. These branding activities are a wonderful way to include students from art, communications, computer, and language arts classes.

As you manage your own promotion, you may want to incorporate the *FIRST* logo in what you do. Because our mark - the combination of the composite graphic element plus the *FIRST* word mark - is registered, we have a few guidelines for you to follow when using the *FIRST* logo or the FRC logo. You can find the logos on FRC Communications Resource Center under “Graphics” at: <http://www.usfirst.org/roboticsprograms/resourcecenter.aspx?id=650>

### **1.12.1 Logo Use**

Once the game is announced at the Kickoff, you will be able to download this year’s game logo at the above link.

## **1.13 CORPORATE SPONSORSHIP**

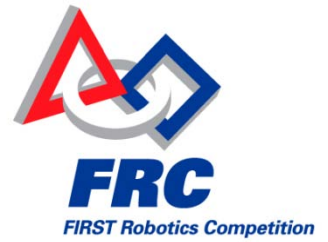
For those interested in providing Corporate Sponsorship to *FIRST*, please contact the Development Department for information regarding the opportunity to provide sponsorship at (603) 666-3906 or (800) 871-8326, Extension 461.

## **1.14 HOW TO VOLUNTEER FOR *FIRST***

Each competition event depends on an abundance of volunteers with a broad spectrum of talents to support operating needs and competition demands. If you have time, we appreciate and can surely use your help. Please visit the *FIRST Website* page, and click on “Community” above the photo. Scroll to Volunteer and then Volunteer Registration (VIMS.) There you can register your preferences for events and volunteer positions.

# TEAM ORGANIZATION

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## 2 TEAM ORGANIZATION

### 2.1 OVERVIEW

The most critical aspects of running a team can be preparing for the season and keeping abreast with current information and deadlines. This section provides some helpful information about the mentoring process as well as required and optional team contacts and their roles.

By reviewing these organizational jobs and their tasks, you will get an overview of what some of the project entails, how your team members can share the project workloads, how to keep team members and mentors up to date, and monitor deadlines.

### 2.2 GETTING STARTED

Take advantage of the information on the *FIRST*® Website dealing with starting, organizing, and maintaining an FRC team. Print out and read the various handbooks and guides listed below, and have them readily available for your team members.

#### 2.2.1 Guides, Handbooks, and Other Helpful Resources

The following documents are available at this web page:

<http://www.usfirst.org/roboticsprograms/frc/content.aspx?id=5504>

- “Starting an FRC Team”
- “FRC Handbook”
- “*FIRST* Mentoring Guide”
- A variety of community sponsored resources

For help with other practical aspects of the competition, refer to the “Resources” flyout on the left hand side of the FRC Home page at <http://www.usfirst.org/roboticsprograms/frc/default.aspx?id=966>. Here you will find sponsorship links, tutorials, technical links for programming and pneumatics, ideas for team sustainability, mentoring resources and other assets.

Safety is an integral part of the *FIRST* programs. Be sure to read the safety page at <http://www.usfirst.org/roboticsprograms/frc/content.aspx?id=470> where you will find the link for the “*FIRST* Robotics Competition Team Safety Manual.” Start your season off by assigning a safety captain, creating safe work places, and establishing a safe work ethic.

#### 2.2.2 Scholarship Opportunities

Students, parents, and teachers should be aware of the wonderful scholarship opportunities for participating students at <http://www.usfirst.org/aboutus/content.aspx?id=508>. Students should work on their applications before the season gets too busy. It is important to pay attention to the associated deadlines.

### 2.3 THE TEAM INFORMATION MANAGEMENT SYSTEM (TIMS)

Your team is encouraged to align its structure with the contact requirements in the TIMS (introduced in Section 1, “Communication”). The following contacts are required in the TIMS:

- 1) Main Contact;
- 2) Alternate Contact; and
- 3) Shipping Contact.

The Main, Alternate and Shipping Contacts must be adults. The Main and Alternate Contacts will receive the majority of the e-mail communications from *FIRST*, and they are usually in charge of disseminating the information to the team. However, the majority of these emails are posted at <http://www.usfirst.org/roboticsprograms/frc/content.aspx?id=6616> and are available to all team members. The Main and Alternate Contacts are also responsible for keeping the team’s TIMS record up to date.

The Shipping Contact must be familiar with all aspects of shipping the team's robot. He/she will also receive any program-related shipments.

## 2.4 SUGGESTED LEADERSHIP ROLES

This section recommends various team contact duties and responsibilities that are essential to maintain the competitive team effort of the season. **Main, Alternate, and Shipping Contacts must be adults. Pre-college students are not permitted in the TIMS.**

Your team will ultimately decide which individual duties it will adopt and ensure that the individuals are capable of performing the assigned tasks. It is the responsibility of these team leaders and other team mentors to establish, instill, and enforce team rules with regard to safety, sportsmanship, and conduct.

It is essential that team members and mentors share the workload and equally commit to the team's success. Ensure everyone understands the various roles enough to be able to cover if necessary.

Examine the roles, and compare recommended qualities and abilities with your mentors from a *FIRST* perspective. Team structure is the team's prerogative and the following are only suggestions.

### 2.4.1 Main Contact Responsibilities

The Main Contact is the main source through which most information flows from *FIRST* to the team. This person may choose to delegate some of the responsibilities listed below, but should still be up to date with their progress and ensure their completion.

Communications:	Receive <i>FIRST</i> communications and reply when necessary. Review <i>FIRST</i> Safety Policies/Procedures and ensure all team members have this information.
Contact Information:	Keep all contact information up to date. Arrange for up to date alternate mailing addresses and phone number to be available in TIMS for use during vacations or team travel.
Event Information:	Register for events and supply all event-related information required in TIMS
<i>FIRST</i> Information distribution:	Receive and disseminate all information from <i>FIRST</i> , including E-mail Blasts and Updates from the website, and handle replying/complying with <i>FIRST</i> requests.
FedEx Donation:	Confirm the Shipping Contact understands the FedEx donation process and use of the on-line FedEx Shipping Administration System. See <u>Section 4 – Robot Transportation</u> of the FRC Manual.
On-Line Submissions	Ensure submissions of Woodie Flowers, Website, Chairman's, and other Awards by the respective deadlines. Find details in the "Awards" section of the FRC Manual.
Participation Medallions:	Ensure they are obtained at team's initial event. Refer to <u>Chapter 3 - At the Events</u> of the FRC Manual for details.
Registration:	Register the team for events.
Consent and Release Forms:	Please refer to <u>Chapter 3- At the Events Section 3.8.1</u> of the Team Manual for more information regarding the Consent and Release form.
Safety:	Work together with your team's Safety Captain and entire team to ensure safety while working and traveling.
Scholarship Opportunities:	Keep students/teachers informed about scholarship opportunities well in advance of the deadlines. <a href="http://www.usfirst.org/scholarships">http://www.usfirst.org/scholarships</a>
Team logon and password:	Receive, and keep confidential, your TIMS logon and password.
TIMS (Team Info System):	Maintain and update team's TIMS record.
Track Twitter Feed	Monitor the FRC Twitter Feed for announcements about updates, news and important information
Updates and archived e-mails:	Disseminate e-mails and web "Updates" information to relevant sub-teams. Refer to web for archived e-mails.
UPS, FedEx, USPS Account Number for TIMS:	Enter the team's account number in the TIMS. A sponsor or your school may let you use their account, or you can get a number from a shipping company's website.
Website Calendar:	Monitor the <i>FIRST</i> website calendar for changes, additions at: <a href="http://usfirst.org/roboticsprograms/frc/content.aspx?id=454">http://usfirst.org/roboticsprograms/frc/content.aspx?id=454</a>
Judges' Page:	Enter this submission into the TIMS by the deadline.



### 2.4.2 Alternate Contact Responsibilities

This person is the Main Contact's "right hand" and is important in the team's structure. He or she should share the team administrative duties, be ready to help in ways the team decides, delegate responsibilities when necessary, and cover the Main Contact's role if that becomes necessary.

Communications:	Receive relevant <i>FIRST</i> communications and reply when necessary. <u>Chairman's Award (CA) project</u> – Collect information about, and document, the successes and accomplishments of the team. Organize the CA submission for the team and help prepare the CA presentation to be given to the judges at the event. Please refer to Team Manual, <u>Chapter 5 – The Awards</u> for more information about the Chairman's Award.
Contact Information:	Provide current contact information for the TIMS, including an alternate phone number and address in case <i>FIRST</i> has to make contact during vacation or while the team is traveling.
Public Relations:	Confer with Main Contact. Notify Public Relations Contact of any upcoming team fundraising or events.
Safety:	Work with team's Safety Captain to ensure safety while working and traveling.
Shipping:	Be familiar with the shipping and drayage responsibilities and deadlines in case the Shipping Contact needs help.
Scholarship Opportunities:	Inform students of scholarship opportunities and their deadlines. <a href="http://www.usfirst.org/scholarships">http://www.usfirst.org/scholarships</a>
Support:	Provide any support the Main Contact or team may need.
Team Logon and Password:	Receive and keep confidential your TIMS logon and password.
Vacation Coverage:	The Main Contact and the Alternative contact will receive and be asked to disseminate <i>FIRST</i> communications.
Website Calendar:	Monitor the <i>FIRST Website</i> calendar for changes, additions.

### 2.4.3 Shipping Contact Responsibilities

This person is responsible for handling both shipping (or bagging) your robot and receiving any items shipped from FIRST to the team.

Kit of Parts:	<p>If your team opted to pay for your Kit of Parts shipment (i.e. elected the “Team Pays” choice in the TIMS), confer with Main/Alternate Contact to ensure that the shipping address in the TIMS is correct.</p> <p>If your team wants to pick up the kit, make sure the Main Contact meets the deadline for this TIMS entry. Designate an adult mentor to pick up the kit at a Kickoff.</p> <p>If your team wants to designate another team to pick up the kit, make sure the appropriate paperwork is delivered to <i>FIRST</i> by the Monday, January 4, 2010.</p>
Communications:	Receive relevant <i>FIRST</i> communications, replying and forwarding when necessary.
Contact Information:	Provide the Main Contact with current contact information for the TIMS, including an alternate phone number to enable <i>FIRST</i> contact during vacation or while the team is traveling.
Robot Shipment	<p>Read <u>Chapter 4 - Robot Transportation</u> in the FRC Team Competition Manual and download the Shipping and Drayage document(s) for your event(s) at: <a href="http://www.usfirst.org/community/frc/regionalevents.aspx?id=430">http://www.usfirst.org/community/frc/regionalevents.aspx?id=430</a></p> <p><b>Be familiar with and conform to the following:</b></p> <ul style="list-style-type: none"><li>* Deadlines/specifications for shipping your robot crate.</li><li>* Customs requirements if you ship over a border.</li><li>* The drayage system and its deadlines and rules On-time robot arrival at each event within the <i>FIRST</i> rules.</li><li>* Bag and Tag requirements and procedures.</li></ul>
FedEx Donated Shipments	<p>Receive and safeguard any shipping paperwork the team is given at Kickoff. The FEDEX donation can save your team hundreds of dollars on shipping your robot. Carefully guard the shipping documents. Bring them to the team’s events and use them as specified in manual <u>Chapter 4 – Robot Transportation</u>.</p> <p><b><u>NEITHER <i>FIRST</i> NOR FEDEX WILL REPLACE LOST SHIPPING DOCUMENTS.</u></b></p>
Team's FedEx, UPS or USPS Account Number:	<p>Provide the Main or Alternate Contact with a shipping account number for the TIMS. This could directly impact the missing, defective, or broken parts replacement system for your team.</p> <p>Sponsor/school may let team use its shipping account, or obtain a number from the companies’ websites.</p>

## 2.5 RECOMMENDED ADDITIONAL CONTACTS

### 2.5.1 Travel Contact Responsibilities

This person will be making event(s) travel and hotel arrangements for the team members and mentors. Tackle this task early to ensure there is room on preferred flights and in preferred hotels.

Communications:	Receive relevant <i>FIRST</i> communications and reply when necessary.
Travel Pricing:	Obtain, consider, and compare travel costs prior to registering for an event(s). The web has many opportunities to compare airfares. Ask for group rates to see if that is a good option. Is bussing an option?
Contact Information:	Provide up to date contact information for the TIMS. Provide an alternate phone number and address in case <i>FIRST</i> needs to make contact during vacation or while the team is traveling.
Hotel Reservations:	<u>Regionals</u> : Refer to <u>Chapter 1 - Communications</u> section of the Manual for hints and good advice on choosing team hotels. <u>Championship</u> : Use the <i>FIRST</i> vendor, Steele Meetings, Inc., located on the website, to obtain reasonable hotel packages.
Manual and Website:	Refer to the "Site Info" on the website for special travel/parking instructions. Bring the directions for the venue.
Stores/Supplies:	Refer to the <u>Chapter 3 - At the Events</u> portion of the Manual to find links to various types of stores, such as printing, supplies, hardware. Find stores near your chosen event and print out the directions to them.

### 2.5.2 Public Relations Contact Responsibilities

This person's role in advertising the team's goals and accomplishments is critical. Work with the team contacts to ensure the partners are apprised of the team's progress and accomplishments.

PR Updates:	Responsible for receiving and disseminating any PR updates issued by <i>FIRST</i> , and using them to the team's advantage in local newspapers, as well as TV/radio stations.
Fundraising:	The team would be wise to advise this person of any fundraising activity or team appearances at least two weeks before the date so that advance notification of the event can be prepared and sent to media contacts.
Sponsors:	Send any PR information to current sponsors all during the year, and prepare "marketing" materials to attract potential new sponsors.
Contact Info.	Provide up to date contact information to the Main Contact for the TIMS.
Communications:	Receive relevant <i>FIRST</i> communications and reply when necessary. Supply up to date contact information to Main Contact for the TIMS.

### 2.5.3 School Contact Responsibilities

This adult representative is responsible for knowing and enforcing all school rules regarding team participation. A teacher or principal may be best qualified for this role to facilitate the team's progress and meeting deadlines.

Communications:	Receive school related team e-mails. Provide information/reply if necessary.  If no one is specified to work on the following projects, work with Main Contact to make sure students get them done. Refer to the web <i>Calendar of Important Deadlines</i> . <a href="http://usfirst.org/roboticsprograms/frc/content.aspx?id=454">http://usfirst.org/roboticsprograms/frc/content.aspx?id=454</a>  Monitor Award due dates. Please refer to the Team Manual – Chapter 5 – The Awards.
Contact Info.	Provide up to date contact information for the Main Contact/the TIMS
Public Relations:	Notify Public Relations Contact of any upcoming team fundraising or events. Conferring with Main Contact.
Safety:	Stress safety whenever possible.
Scholarships:	Inform students early about scholarship opportunities and deadlines, and encourage and assist those interested in applying for them.

### 2.5.4 Corporate / University Contact Responsibilities

This contact provides information about the team to the University or Corporation sponsoring the team. Keeping the sponsor/partner informed of team progress and achievements throughout the season is a great way to ensure their support.

Communications	Receive related team e-mails. Provide information if necessary.
Contact Information:	Provide up to date contact information for the Main Contact for the TIMS. Provide an alternate phone number and address in case <i>FIRST</i> needs to make contact during vacation or while the team is traveling.
Public Relations:	Notify university/sponsor contacts of any upcoming team fundraising or events. Confer with Main Contact. Let supporters know about trials and successes regarding the robot design and build. Get them excited right through the process and continue providing information throughout the year. Invite them to an event.
Scholarships:	Know the website area concerning scholarships and inform students about the opportunities and deadlines. Encourage and assist students interested in applying for them.

### 2.5.5 Technical Contact Responsibilities

This person will assist the team with technical issues and problems related to engineering.

Communications:	Receive relative team e-mails. Provide information/reply if necessary. Keep the rest of the team apprised on your technical successes/failures. Ask for help/ideas.
Contact Information:	Provide up to date contact information for the Main Contact and the TIMS. Provide an alternate phone number and address in case <i>FIRST</i> needs to make contact during vacation or while the team is traveling.
Pre-Ship Inspection:	Work with the team members to perform a robot inspection before your robot ships. Use the Inspection Sheet that will be listed in Team Manual <u>Chapter 8 – The Robot</u> after Kickoff. This inspection will show where problems are so you can correct them before shipment. It will also provide the students with information they will need to know during the on-site, pre-competition inspection since the inspectors will be asking the students questions.
Public Relations:	Notify Public Relations Contact when your robot nears completion or when you have an opportunity to show off your robot.  If the PR contact is not available, notify local media of any upcoming team fundraising or events. Plan these opportunities with your Main Contact.
Safety:	Stress safety and ensure safe working conditions, safety glasses use, etc...
Scholarships:	Encourage students to try for engineering and technical scholarships. Inform them of the deadlines.

## 2.6 OTHER IMPORTANT TEAM POSITIONS

Your team may want to consider appointing one or several Rules Monitors and Safety Captains. Students are welcome to fill these positions if the team members and mentors agree and find responsible candidates. *FIRST* does not need their contact information in the TIMS.

Please read below for some job-related roles these students or adults may want to fill. There will be one Safety Captain Badge at the team's initial Regional event for each team's Safety Captain. If a team has more than one captain, they can take turns wearing the badge at the events.

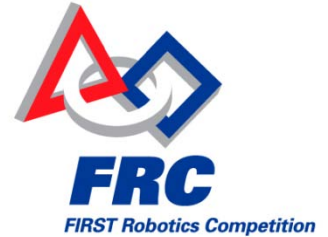
### 2.6.1 Game Rules Monitor Responsibilities

Learn Game Rules:	Read and understand the rules of the game and communicate them to the team members so they know the ins and outs of the game.
Know Point System:	Be sure the team understands the system; implement the best strategy.
Know Penalties:	Be sure all mentors and operators know and understand all penalties.
Learn Web System:	Check the on-line Manual for rules, changes, and web-based question and answer system. Online manual is at <a href="http://www.usfirst.org/roboticsprograms/frc/content.aspx?id=452">http://www.usfirst.org/roboticsprograms/frc/content.aspx?id=452</a> . Q&A is at <a href="http://forums.usfirst.org">http://forums.usfirst.org</a>
Monitor Team Updates:	Communicate any changes, written in the updates, to the team. Team Updates are at <a href="http://www.usfirst.org/roboticsprograms/frc/content.aspx?id=450/">http://www.usfirst.org/roboticsprograms/frc/content.aspx?id=450/</a> . News and Email Blasts are at <a href="http://www.usfirst.org/roboticsprograms/frc/content.aspx?id=6616">http://www.usfirst.org/roboticsprograms/frc/content.aspx?id=6616</a> .

## 2.6.2 Safety Captain Responsibilities

Read FRC Team Safety Manual:	Print and read the “ <i>FIRST</i> Robotics Competition Team Safety Manual.” Meet with the team and go over the manual with everyone.
Read FRC Competition Manual:	Read "Courtesies and Rules" section in <u>Chapter 3 -At the Events</u> section of the Manual. Meet with team members and decide what the team deems important in the safety area. Diplomatically enforce their findings.
Home Work Site:	Obtain enough safety glasses for the team. Ensure all persons wear them over their eyes when working on the robot or in the "work" vicinity. People who wear glasses must have regulation safety glasses with side shields or wear safety goggles over their glasses. Make sure the work area is safe and the floor is clear at the team's workplace and at the events.
Safety Policies:	Review Safety Policies and Procedures in the “ <i>FIRST</i> Robotics Competition Team Safety Manual.” and inform the team of the mandates and suggestions. Encourage all team members and mentors to read the document, follow the suggestions, and become familiar with the safety awards. Suggest that the team build a robot cart if it doesn't have one.
Use Courtesy:	At all times, think with a "Gracious Professionalism" <sup>TM</sup> attitude. Be courteous and helpful, not bossy or rude. This position is one that should make teams aware of safety issues and make team members want to improve conditions, not balk at the methods <i>FIRST</i> uses to ensure a safe environment. Use common sense and good judgment when bringing an infraction to someone's attention. Please be kind and positive because the Safety Captain is an ambassador for your team.
At the Events:	Bring enough safety glasses for the team and all guests. Make sure persons who will unpack your robot crate will have glasses to wear as they arrive at the Pit, and make sure all persons wear safety glasses/goggles properly. Be sure your team transports and lifts the robot safely. Know where the EMT area is, and report any injuries to the Pit Supervisor at the time of injury or treatment. Discourage running in the Pit or Competition Arena, and work with the green-shirted Safety Advisors to keep things safe and the Pit aisles clear. Bring any serious safety infractions, such as metal grinding or open flames to the attention of the Pit Supervisor, as well as any blatant discourtesies.
Safety Tokens	Be familiar with the safety awareness program outlined in the safety manual. Familiarize your team members with the program and associated safety contest at the Regionals and Championship. Bring something to store them in at the events.

# AT THE EVENTS



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## 3 AT THE EVENTS

### 3.1 OVERVIEW

This section provides a general summary regarding safety, mascots/uniforms, recommended items and equipment for teams to bring, Pit rules, generic event schedules, robot inspections, replacement parts and competition manners. The following section provides a "feel" for competition schedules, event check in procedures, practice times and matches. Please familiarize your team with this overview so all team members know what to expect and will understand the routine and the rules.

### 3.2 FIRST SPECIFIC EVENT INFORMATION

To ensure that your team has the proper information for the competitions it will attend, review the information presented at <http://www.usfirst.org/roboticsprograms/frc/regionalevents.aspx?id=430>. This information is only available on the *FIRST* web site and contains critical event-specific information regarding pre-order lunches, agendas, event addresses/directions, drayage locations, team socials and more.

### 3.3 FIRST SAFETY

Participants and team mentors should review the *FIRST* safety policies and the *FIRST* Safety Manual located at [www.usfirst.org/community/frc/content.aspx?id=470](http://www.usfirst.org/community/frc/content.aspx?id=470). It provides sound safety practices for your workplace and *FIRST* events. Additional specific site restrictions can be found within the information referenced in Section 3.2. Every team should know, understand, and follow the safety rules:

- Do not run in the venue;
- Always wear ANSI-approved safety glasses anywhere in the pit area, on the playing field, practice fields, walkways, pit stations, and any area posted with signs requiring the use of eye protection;
- Wear closed-toed shoes to protect feet and toes;
- Charge batteries in an open, well-ventilated area. Do not charge near an open flame or near equipment that may produce sparks. Do not use smoking materials in the battery charging area. Charge in an upright position. It is not safe to charge the SLA battery in an inverted position;
- Open flames are NOT allowed in any of the buildings;
- If the event is not a "Bag & Tag" event, only the drayage company may handle loading robots in and out;
- Robots may be operated via wireless control only on the competition fields; and
- Teams are not allowed to set up their own 802.11a/b/g/n (2.4GHz or 5GHz) wireless communication (access points or ad-hoc networks) in the venue.

#### 3.3.1 Safe Travel

Travel in pairs or larger groups at all times going to, coming from, and during each event. Be sure to include enough informed chaperones, specified meeting places in case someone gets separated from the group, contact information for those traveling, and a room list for hotel stays.

Be sure to specify a meeting place for your group in case of fire or evacuation at the hotel or at an event. Keep an accurate team count and have your team use the buddy system.

### 3.3.2 Safety Captain

Each team should appoint a student safety captain who will observe and make suggestions for a safe workplace and work methods prior to and during the competition events. He or she will receive a badge at the team's initial competition event and should continue to maintain a safe environment, especially the team's pit, at each competition event.

### 3.3.3 Teams Must Supply, Bring, and Wear Safety Glasses

For each competition, *FIRST* requires all teams to bring and supply ANSI-approved safety glasses for all its team members, mentors, and guests since all individuals must wear them in the team pits, the general pit area, and on or near the competition field. *FIRST* recommends that teams mark each pair of glasses with its team number.

Safety glasses must be non-shaded, except for rose, blue, or amber tints. Regular glasses do not qualify as safety glasses. To qualify as safety glasses, glasses must be ANSI-approved and have side shields. ANSI-approved safety goggles may be worn in place of ANSI-approved safety glasses.

### 3.3.4 Other Safety Recommendations

At events, the pure anticipation and excitement of being there sometimes overshadows common sense and safety fundamentals. One safety area that teams sometimes overlook is the particular need to wear appropriate and proper clothing when working or just hanging around the robots. In addition to the ANSI-approved safety glasses required for eye protection, *FIRST* also highly recommends that team members and mentors:

- Refrain from wearing dangling jewelry or loose, baggy clothing near the robots;
- Tie back long hair so that it will not get caught in the robot or other machinery;
- Wear gloves to protect hands and fingers when handling the robot or the robot crate;
- Remember that fire extinguishers are available at the pit Admin station and near the playing field; and
- Please stay within your team pit or move to the competition viewing area. If the pit area becomes too crowded for teams and their machines to move back and forth to the field safely and quickly, *FIRST* will request that some team members leave the area.

### 3.3.5 Robot Carts

To protect team members from muscle strains and other injuries as they transport the robot between the pits and the competition area, we strongly recommend that team members use a cart. Please keep the following in mind:

- Carts must remain in the team pit area when not in use for robot transportation;
- All carts should fit through a standard 30-inch door;
- Wheels on the cart must not damage site flooring; and
- Do not add music or other sound devices to the cart.

Refer to the "*FIRST* Safety Manual" for robot lifting techniques. By practicing these safety techniques, your team members will also develop a quick, fluid routine.

### 3.3.6 Safety Recognition Program

Throughout the competition, the easily recognizable, green-shirted Safety Advisors will continuously tour in pairs to observe activities in the pit, practice field, queue line, and playing fields to observe the safety habits of the teams. This includes observing the uncrating of robots

and transporting them between the pit and playing fields. The Safety Advisors will rate safe performance in three key areas:

- 1.) Safe Behavior;
- 2.) Physical Conditions; and
- 3.) The use of Safety Glasses as well as other Personal Protective Equipment (PPE) as appropriate.

Safety Advisors will use safety tokens to recognize and encourage safe behavior(s) at the competition. Teams will earn tokens for positive safety habits in the above areas.

Teams will receive 10 safety tokens in the event check in packet and should keep 5 of them. They should distribute the other 5, in whatever denomination they wish, to teams worthy of recognition. Teams will return the tokens to the Admin Station for a final count on the last competition day. The 3 teams accruing the most safety tokens will be announced during the Awards Ceremony. They should collect their “safety” award pins at the Pit Admin Station after the ceremony.

### **3.4 COURTESIES AND RULES**

The behind-the-scenes action is in the pit. This is where you can get to know other team members and perhaps pick a few brains and learn something new. The *FIRST* staff and volunteers want you to enjoy the competition and ask that everyone follow courtesy rules while in the pit, on the playing field, and in the audience.

We are trying to encourage support from our audience at our events because we need continued and growing support from outside sources. Please help to make guests feel comfortable and welcome. Provide your team with the site restrictions and rules so everyone can work and compete in a safe, sportsmanlike and friendly environment.

### **3.5 STAFF/VOLUNTEER BADGES**

At events, staff and volunteers will wear distinguishing badges. Should your team members or mentors have questions or a problem, staff and volunteers will help you find the answer, especially the Pit Admin staff.

### **3.6 COMPETITION OVERVIEW**

This section provides general competition information and necessary details regarding scheduling, robot inspection, practice times, safety, rules, regulations and suggestions for teams.

#### **3.6.1 Practice Matches**

Your event check in envelope will contain the Practice Match Schedule. Practice matches take place on the competition field. The Schedule will indicate on which competition field you will practice and with what teams. **Teams cannot switch practice times.**

##### **3.6.1.1 Time Slots**

All teams will receive a comprehensive list of practice times. Your team must be ready to practice at the designated times and on the specified fields. If your team/robot cannot be ready for your practice time slot, don't forfeit your team's practice time entirely. Send in your human player to practice alone. Your team members may want to scout other teams and their strategies during practice and the actual competition matches.

##### **3.6.1.2 The Filler Line**

Although teams may not switch practice times, there will be a designated Filler Line at each competition. Teams whose robots are ready for practice may join the Filler Line. Teams from the Filler Line will be used on a first come, first served basis to fill empty

spots in practice matches left by other teams that do not show up for their own practice match. Filler Lines will be limited to, at most, six (6) robots, but is dependent upon space at venues. Criteria for joining the Filler Line are as follows:

- **Robots in the Filler Line must have passed full inspection;**
- Teams must join the Filler Line with their robot;
- Teams may not work on their robot while in the Filler Line;
- Teams may not occupy more than one spot in the Filler Line; and
- If a team is queued up for their practice match, they may not join the Filler Line.

### **3.6.1.3 Courtesy**

In order to make the most of practice time, there will be specified teams on the field during an assigned practice slot. Each team must be respectful of the other teams sharing the field. Friendly interaction between machines is acceptable, if all teams are willing. Unsportsmanlike conduct on the part of a team during practice could result in loss of practice time.

## **3.6.2 Competition Matches**

Once your team robot passes inspection and receives its official sticker, you are eligible to compete.

### **3.6.2.1 Qualification Match Schedules:**

Before the pit opens on the morning of the second day, the Pit Admin Supervisor will place a copy of the Qualification Schedule on each team's pit table. This list provides information as to when teams will participate, with whom and against whom. The list is final and the schedule will not be altered.

### **3.6.2.2 Scouting:**

Teams often use the Qualification Schedule to scout other teams to watch their strategies and robot capabilities. This is especially helpful when choosing alliances, should your team advance to the final matches.

### **3.6.2.3 Early Matches:**

Make sure your team is on time and in place if you have an early match on competition days. **If your team is scheduled for any of the first four (4) matches on those days, you must queue up before the opening ceremony.** Matches begin immediately after the conclusion of the opening ceremony.

### **3.6.2.4 The Schedule at Events**

You will need to know when you will compete. The Pit Announcer and Queue Team will work together throughout the days to line up teams for competition matches and maintain the schedule. Pay attention to the match schedules and listen for announcements throughout the day, especially about any changes to the number of the ending match before lunch or which match designates the end of the competition day.

Please note that there will not be audible queuing at the Championship. As such, teams must queue up a half hour prior to each designated match.

### 3.6.3 Competition Agendas

Print the event-specific agenda from the web site for each event you will attend. This information can be found at [www.usfirst.org/community/frc/regionalevents.aspx?id=430](http://www.usfirst.org/community/frc/regionalevents.aspx?id=430). Bring it with you so your team will have the event's agenda.

#### 3.6.3.1 Championship Agenda

Please refer to the Championship Agenda at [www.usfirst.org](http://www.usfirst.org)

### 3.7 EARLY UNCRATING PROCEDURE AT NON BAG & TAG EVENTS

For convenience and to help ensure safety in the pit, three (3) people from each team will be allowed to uncrate their robots before the pit officially opens at non-bag & tag events. **At least one (1) of the three (3) must be an adult of post high school status.** If any of the three (3) team members leave the pit area during that time, he/she will not be re-admitted until general pit opening. **Teams cannot work on the robot or set up the team's station during that time.**

**Regional Competitions:** Refer to your event agenda for possible early opening time, for uncrating only, on the morning of the first day of the event.

**The Championship:** Uncrating will be allowed on Wednesday evening from 6 PM to 9 PM. At least one (1) of the three (3) team members entering the pits must be a post-high school adult (The others may be either students or adults).

The rules for Wednesday night pit entry at the Championship are as follows:

- **The priority task for team members is to uncrate their robot and move their crate to the aisle so that it is accessible to Shepard for removal;**
- The three (3) team members will be permitted to load in team materials on Wednesday night;
- Team members may only make one trip with load-in materials;
- There is no set limit to the amount of material teams may load-in, but it must be done in a safe, manageable way (Safety Advisors and other volunteers will be on site checking for, and helping mitigate, unsafe conditions);
- Team members are permitted to stow load-in materials safely in their pit and out of the way of aisle traffic;
- Team members are permitted to begin charging batteries;
- Pit setup will not be permitted (if your crate becomes your pit setup, remember that you may *only* uncrate your robot);
- Working on the robot will not be permitted;
- Safety glasses are required while in the pit; and
- An adult team member (one (1) of the three (3) permitted in the pit) may use this time to check in early to avoid the rush on Thursday morning.

The Shepard Exposition Services (SES) Desk personnel will be on hand to help during this limited opening.

- If your crate has incurred damage, do not open it until you notify the SES Desk personnel right away about the problem.
- Look for any label on your crate having to do with weight or crate damage questions regarding your shipment. Contact the SES Desk before opening the crate. *Once the team opens a crate, you cannot protest a weight issue.*
- **SES - Resolution time for weight overage / damage problems:**  
Notify the SES Desk personnel immediately.
- When you have uncrate, notify the SES Desk personnel so haulers can remove the empty crate(s) and keep aisles clear and safe.

### 3.8 EVENT CHECK IN

Event check in takes place at the Pit at the Admin Station the first morning of the event at the Regional Competitions and Wednesday evening and Thursday morning for the Championship. At each event, *an adult member* of each team should check in *by noon on the first day of the event*.

Prior to attending your event(s), please download the Essential Information Sheet and the Agenda. You can find agendas on the 2010 *FIRST* Robotics Competition Regional Events page.

Please read the following information carefully.

#### 3.8.1 Consent and Release Forms

New for the 2010 FRC season. We are highly encouraging FRC student team members to have their parents/ legal guardians sign their Consent and Release form electronically. Stay tuned for specific information soon to be released on how this can be done!

In the meantime, please note that if a **student** team member decides to submit their Consent and Release form electronically, it will cover the team member's attendance for the entire season – from Kickoff through Championship. However, if a **student** team member chooses to turn in a "hardcopy" of the form (i.e. printed out from the website and signed) they will have to provide it both at the Kickoff event (if attending) and at their initial competition. If they do not attend the Kickoff event, then the **student** team member will only have to provide one (1) form at their initial competition event.

Please also note that during this first "rollout" year, only **student** team members will have the option to provide an electronically signed Consent and Release form. All **adult** team mentors will still fill out hard copies of the Consent and Release form for both the Kickoff (if they choose to attend) and their initial event.

The Consent and Release form will be posted on the *FIRST* website at the same time the electronic Consent and Release form option is made available. We anticipate this to be in early December.

#### 3.8.2 Event Check in Envelope

Upon receipt of the team's consent/release forms, each team will receive an event specific event check in envelope containing:

**Pit Map:** Pit layout. It shows team location, parts replacement, inspection/ weigh/size areas, the traffic flow, and Pit Admin area.

**Practice Match Schedule:** Schedule designating practice times/alliance partners for all teams on the first day of the event.

**Safety Captain Badge:** This safety badge is in the team's initial event check in envelope *only*. Bring it to subsequent Regional events.

**10 Safety Tokens:** These tokens are part of our Safety Recognition Program.

**Team List:** List of competing teams by number, official team name, and state.

**Operator Badges:** These are for participants as defined in the manual, Section 7--The Game.

### 3.9 THE PIT

Teams, volunteers, *FIRST* Staff and guests spend a lot of time in the Pit area. Get to know other teams, help each other when you can, and keep the aisles clear. Time is short and help is very often right "next door" in the adjacent team pits.

*Children under 12 MUST be accompanied in the Pit by an adult at all times!*

#### 3.9.1 Be Safe, Be Kind, Be Gracious

- Use common sense regarding safety and courtesy.
- Wear required ANSI-approved safety glasses both in the pit and on the playing field.
- Choose a student safety captain during the build season to monitor team safety at your work areas and also at the events.
- Respect advice from safety captains and safety advisors.

#### 3.9.2 Pit Admin Station

The Pit Admin Station is centrally located in the Pit area. *FIRST* staff members and/or volunteers run this area to check in teams and help teams and visitors. Come to the Pit Admin station to:

- Turn in a printed roster and the remainder of your team's Consent/Release Forms;
- Check in and receive your check in envelope, safety tokens, and badges. Check your event agenda for the Pit opening/closing time for each event;
- Pick up participation medallions at your initial event of the season;
- Turn in safety tokens for the award count;
- Get answers to most questions, including machine shop access;
- Ask about lost and found articles; and
- Report an illness or injury.

#### 3.9.3 Team Pits

These are the areas where teams work on their robots. These numbered spaces help organize team placement and help team members, judges and visitors find teams easily. These areas are set up to be as equal as possible. Each team's pit will have a table and power outlet.

##### 3.9.3.1 Rules

For safety and because of insurance regulations:

- Teams cannot build any structure that supports people, or items for storage, above the work area in their team pit;
- No Team Station structures, signs, flags, or displays can be higher than 10 feet above the floor;
- Team Station signs, flags, and displays must be securely mounted to the structure; and
- *FIRST* personnel, event management, and/or local committee members will require teams to remove any pit structure that is deemed unsafe or outside specifications.

### **3.9.3.2 Team Pit Numbering**

At every event, each team station will have a pole mounted team number sign.

### **3.9.3.3 Space Regulations**

Each team is allotted approximately the same amount of workspace at an event, usually about 10'x10'x10'; however, the size will vary from event to event, and in many cases the space is smaller. Be sure your equipment will fit in a space smaller than those dimensions. In all cases, the height cannot exceed 10'. This includes the height of signs, flags, banners, etc...

Keep your equipment and team members within your assigned area and do not “grow” into the aisle or undesignated space. If your team is too large to fit into the allotted space, encourage your team to leave the area to scout other teams and/or to watch the matches.

**[Don't add to your space by setting up in another area.](#)**

### **3.9.4 Spare Parts Station**

Spare parts will be available at the events; however, the list of available parts will not be published until after Kickoff. Watch for a Team Update with this information. *FIRST* asks that teams bring any unused parts from their kits to events to assist and support each other or donate them to the spare parts cart (which will be used at other events). This kindness can expand your *FIRST* network of friends as you exchange parts.

***Batteries & chargers will NOT be available at any event unless you have made prior arrangements with FIRST (email [FRCParts@usfirst.org](mailto:FRCParts@usfirst.org) for more information).***

Teams are responsible for all items required at events. If a team needs a replacement high-value item, LOANERS will be available under restrictions that will be published after Kickoff.

### **3.9.5 Inspection**

To ensure all robots are safely constructed and fall within the *FIRST* parameters, there is an official robot inspection at each event. Certified inspectors will be on site all day on the first day of the event, until Pit closing time, to inspect machines. Inspectors can sometimes help find problems and/or provide suggestions during an early inspection. Go to the Inspection Station, shown on the Pit map. Read below for criteria and caveats:

- To ensure safety and readiness, pre-inspect your robot before you ship it. This will make your official inspection go more smoothly and quickly;
- Inspectors will use an official inspection sheet for checking robots; a draft copy of the inspection checklist will be available to teams during the build season. Inspectors check off items on an Inspection Sheet as the team passes those portions of the process;
- Don't wait until the last moment to begin the process. Bring your robot to the Inspection Station early. Partial inspections, such as for height and weight compliance, help prevent an inspection clog at the end of the day;
- Student team members must accompany the robot and be prepared to answer Inspectors' questions;
- Correct items and return for inspection until your robot passes;
- Teams may practice on the first day of the event without completing the inspection process; however, if field personnel deem a robot unsafe, it will not be allowed to practice until the unsafe condition is fixed;



- Robots must pass inspection before actually competing in qualification matches;
- Each time you alter the form, fit, or function of your robot, you must request and pass a robot re-inspection; and
- Inspectors may re-inspect randomly before or after matches to ensure continued safety and compliance.

### 3.9.6 Practice Field

Many events will have practice fields on which teams can share practice time. Adhere to the system in place, work with the schedule and make every effort to keep the area safe, both in and around the perimeter.

### 3.9.7 Drayage Service Desk

Shepard Exposition Services (SES) will have a representative at its service desk to help you with shipping questions or problems. Refer to the Pit Map for its location. The Drayage Service Desk will not be available at specified Bag & Tag events.

### 3.9.8 Machine Shop

Some events have a machine shop to help teams with repair and fabrication either sponsored by NASA or locals. While the machine shops vary, *FIRST* strives to have welding and a variety of high-powered tools available at the shop.

The staff and volunteers in the Pit Admin Station will be able to tell you how to make use of the machine shop. Sometimes the machine shop is on site and readily accessible to all teams, but when it is off site, we require teams to use the mandatory transportation provided at the venue. *Teams cannot travel to the machine shop "on their own".*

<b>Pit/Machine Shop Hours:</b>	Specific hours are necessary to provide teams with equal work time. Please be aware of the opening and closing hours of the Pit/Machine Shop posted on the agenda posted on the website.
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### 3.9.9 Team-Provided Mobile Machine Shops

*FIRST* welcomes team provided mobile machine shop facilities/trailers at events, but the proposed facility has to comply with *FIRST* and venue requirements. The mobile machine shop/trailer sponsor must adhere to the following two (2) sections.

#### 3.9.9.1 Approval, Liability and Security Coverage

- Have *FIRST* approval and clearance prior to each event. E-mail [frcteams@usfirst.org](mailto:frcteams@usfirst.org) to request approval by Kickoff.
- Provide liability coverage. Note that liability coverage at event venues varies, and specific venue policies may further restrict the use of these team provided mobile machine shops. Without the proper additional insurance certificate, the mobile machine shop cannot be used at the event. The requirements are:
  - a) Name *FIRST* as an additional insured.
  - b) Fax the certificate to 603-666-3907, Attention: Team Support.
  - c) Present a copy of the certificate to the Event Manager on site prior to setting up the machine shop.

- Include an appropriate team-provided staffer to perform the requested work. Each staffer must be covered under the provided liability coverage.
- Provide for any security requirements. Neither *FIRST* nor the venue is liable and/or will provide these services for you.

### **3.9.9.2 Local Restrictions**

Although *FIRST* may approve a local machine shop use at any Regional, there are local restrictions such as fire codes and venue approval that you must consider as part of the process. *FIRST* will do its best to convey any relevant needs and work on your behalf to gain venue approval through a professional, legal process.

### **3.9.9.3 Other Requirements**

In addition to the above, the sponsoring team(s) must:

- a) Include an electrical source for the mobile machine shop facility;
- b) Ensure that all teams have the ability to use tools/machines and its use. Access cannot be restricted to certain teams;
- c) Handle job requests through the same counter/process as the *FIRST* provided shop services. This includes the sponsoring team's requests; and
- d) Operate ONLY during event hours when the Pit is open.

## **3.9.10 Machine Tools at Events**

When using tools in the Pit, be sure to use them properly, in a safe and controlled manner. Unsafe operation, especially those that endanger those around you and your team, will be subject to scrutiny by the event staff and safety reviewers. Their findings may result in team caution or event expulsion.

Please adhere to the following safety rules regarding Pit safety and tool use:

- **Tools that throw sparks are prohibited.**

Examples: Electric welders, bench grinders and angle grinders.

- **Tools that produce open flames are prohibited.**

Examples: Gas welders and propane/MAPP gas torches.

- **Floor standing power tools are prohibited.**

Examples: Full-size drill presses, full-size band saws and full-size table saws.

- **Grinding or painting in the Pit is prohibited.** Designated grinding and painting areas are available to teams.

- **Brazing/welding is prohibited at the team pits.** Use the machine shop.

- **Soldering is permitted.** Use electric iron/gun only.

- **Small, bench-top machinery, with appropriate guards, is permitted in team pits.**

Examples: Band saws, drill presses, and sanders.

- **Small, desktop machining centers are permitted as long as they are reasonably sized and easily lifted by one person.** They must be appropriately covered to prevent throwing of chips during operation.

Example: Desktop CNC mill.

### 3.9.11 Suggested Equipment

We suggest you bring the following:

- Extension cord - heavy duty and at least 25 feet long;
- Power strip - to make best use of your power drop;
- Other items as suggested on the *Team Checklist* in this section of this Manual; and
- A relatively small cart to transport your heavy robot from the Pit to the playing field. Do not add music to your cart.

### 3.9.12 First Aid Station

There will be an EMT in the pit to assist in the event of injury and illness. Mentors and the Safety Captain should refer to the Pit Map for the location and alert team members. *Notify the Pit Admin Supervisor of any injuries or illness.* Bring a travel size first-aid kit for minor injuries.

### 3.9.13 Traffic Flow

At each event, there is a predetermined traffic flow pattern to maximize efficiency of the team/robot entrance and exit and to maintain safety to the competition area. Refer to the Pit Map for the flow. The queuing team maintains this pattern at each event. Please obey the traffic rules to ensure an efficient lineup for practice and competition.

It is extremely important to keep aisles clear for safety, judging accessibility, robot mobility, courtesy and maintaining competition schedules. Keep chairs and equipment out of the aisles. Please sit in the audience, not on the floor or in the aisles. Judges/Safety Advisors will notice noncompliance.

### 3.9.14 Announcements

We make every effort to keep noise down and announce only important items and scheduling, so PLEASE do not ask the pit announcer to make frivolous announcements.

### 3.9.15 Queuing Your Team

The Pit announcer and queue volunteers must maintain the practice and match schedules. Your team should designate team members to be your queue captains and carefully watch the schedule and alert the team when its turn is near. The queue captain should:

- Look at the Pit Map to find the pre-set traffic pattern for each event.
- Highlight team practice times on the Practice Schedule on the first day of the event and your competition match times on your Match List for the second and third days.
- Listen carefully for the queuing announcements at Regional events and line up your four (4) competing team members/mentor and robot when your team number is announced.
- Queue your team a half hour prior to your matches at the Championship since there are no match announcements. Ensure that you monitor play within your respective division and adjust your queuing time accordingly. Please check with the Lead Field Queuing personnel on your field if you have questions.

**NOTE:** Check the second and third day schedule. If your team is in the first four (4) matches of either day, the competition team must queue up prior to the Opening Ceremony, on or near the field.

### 3.9.16 Property Security

There have been occasions when items such as cameras and laptops have "disappeared" from the Pit or competition area. Use common sense and do not leave valuable items unattended. Neither the site nor *FIRST* is responsible for any theft. Take valuable items with you, or designate a team representative to remain with them in the team pit or competition areas.

### 3.9.17 Lost and Found

If you find an article or lose one, come to the Pit Admin Table to fill out a "Lost Item Report" or to turn in an article you find. We will make every reasonable attempt to return articles to owners.

## 3.10 CEREMONIES

There are both Opening and Awards Ceremonies on the second and third day of FRC events. These ceremonies allow everyone to show honor and respect for their countries, sponsors, teams, mentors, volunteers and award winners and to provide everyone with the opportunity to applaud the successes of team members and mentors. They also give teams a chance to "meet" the judges, referees, MCs and other important persons and sponsors involved with the event.

At the Awards Ceremony, *FIRST* presents trophies and medallions to outstanding teams.

### 3.10.1 All Teams Should Attend

We encourage all team members to attend the ceremonies, on time, to show appreciation for the event and those people involved who are volunteering their time and efforts.

### 3.10.2 Pit Manners/Rules During the Ceremonies

- Team members will *not* be allowed to use power tools, hammers or other noisy tools during the ceremonies.
- All persons in the Pit should observe the code of behavior for the presentation of all national anthems:
  - Maintain a respectful silence;
  - Stand, facing the flag. If there is no flag, look toward the video screen showing a flag; and
  - ALL hats off please.

## 3.11 PIT CLOSING ETIQUETTE

**On Time:** For many reasons, it is necessary that teams adhere to the Pit closing time each day. Many people working in the Pit are volunteers and deserve to have a set closing time met. Assign team members and mentors to the cleanup/organization of your team pit.

**Robot Transportation:** The team's shipping contact should have a plan to ensure that everything is packed and out the door by closing time. For further details about shipping your robot or participating in the new Bag and Tag system, please refer to Section 4 - Robot Transportation in the 2010 FRC Competition Manual.

Teams who will be shipping their robots must fill out a Shepard Exposition Services (SES) Bill of Lading in addition to the FedEx paperwork. Make sure you check with the shipping desk on the first day of the event to see what paperwork is needed. Please do not wait until the last minute.

When your play in the competition ends at Non-Bag and Tag events, pack your crate and attach the address label for your crate's next destination. Notify the SES shipping desk that your crate is available for removal and hand in the appropriate paperwork. Clean up your area. In the case of a

“Bag and Tag” event, you will bag your robot, close the bag using the new tag and carry the robot out of the event. To avoid congestion and long lines, please do not wait until the end of the competition to prepare your robot for transport.

### **3.12 TEAM SOCIALS**

Team socials may be held after the Awards Ceremony on the evening of the second day, and may include food, fun and an opportunity to unwind and get to know each other in an informal, relaxed and entertaining setting. These are NOT *FIRST* sponsored.

### **3.13 CHAMPIONSHIP *FIRST* FINALE**

This event takes place after the Awards Ceremony on Saturday evening. Please refer to the Championship event Information.

### **3.14 PARTICIPATION MEDALLIONS**

*FIRST* provides 1 box of 25 bronze medallions to each team that has NOT won the following medal(s):

- A Regional Chairman’s Award winner;
- An Engineering Inspiration Award winner; and/or
- A 2010 Regional Champion or Regional Finalist.

#### **3.14.1 Pick up at Your Initial Event**

A box of 25 medallions is given out (at the Pit Admin Station) at each team’s initial event only. Pick up/sign for them on the last day of the event, if you have not received any of the awards listed above. Teams will receive medallions at their first event ONLY regardless of how many events they attend.

#### **3.14.2 If You Forget to Pick Up Your Medallions**

- Teams must request shipment.
- Teams must pay for the shipment cost via their shipping account number in the TIMS.
- The medallions will not ship until after our trucks return from the Championship and materials are unloaded and categorized. Estimated ship time would be mid/end of May.
- We only accept a valid shipping account number from teams when shipping out medallions.

### **3.15 TEAM SPIRIT AND TEAM “LOOK”**

When deciding on a team name or acronym, consider how you can work a theme around it to make your team more fun and recognizable. Part of the pleasure of being a team member or mentor is the way the team stylizes itself.

Team numbers provide unique identification for FRC teams. We strongly recommend that you include the team number on all team T-shirts, trading buttons, hats, cheers and costumes.

#### **3.15.1 Team Giveaways**

Often teams bring small items to give away to others at the event. This is completely optional, but is certainly a great way to promote your team’s identity. The most popular item to give away is a button with your team logo and number.

### 3.15.2 Mascots and Team Costumes

Keep safety in mind. Awards acceptance often means descending and ascending bleachers. Please make sure that mascot and team costumes are safe for the wearer as to vision and movement and that they are comfortable and cool enough to prevent fainting and dehydration.

### 3.15.3 Competition Spirit

We ask that you choose to bring attention to your team in ways that are in good taste and in the spirit of the competition. Please refrain from the following:

- Using obnoxious noisemakers;
- Using objects that can damage bleachers or floors;
- Wearing inappropriate clothing; and/or
- Taping or affixing items or papers to walls, bleachers, floors or other site areas.

Please make sure your team pit and surrounding area is clean when you leave the site.

### 3.15.4 Banners and Flags

Sponsors provide *FIRST* with banners so we can display them in specified areas as a way of thanking them for their generosity. We encourage teams to bring team flags and/or sponsor banners, but we ask that you adhere to the following:

- DO NOT hang them in the competition area, since this area is designated for official *FIRST* sponsor banners ONLY.
- You may bring banners to the competition area while your team competes, but do not leave them or use them to section off seating. *Saving group seats is not permitted.*
- Hang banners *only in your team pit.*

## 3.16 BLEACHER RULES

Sitting together in a group during competition matches makes the game more exciting and fun. It's where you can show support for your team. Since very often there is not enough seating to accommodate everyone, there has to be a policy regarding seating. Teams are not allowed to save seating space.

With this in mind, it is not permitted to hang banners or ribbons to designate such an area. *We will remove and discard any banners, roping, etc...* Please take turns sitting in the bleachers. Share the fun. When you see there is a crowding problem, leave after your team's match and return later for another few matches.

## 3.17 SITE RESTRICTIONS

Please read the following common site restrictions and adhere to them in order to promote an orderly, safe, pleasant and exciting competition. Please refer to Section 3.2 of this manual section for additional site restrictions at your event.

- **Do not take robots from any Regional or the Championship if the event is NOT a Bag & Tag event.** You must go through the drayage company and ship your robot, even if it's your last competition.
- **Do not deliver or ship robots directly to the competition site if the event is NOT a Bag & Tag event.** All shipments must go through the drayage company.
- **Do not bring food** to the site. If you bring food, do not bring it onto the property.
- **Do not use noisy devices**, such as floor stompers, whistles and/or air horns.

- **Do not arrange for Internet access or phone lines** on the site or attempt to connect to the Internet.
- **Do not sell any products.** This includes food, hats, shirts or any promotional products.
- **Do not distribute any food products**, such as candy, water, soft drinks or fruit.
- **Do not sell raffle tickets.**
- **Do not bring bottled gas tanks (e.g. helium).** This is a safety concern.
- **Do not use walkie talkies.**
- **Do not invite or bring live bands to play in the audience.** This dilutes the presentation on the playing field and is too loud and confusing for the audience.
- **Do not play loud music in the Pit** because it interferes with important announcements. If a team receives more than a warning or two, the power to the team pit will be shut off and/or the music confiscated.
- **Do not form "tunnels"** during the Awards Ceremony. This can cause discomfort to those traveling through them and creates safety issues.

### 3.18 CONSIDERATIONS

You will often hear the expression Gracious Professionalism™ throughout your involvement in *FIRST*. You can read Woodie Flowers' definition in Section 0 – Introduction of the 2010 FRC Team Manual. One of our main goals is to encourage ALL team members and mentors to conduct themselves with kindness, sharing and consideration of others.

Gracious Professionalism™ is a central tenet of the *FIRST* experience. It is not acceptable to engage in hostile action, hostile/profane language or any other violent or antagonistic conduct. *FIRST* reserves the right, at its discretion, through the Event Manager or his/her designee, to arrange for any team, team member, event participant or other individual to be removed from participating or attending any *FIRST* event or program for engaging in such conduct. *FIRST* looks forward to everyone's cooperation in keeping our programs and events exciting, educational and full of Gracious Professionalism™.

### 3.19 LOCAL STORES – WEBSITES

Helpful URLs that can assist you in locating stores in the vicinity of your hotel and/or competition site are listed below. Before you travel, print out directions from both the competition site and your hotel. Competition site addresses for each event are on our website in the Events Sections, "Site Info."

**Note for Canada:** Please note that the website addresses for stores in Canada end in ".ca". If the address is for a home page, click on the "find a store," "store locator," or "location."

**Please note that *FIRST* provides this information as a courtesy only and doing so should not be interpreted as a promotion in any way of either the vendor(s) and/or their products/services.**

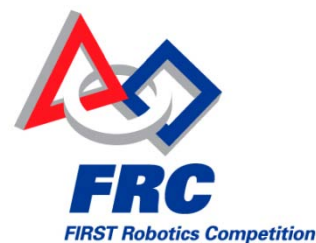
HARDWARE STORES	
Ace Hardware	<a href="http://www.acehardware.com/">http://www.acehardware.com/</a>
Lowe's	<a href="http://www.lowes.com/">http://www.lowes.com/</a>
Menard's	<a href="http://www.menards.com/nindex.jsp">http://www.menards.com/nindex.jsp</a>
The Home Depot	<a href="http://www.homedepot.com">www.homedepot.com</a>
The Home Depot - Canada	<a href="http://www.homedepot.ca">www.homedepot.ca</a>
True Value Hardware	<a href="http://www.truevalue.com/">http://www.truevalue.com/</a>
OFFICE SUPPLIES	
Kinko's	<a href="http://www.kinkos.com">www.kinkos.com</a>
Office Depot	<a href="http://www.officedepot.com/">http://www.officedepot.com/</a>
Office Max	<a href="http://www.officemax.com/">http://www.officemax.com/</a>
Staples	<a href="http://www.staples.com">www.staples.com</a>
Staples Business Depot	<a href="http://www.staples.ca">www.staples.ca</a>
DEPARTMENT STORES	
Kmart	<a href="http://www.kmart.com/shc/s/StoreLocatorView?storeId=10151&amp;catalogId=10104&amp;langId=-1&amp;adCell=A2">http://www.kmart.com/shc/s/StoreLocatorView?storeId=10151&amp;catalogId=10104&amp;langId=-1&amp;adCell=A2</a>
Target	<a href="http://sites.target.com/site/en/spot/page.jsp?title=stores_services_main">http://sites.target.com/site/en/spot/page.jsp?title=stores_services_main</a>
Wal-Mart	<a href="http://www.walmart.com/cservice/ca_storefinder.gsp?NavMode=7">http://www.walmart.com/cservice/ca_storefinder.gsp?NavMode=7</a>
ELECTRONICS	
Best Buy:	<a href="http://www.bestbuy.com/">http://www.bestbuy.com/</a>
Future Shop	<a href="http://www.futureshop.ca">www.futureshop.ca</a>
Radio Shack®:	<a href="http://www.radioshack.com/">http://www.radioshack.com/</a>
DRUG STORES	
CVS Pharmacy	<a href="http://www.cvs.com/CVSAApp/cvs/gateway/cvsmain">http://www.cvs.com/CVSAApp/cvs/gateway/cvsmain</a>
Eckerd, Rite Aid, Brooks	<a href="http://www.riteaid.com/brooks_eckerd/locator/">http://www.riteaid.com/brooks_eckerd/locator/</a>
Sav-On	<a href="http://www.savon.com/default2.asp">http://www.savon.com/default2.asp</a>
Shoppers Drug Mart	<a href="http://www.shoppersdrugmart.ca">www.shoppersdrugmart.ca</a>
Walgreens	<a href="http://www.walgreens.com/">http://www.walgreens.com/</a>



### 3.20 TEAM CHECKLIST

This is a suggested list of items your team may want to bring to events.

<b><u>SAFETY GLASSES are REQUIRED!</u></b> <b>Bring enough for your team and visitors.</b>	<b>Bring required completed <u>CONSENT/ RELEASE FORMS</u> for all team members and mentors!</b>
<p style="text-align: center;"><b>TOOL BOX ITEMS</b></p> <ul style="list-style-type: none"> <li>-- Ball driver set / nut driver set</li> <li>-- Batteries and Charger</li> <li>-- Box cutter</li> <li>-- Broom (small, for team pit cleanup)</li> <li>-- C-Clamp, large, medium, small</li> <li>-- Cutters</li> <li>-- Deburring tool</li> <li>-- Dremel tool/accessories</li> <li>-- Drill - cordless w/charger, Drill bit set</li> <li>-- Flashlight</li> <li>-- Glue, super and/or glue stick</li> <li>-- Hacksaw and blades</li> <li>-- Hammer (ball peen &amp; brass)</li> <li>-- Heat gun</li> <li>-- Leatherman-type tool</li> <li>-- Level, small</li> <li>-- Lithium grease, spray can</li> <li>-- Magnet on a stick</li> <li>-- Paint brush</li> <li>-- Pliers - large, small, needle nose assort.</li> <li>-- Power outlet strip / extension cord (2)</li> <li>-- Power screwdriver</li> <li>-- Saber saw/wood &amp; metal blades</li> <li>-- Sandpaper - various grits</li> <li>-- Screws - nuts - washers</li> <li>-- Screw driver assortment, flat and Phillips</li> <li>-- Shrink tubing</li> <li>-- Socket set – 1/4", 3/8" drive</li> <li>-- Soldering iron (electric), solder, wick, flux</li> <li>-- Spare parts</li> <li>-- Square - small, medium</li> <li>-- Tap &amp; die set/assorted taps</li> <li>-- Tape: clear/electrical/masking</li> <li>-- Tape measure / ruler</li> <li>-- Tie wraps / connectors / rubber bands</li> <li>-- Tin snips</li> <li>-- Tweezers / scissors</li> <li>-- USB stick/drive -- Vice grip - large, small</li> <li>-- Volt meter</li> <li>-- WD-40 / lithium grease, spray can</li> <li>-- Wire terminal crimpers / Wire strippers</li> <li>-- Work gloves- several pairs</li> <li>-- Wrenches, Allen, crescent, open and box</li> <li>-- X-Acto type knife and blades</li> </ul>	<p style="text-align: center;"><b>ADDITIONAL ITEMS</b></p> <ul style="list-style-type: none"> <li>-- Banners - Corporate signs &amp; flags for team pit</li> <li>-- Camera and film, disposable</li> <li>-- Cart for moving robot</li> <li>-- Drop light</li> <li>-- Epoxy</li> <li>-- File folder box for paperwork</li> <li>-- Hand truck</li> <li>-- Laptop / software / cables / discs</li> <li>-- Manual and Updates</li> <li>-- Medical Release Forms</li> <li>-- Message board - dry erase marker set</li> <li>-- Notepads / spiral notebook / clipboard</li> <li>-- Paper / Sticky Notes</li> <li>-- Paper towels and paper cups</li> <li>-- Pens / pencils / sharpies / markers</li> <li>-- Portable printer</li> <li>-- Release form for each person, completed</li> <li>-- Seat(s) for team pit (small, foldable)</li> <li>-- Schedule to set up and break down team pit</li> <li>-- Spray cleaner</li> <li>-- Stapler / staples</li> <li>-- Storage box / bins- trinkets &amp; trash (buttons)</li> <li>-- Team roster and contact information</li> <li>-- Trash can (small) / trash bags</li> <li>-- Plastic zip type bags</li> </ul> <p style="text-align: center;"><b>PERSONAL ITEMS</b></p> <ul style="list-style-type: none"> <li>-- First Aid Kit - Band-Aids / Blister Kit / Ice Pack</li> <li>-- OTC Pain Medication; i.e., Aspirin, etc...</li> <li>-- Alcohol Prep Pads / First Aid Tape</li> <li>-- Cough Drops / Sore Throat Medicine</li> <li>-- Eye Wash And Drops</li> <li>-- Hand Sanitizer / Liquid Soap</li> <li>-- Feminine Products</li> <li>-- Insect Sting Medicine / Insect Repellent</li> <li>-- Facial Tissues/ Cotton Balls / Wet Cloths/</li> <li>-- First Aid Cream</li> <li>-- Anti-Nausea or Diarrhea Medication</li> <li>-- Safety Glasses</li> <li>-- Sewing Kit (Small)</li> <li>-- Sunscreen / Sunburn Spray / Aloe Vera Gel</li> </ul>



# ROBOT TRANSPORTATION

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## 4 ROBOT TRANSPORTATION

### 4.1 OVERVIEW

FRC teams ship their robots to ensure that all teams have an equal amount of time to build, test and modify their robots. Robots are shipped to the drayage site for the first event that your team will attend and then shipped to any subsequent events.\*

This section provides information regarding shipping and associated requirements, the drayage system, crate specifications and an introduction to the FedEx® shipping donation. Please make sure those persons responsible for shipping your team's robot understand and follow the rules in this chapter. Following the guidelines will ensure that your robot arrives where it needs to be on time, so that your team can focus on the important thing – participating in the event!

\*Please note: Teams planning to attend a Bag and Tag Event will have specific requirements – please read this entire chapter!\*

### 4.2 ROBOT SHIP DAY

All Robots must be out of the teams' hands before midnight local time on ROBOT SHIP DAY.

**ROBOT SHIP DAY is Tuesday, February 23, 2010**

#### 4.2.1. Robot Ship Day Options

Robots may be “shipped” on or before ROBOT SHIP DAY in one (1) of four (4) ways:

1. Deliver your robot to the drayage location of your first event. Please see <http://www.usfirst.org/roboticsprograms/frc/regionalevents.aspx?id=430> to find the drayage location for your first event.
2. Use one (1) of your team's donated FedEx shipments to ship to the drayage location for your first event. Teams using this method must read Section 4.7 carefully and abide by all requirements.
3. Arrange shipment through Shepard Exposition Services (SES) or another freight carrier to ship your robot to the drayage location for your first event.
4. If your first event is a Bag and Tag event, bag your robot per the instructions in Section 4.8. (Only applies to designated Bag and Tag events!)

**NOTE:** Teams must work within the business hours of the shipper and drayage facilities. Shepard Exposition Services (SES) warehouses have business hours Monday – Friday, from 8 AM to 4 PM.

#### 4.2.2. Required Verification

Robot shipments will be verified by *FIRST* following ROBOT SHIP DAY. Any team that fails to comply may jeopardize their participation in the rest of the FRC season. See Section 4.5.2.

- Any team that ships using their first donated FedEx shipment does not need to send any verification.

- Any team that uses another method of delivery to the drayage facility for their first event must obtain a hard copy of the delivery receipt. Please see [Section 4.5.3](#) for complete instructions.

### 4.3 SHIPPING AND DRAYAGE DEFINITIONS

**BILL OF LADING** White FedEx Freight shipping document printed in purple and red. Provided by *FIRST* at Kickoff and used to ship the team's robot. US teams receive one (1) bill of lading for each leg of the robot's journey that is covered under the 2010 FedEx donation.

**Consignee** Term on a FedEx Bill of Lading that refers to the recipient of the crate. The Consignee is the "Ship To" address for your crate. When shipping your robot to a drayage warehouse, your Consignee would be the drayage company and the address of the warehouse.

**Drayage** In our case, drayage refers to the system of storing robot crates between traditional (non-Bag and Tag) events and delivering them to the event venue. Drayage also includes coordinating outbound shipment of robot crates after each event.

**Payment Authorization Form** A form required by Shepard Exposition Services (SES) in order to handle your crate through the drayage system. Teams must provide credit card information on this form to cover any freight overages. This form must be completed regardless of which shipping method you will use.

**PRO NUMBER** A number used to track the movement of a shipment through the FedEx Freight system. Each Bill of Lading will have a Pro Number and barcode in the upper left-hand corner.

**Shipper** Term on a FedEx Bill of Lading that refers to who is shipping the crate. Please fill in the school/company name and address, as well as the contact name and phone number for the person shipping the crate.

**Shipping** In this case, the term "shipping" refers to the transportation of your robot in its crate:

- 1) To the Drayage warehouse
- 2) From the Drayage warehouse to the next event's Drayage warehouse
- 3) Home after your last event

**TRACKING NUMBER** A number used to track the movement of a shipment through the FedEx Express system. Each US Airbill or International Air Waybill will have a Tracking Number pre-printed on the form. Only a limited number of teams will receive a US Airbill or International Air Waybill.

**BAG** Plastic BAGS large enough to contain your robot. Provided by *FIRST* to isolate your robot under the Bag and Tag system.

**TAG** Zip tie TAGS with individual serial numbers used to seal BAGS for teams attending Bag and Tag events.

#### **4.4 DRAYAGE – WHAT IS IT AND WHY DOES IT MATTER?**

*FIRST* contracts with a drayage company for each traditional (non-Bag and Tag) event. They receive and store your robot until it is needed, transport it to and from the event venue and ensure that your robot ships off to its next destination. Every team attending a traditional Regional Event must ship its competition crate(s) to the designated drayage. Only teams attending Bag and Tag events will be allowed to transport their robots directly to the event venue.

Shepard Exposition Services (SES) is the designated drayage company for all events except the SBPLI Long Island Regional and New York City Regional. FESTO Corporation handles materials for the SBPLI Long Island Regional event.

The drayage company provides the following services:

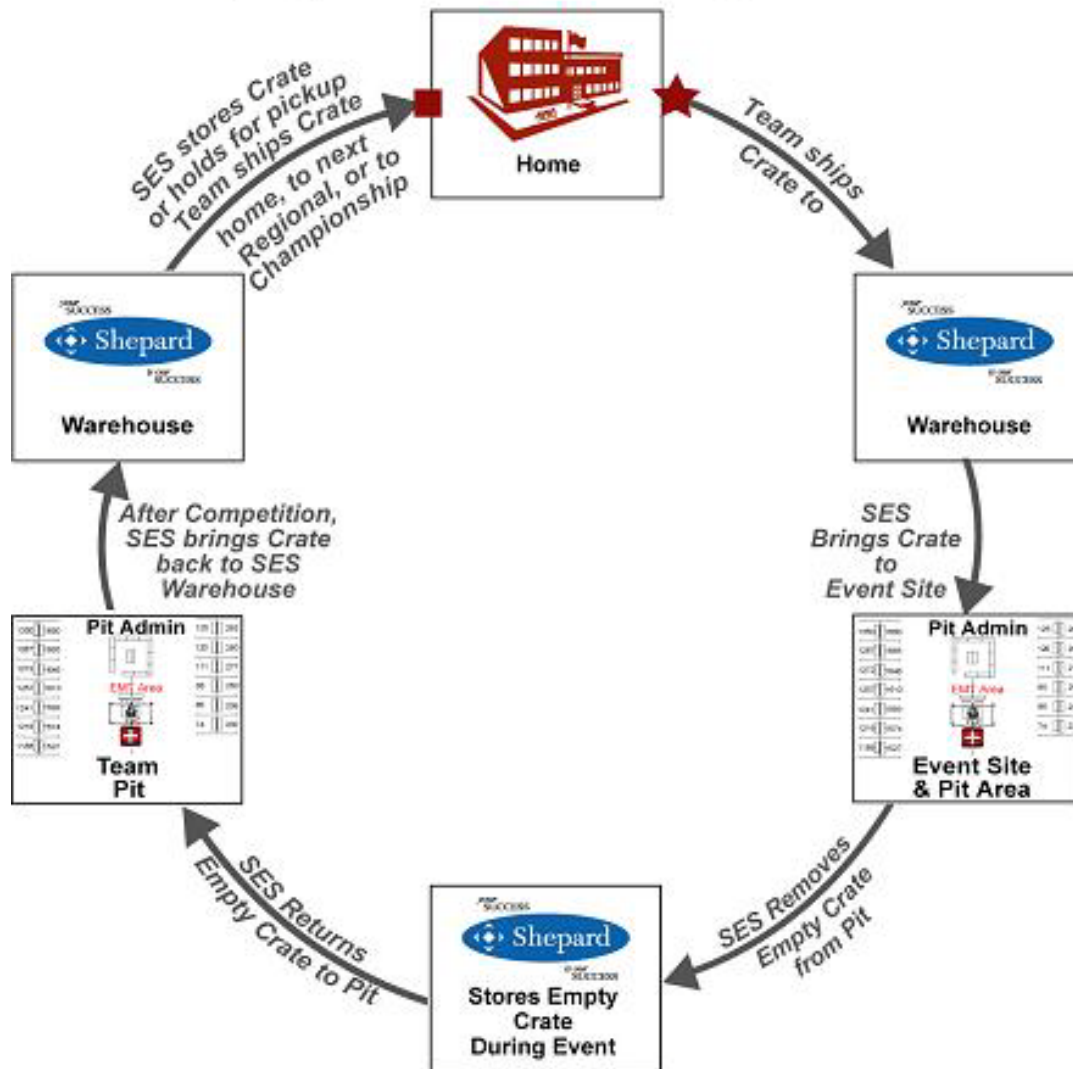
- a. Robot storage prior to the events;
- b. Ensuring on-time crate delivery to team Pit stations at the Regional Events;
- c. Storage for empty crates at the venue;
- d. A staging location for outbound shipments;
- e. Protecting staff and teams from crowded load-in and load-out situations; and
- f. Compliance with venue contracts which prohibit the acceptance of shipments on site.

##### **4.4.1. Visual Depiction of Shipping / Drayage Process**

The figure below will help you understand the path of your robot and crate as they move through the drayage system during the 2010 season. Teams attending a traditional Regional Event or the Championship will use the drayage system.

# Shepard Exposition Services (SES) *FIRST* Drayage Contractor

## Understanding Drayage and Robot Transportation



\* Shepard Exposition is not responsible for Drayage service for Long Island Regional Diagram and service applies for all other Regionals

### 4.4.2. Rules of the Drayage System

#### 4.4.2.1. Before Your Events

- All teams **MUST** complete a “Payment Authorization Form” prior to your team’s initial event. Go to [www.shepardes.com/first](http://www.shepardes.com/first) to complete an online payment authorization or print a faxable form. If your team does not complete the form prior to

attending an event, you will be required to provide a valid credit card on the spot to cover any shipping or weight overage charges.

- Teams may plan to ship their robot through SES because they are a) saving their Donated FedEx shipments; or b) all the team's FedEx shipments have been used up. Arrangements for the shipment must be made before the event (see [Section 4.5.4](#)).

#### 4.4.2.2. At the Events

Drayage personnel are not allowed to, and will **not**, load your crate onto your vehicle. At a traditional Regional Event (non-Bag and Tag) teams must:

- a. Provide either a completed FedEx BILL OF LADING or schedule a shipment with SES.
- b. Fill out an SES BILL OF LADING in addition to any other shipping paperwork.
- c. If you will be shipping with SES, they must have a Payment Authorization Form on file for your team before you will be able to make shipping arrangements.
- d. **All shipments must be paid before you leave the Regional. Payment is accepted in the form of credit card on file, money order, or school check.**

#### 4.4.2.3. Drayage Costs and Other Details

*FIRST* pays the drayage costs for robot crates up to 400 pounds. Certain rules apply to crates moved through the drayage system:

- Crates will be weighed at each event and charges will be assessed separately at each event.
- Any robot crate heavier than 400 pounds will be charged as follows:
  - \$55 for crates weighing 400-450 pounds;
  - \$100 for crates 450-500 pounds; and

**NOTE:** A team's scales may vary from the drayage company's scales. It's in a team's best interest to stay well under break points in the drayage charges. For example: a crate weighing 435 pounds would be charged \$55 but a crate weighing 460 pounds would be charged \$100.

  - An additional \$100 for every 1-100 pounds over 500. For example: a crate weighing 545 pounds would be rounded up to 600 pounds and would be charged \$200.
- Any tool crate (second crate) will be charged \$55 for every 1-100 pounds for the entire weight of the crate. For example: a tool crate weighing 340 pounds would be rounded up to 400 and charged \$220. **NOTE:** Teams are responsible for shipping charges on tool crates as well. See [Section 4.5.7](#).
- **Weigh In:** The drayage warehouse handlers will weigh team crates as they arrive at each facility. These weights will be certified and any crates exceeding 400 pounds will be subject to drayage overage fees.
- If a team wants to dispute the weight of its crate, a scale will be on site at each event for reweigh. **Teams must request reweighing BEFORE opening the crate.** Once the crate is opened, the team relinquishes any appeal rights.
- **Damage:** The drayage warehouses will not be responsible for damage to uncrated materials, improperly packed materials, or any concealed damages, loss, or theft of materials after crates have been picked up for loading out of the competition site.



## 4.5 SHIPPING YOUR ROBOT

**Event sites do not accept or store team robots, crates or toolboxes.** All teams must ship to the designated drayage warehouse facility which stores the robots and then transports them to the event site and back to the warehouse for outbound shipment.

If you ship two (2) crates, both crates must adhere to all shipping rules and deadlines. Teams are responsible for paying for ALL charges at the time of shipment.

### 4.5.1. Robots MUST Ship Through the Drayage System

In order to maintain a fair and safe robot shipping process and honor our venue agreements, union rules, and on-site safety, teams must ship robots from event to event through SES.

**4.5.1.1. Do not ship your robot to the event location. Venues will NOT accept robot crates and *FIRST* will NOT take responsibility for robots shipped by any method other than those outlined in this chapter.**

**4.5.1.2. The ONLY events that allow teams to carry their robots directly into the venue are Bag and Tag events. For 2010, this includes Greater Kansas City, Pittsburgh, Oklahoma, Waterloo, Sacramento, Greater Toronto and all Michigan Events.**

### 4.5.2. Shipping to Your First Event

**For your initial event only**, you have three (3) options to transport your robot to the drayage facility. You may:

1. ship your robot using the FedEx donation;
2. ship your robot either through Shepard Exposition Services (SES) or using an alternate shipper of your choice; or
3. hand deliver your robot to the drayage facility for your first event.

#### 4.5.2.1. All teams must follow these procedures:

- Locate “Shipping and Drayage” information for your initial event on the *FIRST* website at <http://www.usfirst.org/roboticsprograms/frc/regionalevents.aspx?id=430>
- Print the related shipping labels for your crate(s);
- Refer to Section 4.7 for further details about shipping via the FedEx donation;
- Make shipping arrangements well before the ship deadline. *FIRST* will not make exceptions for teams that did not ship on time; and
- Print, read and save all relevant sections of this manual as well as the Shipping and Drayage document for the event you will attend. Bring them to your event.

#### 4.5.2.2. Special notes for teams using SES, an alternate shipper or hand delivering their robot to the drayage facility for their first event

- Teams may wish to consider these alternate options for their first event if they expect to use all of their donated FedEx shipments before they finish competing for the season. Teams are financially responsible for any shipments they require outside of the FedEx donation.
- Obtain a dated receipt from your carrier. You will need to track your crate’s progress yourself, as well as providing a copy to *FIRST* to verify your initial shipment (see [Section 4.5.3](#)).

- You will need the total weight and dimensions of your crate and its contents to request an accurate price estimate from alternate shippers;
- If you drive your robot to the drayage facility, your truck must have a 48" bed height or you will be turned away at the warehouse; and
- If you don't have a loading dock, notify your shipper that your crate pickup area does not have a loading dock so the shipper will send a truck with a lift gate.

#### **4.5.3. Verify Initial Crate Shipment – Mandatory**

Every team must provide proof that their robot shipped on or before ROBOT SHIP DAY. Please follow the instructions below for your chosen shipment method.

##### **4.5.3.1. If You Ship Using the FedEx Donation**

*FIRST* will receive shipment information directly from FedEx and verify that your shipment was picked up on or before ROBOT SHIP DAY.

##### **4.5.3.2. If You Drive Your Robot to the Drayage Facility**

- Ask the drayage warehouse personnel to put the time and date of delivery on an official receipt;
- Write your team number clearly on the receipt;
- Make a copy and retain for your records;
- Address the envelope as shown below, using all capital letters; and
- Send the receipt to *FIRST* so it arrives by Monday, March 1.

##### **4.5.3.3. If You Use an Alternate Shipper**

- Obtain a receipt from the shipper and ensure it clearly shows the date and time the crate left your team's hands;
- Write your team number clearly on the bill of lading/receipt;
- Make a copy for tracking purposes and retain for your records;
- Address the envelope as shown below, using all capital letters; and
- Send the receipt to *FIRST* so it arrives by the following Monday.

##### **4.5.3.4. If Your First Event is a Bag and Tag Event**

- Bag and seal your robot on or before ROBOT SHIP DAY.
- Fill in the Robot Lock-Up Form, clearly noting the date and time (see [Section 4.8](#) for further details).

##### **4.5.3.5. Verification Mailing Address – Use capitals please.**

**YOUR TEAM # and EVENT NAME AND EVENT DATE**

TEAM SUPPORT / OPERATIONS

*FIRST* ROBOTICS COMPETITION

200 BEDFORD STREET

MANCHESTER, NH 03101

#### **4.5.4. Event to Event Shipping – After Your First Event**

After your team attends its first event, you must ship through the DRAYAGE system (unless your second event is a Bag and Tag event).

Crates must ship directly from event to event, either through:

1. Shepard Exposition Services and its Logistics carrier. Make arrangements before your event if you plan to ship through SES. To request a price quote and schedule your shipment, visit the SES website: [www.shepardes.com/first](http://www.shepardes.com/first) OR
2. Using a FedEx Freight donated shipment. Bring the supplied BILL OF LADING and PRO NUMBER stickers with you to the event if you intend to use this method. Replacements will not be provided for lost or forgotten shipping paperwork.

#### **4.5.5. Shipping to Events in Consecutive Weeks**

*FIRST* discourages teams from competing in events on consecutive weekends if they are more than 1,000 miles apart. If you choose to attend two events in consecutive weeks, please consider these points:

- **You cannot use a FedEx donated shipment for back-to-back events.**
- The shipping cost for back-to-back events is extremely costly. Compare shipping a small package to a location at a “ground” rate and the cost of sending it overnight. Use this same scenario to compare freight shipping rates for a 3 or 4 day freight shipment to an overnight or airfreight shipment. *The difference can be staggering!*
- Teams attending events in consecutive weeks must make special shipping arrangements with SES. Make these arrangements early to make sure that SES can accommodate your request.
- Teams will not be allowed to bag their robots if they are not attending a Bag and Tag event.

#### **4.5.6. Delivery Deadlines**

Crates must arrive at the drayage site by the Monday before the event in order to be in place for the beginning of the event. If you are concerned that your crate may not arrive in time, make prior arrangements with the drayage company.

#### **4.5.7. Shipping a Tool Crate**

Some teams choose to ship a second crate containing tools to the event(s). Shipping a second crate is allowed, but only if the crate meets the following conditions:

- The second crate may NOT be shipped using the FedEx donation. Abuse of the FedEx donation may result in a loss of this option for all teams in the future.
- The team is financially responsible for all shipping and drayage costs for their second crate. The team must call SES prior to ROBOT SHIP DAY to arrange shipment of the second crate and payment of the drayage charges.
- Paint or stencil “TOOL CRATE – Pc 2 of 2” in letters at least 6 inches tall on each face of the crate. Failure to properly label which crate contains tools may delay arrival of your robot at the event.

#### **4.5.8. Outbound Shipments from Events**

1. Remove all old PRO NUMBER stickers from your crate;
2. Attach address labels to your crate showing the next destination;
3. Fill out all required BILLS OF LADING using the drayage location for the current event as the “Shipper” and the next destination as the “Consignee”;

4. Turn in all shipping paperwork to the SES shipping desk at the event. Teams that leave their shipping paperwork on the crate or fail to provide correct shipping paperwork will be charged for their shipment; and
5. SES will contact FedEx or the SES house shipper (depending on what you indicated on your shipping paperwork) to schedule the outbound shipment from the drayage warehouse.

#### 4.5.9. Shipping Home from Your Last Event

Teams must also use SES to ship their robot and crate(s) home from traditional Regional Events. Exceptions to this rule will be made on a case-by-case basis.

1. Requests will be considered for a team's last event of the season only.
2. Teams requesting an exception must contact Team Support via [frcteams@usfirst.org](mailto:frcteams@usfirst.org).
3. **Complete the exception application process by February 26, 2010** to allow for processing. Make the request clear and provide the:
  - Subject line: "Robot Removal, "Name of Event - Team (your team #)";
  - Reason you are requesting an exception – detailed explanation; and
  - Event from which the robot would be taken.

Upon reception of this information, *FIRST* will, in good faith, consider your request. Be advised that each venue, its rules, and safety situations are unique. Some events are not laid out for safe robot removal and you will be refused for that reason. The Director of FRC will review each case and will provide a written response. This decision will be final.

##### 4.5.9.1. Exception Stipulations

- The drayage company will not help or provide equipment for the removal and teams will not be permitted to use the loading dock.
- You may have to wait to load out at an earlier or later time than may be convenient.
- You will also be responsible for dismantling and removing your robot crate. Do not expect to receive assistance in those processes.
- A \$150 clean-up fee will be assessed for any crates left behind.

## 4.6 CRATE CONSTRUCTION REQUIREMENTS

Build your crate so it is sturdy and falls within height and weight parameters when packed for shipment. If a crate exceeds size specifications or is poorly constructed, *FIRST* will not guarantee its security or its delivery to the site.

### 4.6.1. All Crates MUST:

1. **Weigh less than 400 pounds when fully loaded.**
2. "Sit" on 2 pieces of 4" x 4" lumber, spaced at least 28" apart so it can be moved by a forklift.
3. Have a footprint no greater than 4' x 4' and be no taller than 5'10" (70") high. This maximum includes the 4" x 4" lumber mentioned above.
4. Be constructed so it can withstand stacking during transport and storage.
5. Have "**TEAM # XXXX**" (insert your team number) painted or stenciled in letters at least 6" high on at least one side of the crate. Shipping labels and paperwork often

get lost in shipping. Painting your team number clearly on the crate will help to ensure that it arrives at your Pit Area on time.

#### **4.6.2. Shipping Batteries**

It is not mandatory that you ship your batteries with the robot, however, if you choose to ship the 12VDC batteries in the crate with the robot, federal regulations require teams to follow the instructions below.

- NO batteries are to remain mounted on the robot (connected or not)!
- Ship them inside their original box or carton packaging.
- Use the Styrofoam covering with protective caps to cover the battery terminals.
- Secure the boxed batteries inside an “inner battery box.” See the Robot Shipping web page for further instructions on constructing an inner battery box.
- Both the inner battery box and the outside of the crate must be labeled “NON-SPILLABLE BATTERY INSIDE.” The Shipping and Drayage document for your Regional Event will include printable labels for your use.
- **NOTE:** International teams do not need to ship batteries with their robots to events in the US. Batteries will be provided for your use, via the spare parts table, at the regional events.

**For further instructions and suggestions about building your crate, refer to the Robot Shipping web page at <http://www.usfirst.org/roboticsprograms/frc/content.aspx?id=3570>.**

#### **4.6.3. International Teams - Crates Crossing US Borders**

The above sections apply to all crates. Crates crossing a US border have additional limits. Federal Rules apply to the crating and the pallets you will use to ship crates across US Borders to FRC events.

The US Dept. of Agriculture has adopted international guidelines to decrease the potential for the introduction of certain plant pests that may accompany wood materials arriving from other countries. The crate construction and pallet guidelines stipulate that wood packing materials be either heat treated or fumigated with methyl bromide in accordance with applicable rules. These wood materials must have the approved international mark certifying treatment.

**ALL IMPORTS (with certain exceptions) WILL BE DENIED ENTRY IF THEIR WOOD PACKING MATERIAL DOES NOT CONFORM TO THESE GUIDELINES AND MARKING REQUIREMENTS.**

All international teams, or US teams shipping into and out of the US, must do the following to comply:

- Use only plywood or other exempted wood materials when constructing their shipping crates and robots;
- If using raw wood materials such as 4” x 4”, 2” x 4”s, 1” x boards, etc..., obtain the materials from a lumber dealer who sells compliant wood products;
- Be sure the wood is marked with the approved international mark;
- Make sure you use properly treated and labeled wood for the 4” x 4”s under your crate used for facilitating forklift use;
- If you must use a pallet to ship your crate, make sure it is either non-wood or a compliant wood pallet, available from commercial pallet distributors;
- Canadian teams should obtain an appropriate importer’s statement as indicated; and

- Contact your local FedEx office for additional information and assistance. You can also find information at: <http://fedex.com/us/promo/woodpackaging.html>

## 4.7 USING THE FEDEX® DONATION TO SHIP YOUR ROBOT

FedEx has again graciously agreed to partner with *FIRST* for the 2010 FRC season. FedEx's donation will allow all FRC teams to ship their robot to and home from one (1) traditional Regional Event. *FIRST* expects all teams to follow the instructions below carefully. Neither FedEx nor *FIRST* can reimburse teams for shipments that violate the terms of the donation.

**NOTE:** Teams will only participate in the FedEx donation if they are attending a traditional Regional Event or the Championship. Shipping will not be available to or from Bag and Tag events.

### 4.7.1. Shipping Within the 48 Contiguous US States – FedEx Freight

Each US team will receive up to two (2) FedEx Freight BILLS OF LADING to use during the season. The number of BILLS OF LADING received will depend on the events the team will attend, but no team will receive more than two (2).

**Teams must call FedEx by February 16, 2010 to schedule a pickup appointment on or before ROBOT SHIP DAY.** Failure to schedule your pickup by February 16 may result in your robot not being picked up on ROBOT SHIP DAY, which may jeopardize your participation in the rest of the FRC season. Call FedEx Freight at 1-866-393-4585.

- FedEx will not pick up a robot that is not in a crate. See [Section 4.6](#) for crate requirements.
- Teams are financially responsible for any shipments they require outside of the FedEx donation.
- Teams will receive their BILLS OF LADING with the Kit of Parts in January. The BILLS OF LADING will be packaged in a FedEx Express envelope with your team number on the front. Once your team signs off on their Kit of Parts receipt, YOU are responsible for keeping track of your BILLS OF LADING.
- Treat your BILLS OF LADING like gold! The FedEx donation can save your team several hundred dollars on shipping your robot. **FIRST will not provide replacement BILLS OF LADING for teams that lose, forget or otherwise fail to properly use their shipping paperwork.**
- Only the pre-printed FedEx Freight BILLS OF LADING provided by *FIRST* will count as part of the FedEx donation. Teams that obtain BILLS OF LADING from any other source will not have their shipments covered.
- Each BILL OF LADING is made up of a top sheet and a carbonless copy underneath. Provide the top copy to the FedEx driver when they pick up your robot and retain one for your records. You will need the PRO NUMBER in the upper left-hand corner to track your shipment.
- If you do not intend to use all of your team's donated shipments, please mail the BILL OF LADING back to Team Support/Operations at *FIRST*, 200 Bedford Street, Manchester, NH 03101. Abuse of the FedEx donation could result in the loss of the donation for all teams in the future.
- Teams **CANNOT** use the FedEx donation for back-to-back events (aka consecutive weekends).
- If your team is registered to compete at the Championship, the FedEx donation provides one (1) additional shipment home from the Championship. You will receive the additional BILL OF LADING at the Championship.

- Teams qualifying for the Championship at a traditional Regional Event will **NOT** receive any additional BILLS OF LADING at the qualifying event. Teams are responsible for managing how they use their two (2) donated shipments. Event Managers will not have extra copies available. The only exception to this rule will be teams qualifying for the Championship at a Bag and Tag event (see Section 4.9).

**Example:** If a team uses one (1) Bill of Lading to ship to their initial Regional and their second Bill of Lading to ship to their second Regional, then the team must pay SES to ship their robot home OR to the Championship. If a team has qualified to go to the Championship at a Regional and they have already used their two (2) donated shipments, then the team **MUST** ship to the Championship through SES.

For further details on the FedEx donation and examples of how to fill out your BILLS OF LADING, see the Robot Shipping web page here:

<http://www.usfirst.org/roboticsprograms/frc/content.aspx?id=3570>

#### 4.7.2. Track Your Shipment

FedEx Freight Shipments may take up to 5 or 6 business days to arrive. Bad weather may delay shipments by an additional day or two. (Do not count the day you ship). If this will not allow your robot to arrive at its next destination on time, you must work with SES to arrange and pay for the shipment.

To estimate the travel time for your robot to arrive, please use the FedEx service map here: [www.fedexfreight.fedex.com/servicemaps.jsp](http://www.fedexfreight.fedex.com/servicemaps.jsp). Make sure that you select FedEx Freight.

Your PRO NUMBER will allow you to track your shipment online. Your PRO NUMBER is located in the upper left-hand corner of your copy of the BILL OF LADING (above the bar code).

Track your FedEx shipment at <http://www.fedex.com/us>

#### 4.7.3. Shipping Into and Out of the 48 Contiguous US States – FedEx Express

The FedEx donation will cover up to two (2) complimentary shipments to teams shipping into and out of the 48 contiguous US states. This includes Alaska, Hawaii, Puerto Rico, and outside the US. *FIRST* will distribute these shipments to give teams the best value possible.

##### 4.7.3.1. US Teams Shipping to a “Mainland” Event

Teams will receive up to two (2) FedEx Express AIRBILLS to ship your robot to the mainland event and home. Shipping between events will not be covered under the donation.

##### 4.7.3.2. International Teams Shipping to a US Event

Teams will receive up to two (2) FedEx Express AIR WAYBILLS to ship your robot to the US event and home. Shipping between US events will not be covered under the donation.

- Teams are financially responsible for any shipments they require outside of the FedEx donation.
- Teams will receive their AIRBILLS or AIR WAYBILLS with the Kit of Parts in January. The shipping documents will be packaged in a FedEx Express envelope with your team number on the front.
- Teams **CANNOT** use the FedEx donation for back-to-back events (aka consecutive weekend).



- If your team is registered to compete at the Championship, the FedEx donation provides a third shipment home from the Championship.
- Teams qualifying for the Championship at a Regional Event will **NOT** be given BILL OF LADING to ship to the Championship. Event Managers will not have extra copies available.
- You **cannot** take your robot home from any event, including the Championship, unless it is a designated Bag and Tag event. You must ship your crate(s) unless you have been granted an exception (refer to Section 4.5.9).
- International AIR WAYBILLS may only be used to ship into and out of the US. They may not be used to ship between events inside the US.

For further details on the FedEx donation and examples of how to fill out your AIRBILLS and AIR WAYBILLS, see the Robot Shipping web page here:

<http://www.usfirst.org/roboticsprograms/frc/content.aspx?id=3570>

#### **4.7.4. International Shipments and Customs**

1. Teams shipping to international events and international teams shipping into the US and back, should research Customs requirements weeks in advance.
2. *FIRST* strongly recommends using a Customs Broker so your team knows exactly what paperwork it needs to complete/supply to correctly import and export your crate. If you wish to use FedEx as a customs broker, please call 1-800-GO-FEDEX.
3. Comply with the requirements for Crates Crossing US Borders listed in Section 4.6.3.

#### **4.7.5. Shipments the FedEx Donation Does Not Cover**

The FedEx donation does not cover shipments intra-Hawaii, intra-Canada or intra-Israel. This means teams shipping within these areas must pay for their own shipping arrangements. Teams are responsible for all shipping costs.

### **4.8 BAG AND TAG**

Teams attending the **Greater Kansas City Regional, Pittsburgh Regional, Oklahoma Regional, Waterloo Regional, Sacramento Regional, Greater Toronto Regional**, and the **Michigan Events** in the 2010 season will use the Bag and Tag method to transport their robots.

**Teams will NOT be allowed to carry their robots in or out of any other events unless they receive special permission as outlined in Section 4.5.9.**

Drayage will not be available for Bag and Tag events. Do not ship your robot to the event.

#### **4.8.1. Supplies**

Each team attending at least one (1) Bag and Tag Regional Event will receive a special Bag and Tag kit in January with their Kit of Parts. The kit will contain:

- Two (2) plastic BAGS large enough to contain your robot. Only the *FIRST*-provided bags may be used – teams may not supply their own bags.
- At least six (6) zip tie TAGS with individual serial numbers.



#### 4.8.2. General Rules For Bagging Your Robot

Every team must abide by ROBOT SHIP DAY regardless of whether they are attending a traditional Regional Event OR Bag and Tag event for their first event (see Section 4.2).

##### Proper bagging procedure:

1. Set the BAG on the floor, leaving room for the robot in the center.
2. Place the robot in the center of the BAG and pull the bag up around the robot. Be careful not to catch the bag on any corners or sharp edges.
3. Tightly seal the BAG with your next numbered TAG.
4. Complete the *Robot Lock-Up Form* as required in **Section 4.8.4** to verify the date and time that the BAG was sealed.

##### 4.8.2.1. Your first event is a Bag and Tag event

If the first event your team will attend for the season is a Bag and Tag event, follow this procedure:

1. Bag and Tag your robot on ROBOT SHIP DAY, and complete the *Robot Lock-Up Form*
2. Transport your robot to your event venue in your own vehicle. If you plan to transport your robot in a personal vehicle, please ensure that you have adequate means to secure the robot. If the robot is being transported in open air, such as in the back of a pickup, be very careful to shield the BAG from excessive wind. Wind can cause the BAG to flap against the robot, causing damage to the BAG.
3. You must carry your own robot into the event sealed in the BAG. Teams will not have access to the loading docks or forklifts; we recommend bringing a rolling cart or dolly to facilitate load in.
4. You may NOT open your BAG until it has been checked and signed off. Upon check-in at Pit Admin, ask for the person in charge of checking Robot Lock Up Forms. **YOU MUST HAVE YOUR ROBOT LOCK-UP FORM READY FOR REVIEW AT THE EVENT. DO NOT FORGET TO BRING IT.**
5. After your Robot Lock-Up Form has been properly filled out to reflect the open time and date, your team may open the BAG and prepare to compete.
6. After the event, if your waitlisted or will be attending another event, re-seal your robot in the BAG with a new TAG and fill out the Robot Lock-Up Form.
7. Remove your robot from the event through the front door or designated exit.
8. **IF** you are attending a traditional Regional Event or the Championship next:
  - a. Crate your robot (in the bag). FedEx and Shepard Exposition Services will not pick up a robot that is not in a crate. See Section 4.6 for crate construction requirements.
  - b. Ship it to the drayage location for your Regional Event following the instructions in Sections 4.5 and 4.6.
  - c. **All robots going to a second event must be shipped by the Tuesday following the Bag and Tag event.** For example, a team attending the Greater Kansas City Regional March 4-6 must ship to their next event by March 9.

- d. FedEx Freight requires prior notice for pickups, especially if your location does not have a loading dock. If you plan to ship after a Bag and Tag event, you must call one (1) week ahead to schedule your pickup.
- e. DO NOT open your BAG at the next event until it has been checked and signed off by the appropriate person at that event.

#### **4.8.2.2. Your Second Event is a Bag and Tag Event**

If your first event is a traditional Regional Event, and then you will attend a Bag and Tag event, follow this procedure:

1. Follow standard Robot Shipping procedures on ROBOT SHIP DAY.
2. At the end of your first Regional Event, bag your robot per the bagging procedure outlined above **before** packing in your crate. Make sure to fill out your *Robot Lock Up Form*. Crate your robot for shipment.
3. Ship your robot to your home location through the drayage system.
4. Before your Bag and Tag event, remove your robot from the crate, and transport to your event venue in your own vehicle. If you plan to transport your robot in a personal vehicle, please ensure that you have adequate means to secure the robot. If the robot is being transported in open air, such as in the back of a pickup, be very careful to shield the BAG from excessive wind. Wind can cause the BAG to flap against the robot, causing damage to the BAG.
5. You must carry your own robot into the event sealed in the BAG. Teams will not have access to the loading docks or forklifts, so we recommend bringing a rolling cart or dolly to facilitate load in.
6. You may not open your BAG until it has been checked and signed off. Upon check-in at Pit Admin, ask for the person in charge of checking Robot Lock Up Forms. **YOU MUST HAVE YOUR ROBOT LOCK-UP FORM READY FOR REVIEW AT THE EVENT. DO NOT FORGET TO BRING IT.**
7. After your Robot Lock Up Form has been properly filled out to reflect the open time and date, your team may open the BAG and prepare to compete.
8. After the event, if you're waitlisted or will be attending another event, re-seal your robot in the BAG with a new TAG and fill out the Robot Lock-Up Form.
9. Remove your robot from the event through the front door or designated exit.

#### **4.8.3 Teams Attending 2-Day Events**

Two-day events for the 2010 season include Pittsburgh, Sacramento, and all Michigan District Events. Teams attending these events will not have as much time to work on their robots at events as teams attending traditional 3-day events. Because of this difference, these teams are granted an additional 'Robot Access Period' to unbag their robot between robot ship day and their 2-day events.

##### **4.8.3.1 'Robot Access Period' – Permitted Actions**

During the Robot Access Period, teams may perform any activity they would normally do during the build season, including practicing with the robot.

#### 4.8.3.2 'Robot Access Period' - Schedule

Teams may unlock their robot for a total of 6 hours during the 7-day period preceding any two-day event in which their team will be competing with their robot. The 6 hours may be broken up in any way the team wishes, with the exception that no single access period may be shorter than two hours. The robot must be locked up in between sessions and this must be documented on the *Robot Lock-Up Form* each time.

### 4.8.4 Robot Lock and Unlock Instructions

#### 4.8.4.1 Completing the *Robot Lock-Up Form*

The *Robot Lock-Up Form* is available on the Robot Shipping page of the *FIRST* website at <http://www.usfirst.org/roboticsprograms/frc/content.aspx?id=3570>. Make sure that you complete every item on the line. **Incomplete forms will be rejected by inspectors at events.** The *Robot Lock-Up Form* must be filled in by an adult, 18 years or older, who is not a student on the team. By signing this form the signor attests to the fact that he/she is 18 years old or older, is not a student member of the team, and that all rules and regulations regarding access periods and lock or unlock are being followed. Phone numbers are required for verification in case inspectors at events have questions regarding the form.

#### 4.8.4.2 When the *Robot Lock-Up Form* must be used

The *Robot Lock-Up Form* must be filled in during the periods indicated in **Sections 4.8.2** and **4.8.3**. The forms also apply when the robot is being locked up *and* when it is being unlocked. Robots do not need to be locked up during the regular build season before ROBOT SHIP DAY.

## 4.9 QUALIFIED FOR CHAMPIONSHIP? KNOW YOUR OPTIONS.

All shipping rules stated previously in this chapter apply to shipments to Championship.

### 4.9.1. What Happens if You Qualify at a Bag and Tag Event?

- Teams that qualify for the Championship at a Bag and Tag event must follow all procedures in Section 4.8.2.1. Bag your robot as described and ship it to the drayage location for the Championship.
- Teams qualifying at a Bag and Tag event will receive one (1) FedEx Freight BILL OF LADING at the event **IF** they have not already received the maximum number allowed. Teams may receive up to two (2) shipments prior to the Championship under the FedEx donation. Teams that have already received two (2) shipments will NOT receive any additional BILLS OF LADING.

### 4.9.2. Traditional Regional Event - If You Know You Will Attend Championship

Already know you will be able to attend the Championship? Simply ship your robot the way you would to any other event.

- If you have a FedEx shipment left, fill out the FedEx BILL OF LADING and the SES BILL OF LADING with the Championship drayage address.

- If you do not have any FedEx shipments left, fill out a SES BILL OF LADING to indicate that you will be shipping through SES and provide the shipping desk with your payment information.

#### 4.9.3. Traditional Regional Event - Not Sure Whether You Can Attend Championship?

If you are not sure your team will be able to attend the Championship, SES will attempt to hold your robot until the Tuesday following your event. **SES cannot guarantee that they will be able to hold your crate at the warehouse after the event.** They will do their best to ensure that your robot does not ship out before Tuesday, but please call SES as early as possible with your decision.

Please follow these guidelines to request a shipping hold on your robot:

1. Talk to a representative at the shipping desk at your event. Explain your intention to place a temporary hold on your robot while you determine if you can attend the Championship.
2. Fill out your paperwork with the address of the drayage location for the Championship. Make sure that you write "Hold until Tuesday" in the special instructions box on the SES BILL OF LADING. Also fill out your FedEx BILL OF LADING if you have one left. Turn in all paperwork to the shipping desk.
3. Label your crate. Use an 8 ½" x 11" sheet of paper to create a sign for your crate that says:

**TEAM WILL CALL  
HOLD UNTIL TUESDAY**

4. Follow up with SES by Tuesday. Call SES at (704) 394-9140 to let them know whether you will attend the Championship or not.
5. If you will not attend the Championship, provide SES with your complete shipping address so that they can update your BILL OF LADING to ship to your team's location.
6. Track your shipment online to ensure it arrives in time.

#### 4.9.4. After Championship

All teams attending the Championship will receive one (1) shipment home for their robot under the FedEx donation. The BILL OF LADING for this shipment will be distributed at the Championship in the team's registration packet.

### 4.10 IMPORTANT SHIPPING CONTACTS

#### 4.10.1. *FIRST* is Your First Contact

If you have any questions about robot shipping rules or processes, **CALL FIRST!** Rules in this chapter are written and administered by *FIRST*, not Shepard Exposition Services or FedEx. *FIRST* is not responsible for information given by representatives of outside vendors.

**Robot Shipping Web** <http://www.usfirst.org/roboticsprograms/frc/content.as>

<b>Page:</b>	<a href="http://www.usfirst.org/roboticsprograms/frc/regional-events.aspx?id=3570">px?id=3570</a>
<b>Shipping &amp; Drayage Documents by Event:</b>	<a href="http://www.usfirst.org/roboticsprograms/frc/regional-events.aspx?id=430">http://www.usfirst.org/roboticsprograms/frc/regional-events.aspx?id=430</a>
<b>Phone:</b>	(800) 871-8326 - 8:30 AM to 5:00 PM EST
<b>E-mail:</b>	<a href="mailto:frcteams@usfirst.org">frcteams@usfirst.org</a> <b>Subject line:</b> <i>FIRST</i> Team [your #] Shipping Question
<b>Fax:</b>	(603) 666-3907
<b>Address:</b>	Team Support/Operations 200 Bedford Street Manchester, NH 03101

#### 4.10.2. Shepard Exposition Services (SES)

Call SES if you have questions about how drayage works, if you need to schedule a shipment outside the FedEx donation, or if you have SES billing questions.

<b>Web site:</b>	<a href="http://www.shepardes.com/first">www.shepardes.com/first</a>
<b>Phone:</b>	(704) 394-9140 – 8:00 AM to 5:00 PM EST Western teams may call after hours until <b>10:00 PM EST</b> at (704) 201-2058
<b>E-mail:</b>	<a href="mailto:pmullis@shepardes.com">pmullis@shepardes.com</a> <b>Subject line:</b> <i>FIRST</i> Team [your #] for [event name]
<b>Fax:</b>	(704) 398-0914
<b>Address:</b>	Paula Mullis – <i>FIRST</i> Robotics Shepard Exposition Services 5401-M Hovis Road Charlotte, NC 28208

#### 4.10.3. FedEx

Call FedEx to schedule your pickup and with any FedEx tracking questions. Have your BILL OF LADING and PRO NUMBER available when you call.

<b>Web site:</b>	<a href="http://www.fedex.com/us">www.fedex.com/us</a>
<b>Phone - FedEx Freight:</b>	1-866-393-4585
<b>Phone - FedEx Express:</b>	1-800-GO-FedEx (1-800-463-3339)

# THE AWARDS

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## 5 THE AWARDS

### 5.1 FIRST ROBOTICS COMPETITION AWARDS

This chapter contains descriptions of the *FIRST*® Robotics Competition Awards as well as any required submission criteria. Note an asterisk designates a new or “changed” award. Unless otherwise noted, all awards are given at Regional events, District events and the *FIRST* Championship. *FIRST* will hold an Awards Ceremony to present these awards at each appropriate event.

### 5.2 COMPLETE AWARDS LIST

Award	Description	Selected By	Regional	District	CMP Division	FIRST CMP
Chairman's Award	The Chairman's Award represents the spirit of <i>FIRST</i> . It honors the team that, in the judges' estimation, best represents a model for other teams to emulate. It embodies the goals and mission of <i>FIRST</i> . It remains our most prestigious award.	Chairman's Judge Panel (application and interview process)	√	√		√
Champion	This award celebrates the alliance that wins the final match of the Championship Playoffs	Robot Performance				√
Championship Finalist	This award celebrates the alliance that makes it to the final match of the Championship Playoffs	Robot Performance				√
*Coopertition™ Award	The Coopertition™ Award celebrates the team that best demonstrates the ability to help their opponents compete. In the inaugural year of the Coopertition Award, the award will be granted to the team that earns the most Coopertition bonus points during the competition (See <a href="#">Section 9</a> for details about Coopertition bonus points).	Performance	√	√		√
Creativity Award <i>Sponsored by Xerox</i>	This award celebrates creative design, use of a component, or a creative or unique strategy of play.	Judges	√	√		√
Division Champion	This award celebrates the alliance that wins the final match in their division at the Championship.	Robot Performance			√	
Division Finalist	This award celebrates the alliance that makes it to the final match in its division at the Championship.	Robot Performance			√	

Award	Description	Selected By	Regional	District	CMP Division	FIRST CMP
*Engineering Excellence Award <i>Sponsored by Delphi</i>	This award celebrates an elegant and advantageous machine feature that recognizes any aspect of engineering excellence and innovation in the real world. This includes, but is not limited to: design, wiring methods, material selection, programming techniques, and unique machine attributes. The criteria for this award are based on the team's ability to concisely describe verbally, as well as demonstrate, this chosen machine feature.	Judges	√	√		√
Engineering Inspiration Award	This award celebrates a team's outstanding success in advancing respect and appreciation for engineering and engineers, both within their school as well as their community. Criteria include: the extent and inventiveness of the team's efforts to recruit students to engineering, the extent and effectiveness of the team's community outreach efforts, and the measurable success of those efforts.	Judges	√	√		√
Entrepreneurship Award <i>Sponsored by Kleiner Perkins Caufield &amp; Byers</i>	This award celebrates the entrepreneurial spirit. This award recognizes a team, which since its inception has developed the framework for a comprehensive business plan in order to scope, manage, and obtain team objectives. This team displays entrepreneurial enthusiasm and the vital business skills for a self-sustaining program. (Please note, a formal business plan must be completed and given to the judges during the Pit interview process. Teams should be prepared to talk about their plan at that time. Look on the <i>FIRST</i> Website under <a href="#">FRC Awards</a> for more information.)	Judges	√	√		√
*Excellence in Design Award <i>Sponsored by Autodesk</i>	This award honors clear and compelling evidence of excellence in design development, documentation, communication, and presentation. The intention of the Award is to inspire, recognize and celebrate design as one way in which you can change your world.	Reg: Students CMP: Autodesk	√			√
Founders Award (not a team award)	Each year <i>FIRST</i> presents this award to honor an organization or individual that has contributed significantly to the growth of <i>FIRST</i> .	<i>FIRST</i>				√



<b>Award</b>	<b>Description</b>	<b>Selected By</b>	<b>Regional</b>	<b>District</b>	<b>CMP Division</b>	<b>FIRST CMP</b>
Gracious Professionalism™ Award <i>Sponsored by Johnson &amp; Johnson</i>	<b>This award</b> celebrates outstanding sportsmanship and continuous Gracious Professionalism™ in the heat of competition, both on and off the playing field.	Judges	√	√		√
Highest Rookie Seed Award	This award celebrates the highest-seeded rookie team at the conclusion of the qualifying rounds.	Robot Performance	√	√	√	
Imagery Award (in honor of Jack Kamen)	This award celebrates attractiveness in engineering and outstanding visual aesthetic integration from the machine to team appearance.	Judges	√	√		√
Industrial Design Award <i>Sponsored by General Motors</i>	This award celebrates form and function in an efficiently designed machine that effectively achieves the game challenge.	Judges	√	√		√
Industrial Safety Award <i>Sponsored by Underwriters Laboratories</i>	This award celebrates the team that progresses beyond safety fundamentals by using innovative ways to eliminate or protect against hazards. The winning team consistently demonstrates excellence in industrial safety performance that shines throughout the competition from uncrating to re-pack.	Safety Advisors	√	√		√
Innovation in Control Award <i>Sponsored by Rockwell Automation</i>	This award celebrates an innovative control system or application of control components to provide unique machine functions.	Judges	√	√		√
Judges Award	During the course of the competition, the judging panel may encounter a team whose unique efforts, performance, or dynamics merit recognition.	Judges	√	√		√
Quality Award <i>Sponsored by Motorola</i>	This award celebrates machine robustness in concept and fabrication.	Judges	√	√		√
Regional/District Finalist	This award celebrates the alliance that makes it to the final match of the competition.	Robot Performance	√	√		
Regional/District Winner	This award celebrates the alliance that wins the final match of the competition.	Robot Performance	√	√		
Rookie All Star	This award celebrates the rookie team exemplifying a young but strong partnership effort, as well as implementing the mission of <i>FIRST</i> to inspire students to learn more about science and technology.	Judges	√	√		√
Rookie Inspiration	This award celebrates a rookie team's outstanding success in advancing respect and appreciation for engineering and engineers both within their school, as well as in their community.	Judges	√	√		√
Team Spirit Award <i>sponsored by Chrysler</i>	This award celebrates extraordinary enthusiasm and spirit through exceptional partnership and teamwork.	Judges	√	√		√

Award	Description	Selected By	Regional	District	CMP Division	FIRST CMP
Website	The Website Award recognizes excellence in student-designed, built, and managed <i>FIRST</i> team websites.	Website Evaluators (prior to the event)	√	√		√
Woodie Flowers	The Woodie Flowers Award celebrates effective communication in the art and science of engineering and design. Dr. William Murphy founded this prestigious award in 1996 to recognize mentors who lead, inspire and empower those around them using excellent communication skills.	Panel of prior WFA Winners	√			√

### 5.3 NEW AWARDS SUBMISSION PROCESS

The Regional Chairman's Award, the Woodie Flowers Award and the Website Award must be submitted through the *FIRST* Student Team Members Information System <https://my.usfirst.org/frc/goteams/site.lasso>. The Main or Alternate contact for your team must assign up to four (4) student award summitters in FRC TIMS. Those students will be notified of their status via email and may then log into the Student Team Member system and be able to view the awards submission section on their main page. The Awards Submission section of the *FIRST* Student Team Members Information System will open for submissions at **noon EST on January 12, 2010** and close for submissions on **Thursday, February 18, 2010 at 11:59 PM EST.**

### 5.4 CHAIRMAN'S AWARD

The *FIRST* Robotics Competition is about much more than the mechanics of building a robot or winning a competitive event. It is about the partnership among people who are part of the *FIRST* community and the impact on those who participate in *FIRST* programs with a united goal of achieving *FIRST*'s mission. *FIRST*'s mission is to change the way young people regard science and technology and to inspiring an appreciation for the real-life rewards and career opportunities in these fields.

The concept of the Chairman's Award includes Regional Chairman's Awards, which enable *FIRST* to recognize more teams for their exemplary efforts in spreading the *FIRST* message, as well as their talents in organizing materials for their presentations.

The winning entries of the Regional Chairman's Awards will travel to the Championship for the continuing process of consideration for the most prestigious 2010 Chairman's Award.

#### 5.4.1 Overview

The Chairman's Award was created to keep the central focus of the *FIRST* Robotics Competition as our ultimate goal for transforming the culture in ways that will inspire greater levels of respect and honor for science and technology, as well as encourage more of today's youth to become scientists, engineers, and technologists.

The Chairman's Award represents the spirit of *FIRST*. It honors the team that, in the judges' estimation, best represents a model for other teams to emulate, and which embodies the goals and purpose of *FIRST*. It remains *FIRST*'s most prestigious award.

*FIRST* will present a Regional Chairman's Award at each Regional and three (3) Regional Chairman's Awards at the Michigan State Championship in 2010. Only the winners of the Regional Chairman's Award will be eligible to compete for the Chairman's Award presented at the *FIRST* Championship.

Hall of Fame members; i.e., teams that have already won the Chairman's Award, are ineligible to compete for the Regional Chairman's Award for five (5) years. Teams that won the Chairman's Award at the Championship prior to 2005 are eligible to participate in 2010. Teams that won in 2005-2009 are ineligible.

#### **5.4.2 First-Year (Rookie) and NASA Grant Teams:**

Because the Chairman's Award recognizes sustained excellence and impact, not just a one (1) year team effort, it is not possible for a first year (rookie) team to receive this honor. *FIRST* does, however, invite and encourage rookies to develop a Chairman's Award submission which may be evaluated by the judges determining the winner of the **Rookie All-Star Award**. This submission will document where the team started its *FIRST* journey and will also provide background for documenting the results of the team's efforts – it will be a great way to start the team's efforts to win the Chairman's Award.

*Rookie Teams:* If you prepare a Regional Chairman's Award submission, print a copy to give the Judges when they visit you at your Pit Station. Judges will not be viewing them online.

Teams receiving **NASA Grants** must provide a copy of this submission as part of the grant.

All teams are encouraged to print a copy of their final submission for their records and to confirm for themselves that the submission was accepted.

#### **5.4.3 Submission Information**

The criteria for the 2010 Chairman's Award are essentially identical to those in the past, with special emphasis on recent accomplishments in both the 2009/2010 year and the preceding two (2) years. The judges focus on teams' activities over a sustained period, as distinguished from just the six (6) week design and build time frame.

As in the past, teams may only submit at one (1) Regional competition for judging. Teams submitting for both the Chairman's Award and the Woodie Flowers Award should note that both awards are judged at the same event. Students working on the Woodie Flowers Award submission and those team members working on the Chairman's Award submission should coordinate to select the best event for the team.

More information on this award can be found on the *FIRST* Website under <http://www.usfirst.org/roboticsprograms/frc/content.aspx?id=440>

Submission Deadline for Chairman's Awards are no later than **Thursday, February 18, 2010 @ 11:59 PM EST.**

##### **5.4.3.1 Additional Requirement for 2010 Season**

Teams competing for the Regional Chairman's Award must provide a video to the judges at the event. The content of the video should explain what the team has done to be a Regional Chairman's Award winning team. The video may be shown to the judges during the teams 5 minute presentation time at the discretion of the teams; however the team must provide the equipment for viewing (i.e., laptop). Although it is a requirement of submission, it is not a requirement for the judging process for 2010. Specifications for the DVD will be found on the *FIRST* website under <https://my.usfirst.org/frc/goteams/site.lasso>

##### **5.4.3.2 The Chairman's Award Championship Award Process**

At The Championship, a panel of judges will review the all the winning submissions and will select one ultimate Chairman's Award winner. This winning team has the additional

honor of choosing one of its junior or senior student members to be the recipient of the Allaire Medal.

#### **5.4.4 The Allaire Medal - Leadership Exemplified**

The Chairman's Award is presented at the Championship to the *FIRST* team judged to have the best partnership effort. The Allaire Medal recognizes leadership exemplified and is awarded to an individual student on the winning Chairman's Award team.

Named in honor of Paul A. Allaire, a long-serving *FIRST* Chairman of the Board, the Allaire Medal is given to the student who has demonstrated outstanding leadership on his/her *FIRST* team, within his/her school and community and whose personal character best embodies the spirit of *FIRST*.

The team receiving The Chairman's Award at the Championship will select the Allaire Medal recipient. The adult and student team members determine the winner. The recipient must be a high school junior or senior who has been accepted into a four (4) year degree program at a college or university. The Allaire Medalist receives the Allaire medallion and up to \$10,000 in total scholarship support for undergraduate tuition, room and board, fees and books at his or her intended university or college.

### **5.5 EXCELLENCE IN DESIGN AWARD, SPONSORED BY AUTODESK**

#### **5.5.1 Purpose of Award**

This award honors clear and compelling evidence of excellence in design development, documentation, communication and presentation. The intention of the Award is to inspire, recognize and celebrate design as one way in which you can change your world.

#### **5.5.2 Award Overview**

With a distinctive history of 18+ years of sponsorship of *FIRST*, Autodesk continues to honor the inventors, engineers and design professionals of the future who are at the center of the *FIRST* Robotics Competition. They want to help teams develop an awareness of the power of design; learn the processes and tools for great design; and award achievement in design excellence. Autodesk understands that you want to have a positive impact on the world and now more than ever, design technology is helping to improve the way we live and shape the world in which we live.

#### **5.5.3 Award Specifics**

This year, Autodesk is proud to sponsor the Award for Excellence in Design – with two separate categories in this single Award. Category One will involve 3D Design; and Category Two will involve Animation.

All competitors for the Award will have the opportunity to choose from a range of 22+ Autodesk products to incorporate in their entry in 2010. Products are available for free\*, along with learning materials and tech support, when you join [www.autodesk.com/first](http://www.autodesk.com/first). However, if you enter in Category One your entry **MUST** include use of at least Autodesk Inventor Professional 2010. If you enter in Category Two, your entry **MUST** include use of at least either Autodesk 3ds Max or Autodesk Maya (GREAT news for those of you who enjoy working with the Macintosh platform: Maya runs on a Mac). Remember, you can use as many Autodesk products as you like...but use of at least one of the above products is required in the competition categories.

The complete and detailed information about the Award, including submittal format, deadlines, criteria, and judging process will be posted no later than January 9, 2010 on the *FIRST* website and on the *FIRST* section of the Autodesk Education Community at: [www.autodesk.com/first](http://www.autodesk.com/first).

### 5.5.4 Award Judging

All entries in Category One, 3D Design, will be submitted and judged at the Championship level, only. There will be a winner in this Category announced at Championship.

Entries in Category Two, Animation, will be submitted and peer judged at each Regional event. Each team in each Regional that has submitted for the Award in that Regional will have the opportunity to view the entries in that Regional and will have the opportunity to vote for a winner of the Award at that Regional event. The winner at the Regional level will be announced and shown at the event awards ceremony. All winners at the Regional level, potentially with others identified by Autodesk experts, will be judged at the Championship level by a panel of professionals. There will be a Championship winner in this Category announced at the 2010 Championship event.

At the 2010 Championship, the winner of the Autodesk Award for Design Excellence (in both of the two Categories) will be announced and shown at the awards ceremony.

*FIRST* and Autodesk value design and are committed to honoring the teams who compete for this Award by showing the amazing work created by each of them as often as possible.

### 5.6 THE FOUNDER'S AWARD (CHAMPIONSHIP ONLY)

Each year *FIRST* presents this award to honor an organization or individual that has contributed significantly to the growth of *FIRST*.

Past winners of the Founder's Award include:

1993	Motorola, Inc.
1994	Honeywell
1995	Walt Disney World's Epcot
1996	City of Manchester, NH
1997	Francois Castaing Chrysler Corp
1998	Johnson & Johnson
1999	NASA
2000	William Murphy, <i>Founder</i> Cordis Corp & Small Parts, Inc.
2001	Autodesk, Inc.
2002	John Doerr, Partner Kleiner, Perkins, Caufield & Byers
2003	Innovation First
2004	FedEx Corporation
2005	The Lego® Group
2006	United Technologies Corporation
2007	General Motors
2008	BAE Systems
2009	National Instruments

## 5.7 WEBSITE AWARD

The Website Award recognizes excellence in student designed, built and managed *FIRST* team websites. Two (2) subcategories are awarded:

“Website Excellence” - Every submission that meets the first website design standards of excellence will receive the website excellence award.

“Best Website” –One (1) best website award will be given at each regional competition. the championship best website award winner will be chosen from among the regional best website award winners.

### 5.7.1 Submission and Deadline Information

Teams must enter their website into the *FIRST* awards submission site by **11:59 PM EST on February 18, 2010** to be evaluated. Each team’s website is eligible for a website award at every regional event at which the team is competing. The website must be complete and functional by the date of submission. Any website found to be “down,” and not viewable by the evaluators, will be disqualified.

Additional information can be found on the *FIRST* website under:  
<http://www.usfirst.org/roboticsprograms/frc/content.aspx?id=440>.

## 5.8 WOODIE FLOWERS AWARD

The Woodie Flowers Award celebrates effective communication in the art and science of engineering and design. Dr. William Murphy founded this prestigious award in 1996 to recognize mentors who lead, inspire and empower using excellent communication skills.

Each year, students may submit an essay nominating one (1) mentor from their team to be considered for this award. If a team already has a mentor who has won the Regional Woodie Flowers Award in a prior year, then that team may resubmit that mentor in the current year. *FIRST* will recognize one (1) adult mentor at each Regional for receipt of the Regional Woodie Flowers Award. The current year Regional Woodie Flowers Award winners, along with those mentors who won a Regional Woodie Flowers Award in a prior year and have been re-nominated, will be judged to receive the Woodie Flowers Award at the FRC Championship.

### 5.8.1 Spirit of the Award

High school students on a *FIRST* Robotics team may choose one (1) adult team member as their Woodie Flowers Finalist Award (WFFA) candidate (eligibility information on *FIRST* website under <http://www.usfirst.org/roboticsprograms/frc/content.aspx?id=440>). The students will describe how this mentor has given them the best understanding of the challenges, opportunities and satisfaction involved in the discipline of engineering and design. Dr. Flowers will lead the past Championship Woodie Flowers Award (WFA) winners as they judge and select the Finalists and ultimate Championship winner based on student essays.

This award recognizes an individual who has done an outstanding job of motivation through communication while also challenging the students to be clear and succinct in recognizing the value of communication. As such, it is very important that this be a student-led effort and a student decision. Team mentors should direct their students to the online entry site and let the high school student nominators decide whom to nominate. Adults can help edit, but this must be a student-led effort, since any team mentor is eligible. Authors must be **clearly** identified as high school students in the online submission.

### 5.8.2 Submission Deadline

The Woodie Flowers Award entries are due **Thursday, February 18<sup>th</sup> 11:59 PM EST**. Eligibility and entry requirements, judging criteria and details on the entry process can be found on the *FIRST* website under <https://my.usfirst.org/frc/goteams/site.lasso>.

### 5.8.3 Prior Year Regional WFFA Winner Re-submission

Please refer to the current Championship WFA eligibility requirements on the *FIRST* website. Student nominators must submit a new 600 word (maximum) essay in order to re-nominate their previous year Regional WFFA winner to be eligible for the current Championship WFA. Student nominators will not be able to edit the original submission. Past winners without a new essay will not be eligible for the WFA. While the judges can review past essays, the new essay must be able to stand alone as a complete submission.

Each *FIRST* team can nominate/re-nominate a maximum of one (1) candidate for the Championship WFA.

# THE ARENA

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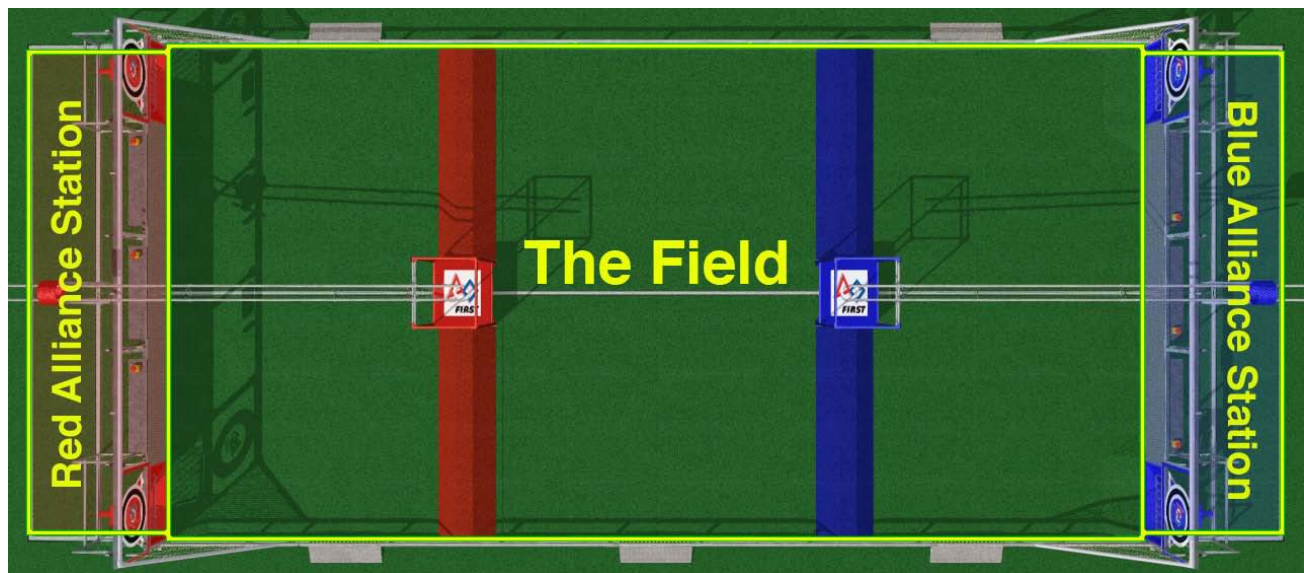
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## 6 THE ARENA

### 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](http://www.usfirst.org/frc/2010/fielddrawings). 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](http://www.usfirst.org/frc/2010/fielddrawings).

### 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
<i>2010 Arena Layout and Marking*</i>	<i>Overall Arena Assembly</i>	<i>FE-00033*</i>	<i>5 Sheets</i>
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
<i>Ball Return, Assembly*</i>	<i>2010 Game Specific</i>	<i>GE-10021*</i>	<i>2 Sheets</i>
<i>Tower, Assembly*</i>	<i>2010 Game Specific</i>	<i>GE-10027*</i>	<i>1 Sheet</i>
<i>Goal, Assembly*</i>	<i>2010 Game Specific</i>	<i>GE-10061*</i>	<i>2 Sheets</i>
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
<i>Field Rail Assembly - Middle*</i>	<i>Generic Field Drawing</i>	<i>FE-00022*</i>	<i>1 Sheet</i>
<i>Field Rail Assembly - End*</i>	<i>Generic Field Drawing</i>	<i>FE-00023*</i>	<i>1 Sheet</i>
<i>Field Rail Assembly – Gate*</i>	<i>Generic Field Drawing</i>	<i>FE-00029*</i>	<i>1 Sheet</i>

*\*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

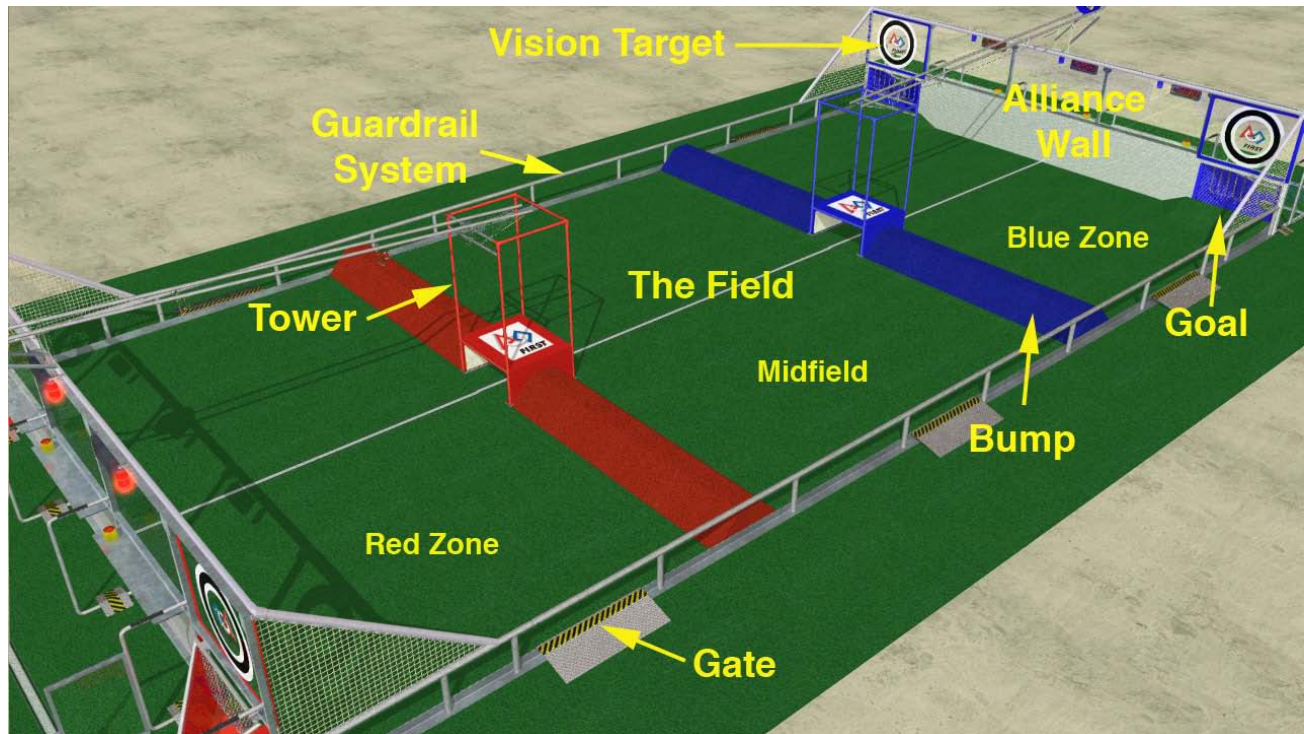
within ¼ inch. Overall gross dimensions of the entire field may vary up to 4 inches. Successful teams will design ROBOTS that are insensitive to these variations.

## 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

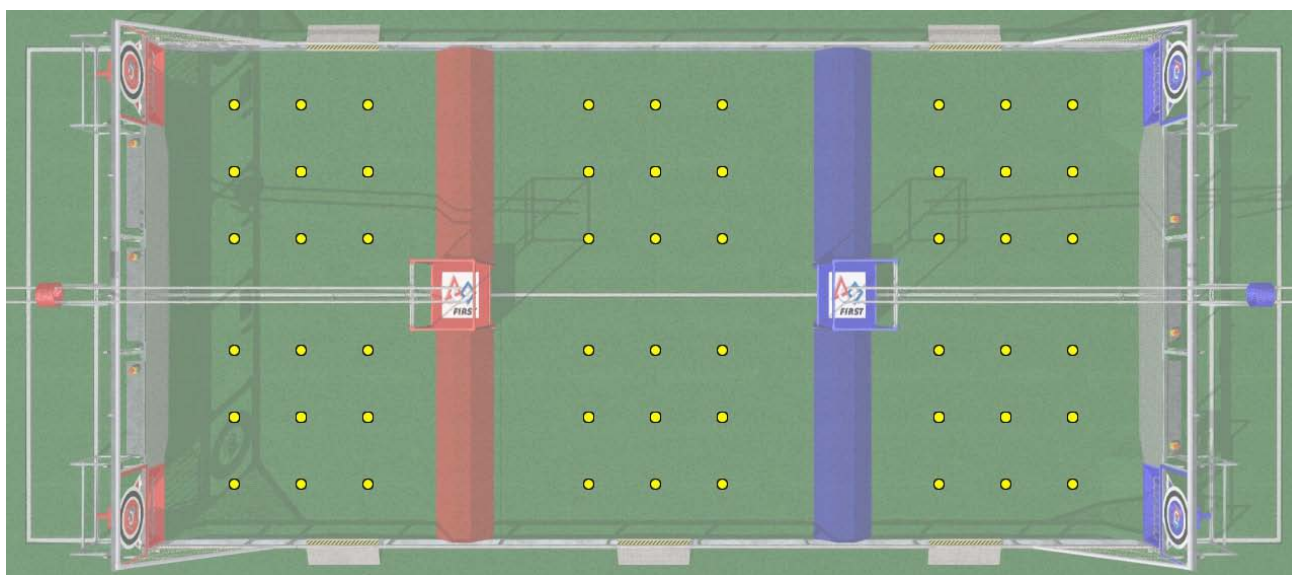


FIELD during a match. The Guardrail System defines the borders of the FIELD, except where it is bounded by the ALLIANCE WALL.

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

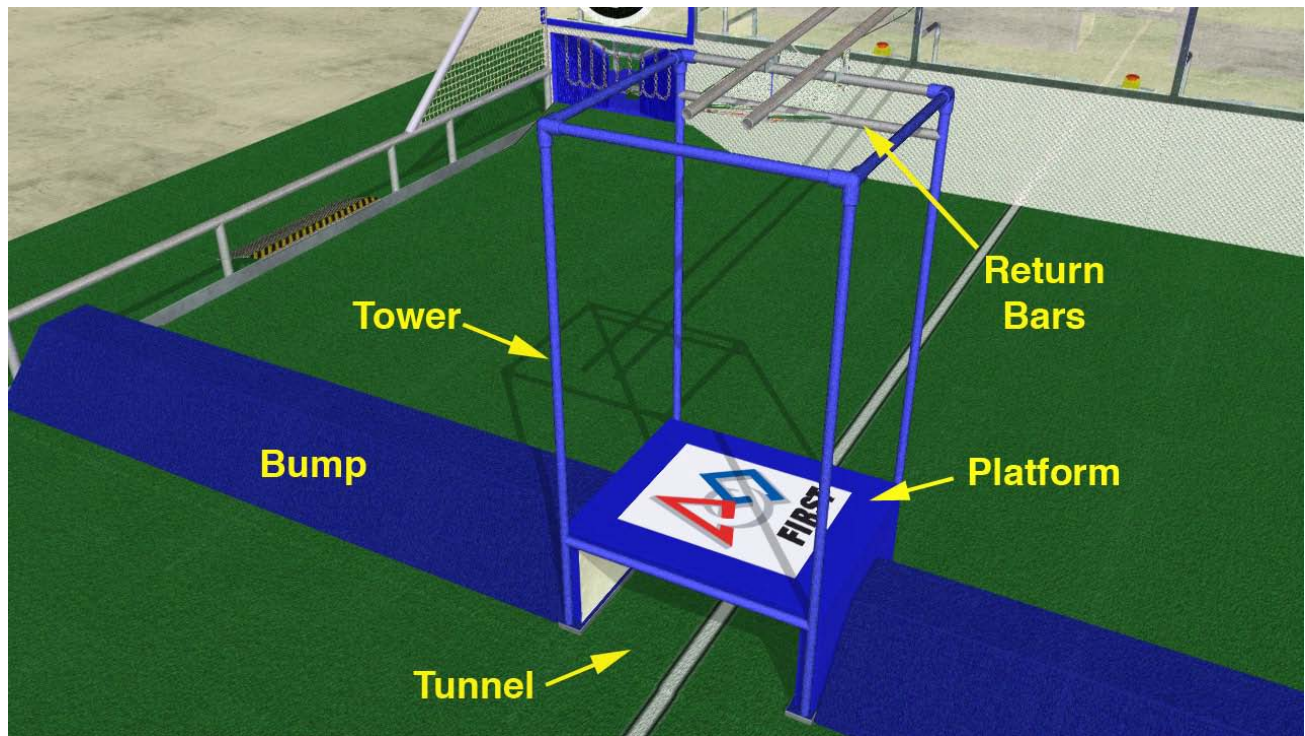
Each region of the FIELD (the RED ZONE, the MIDFIELD, and the BLUE ZONE) includes a STARTING GRID on each side of the CENTER LINE. The STARTING GRIDS are used to indicate locations where the BALLS may be located at the start of the MATCH. Each STARTING GRID is a series of nine dots lightly marked on 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 13½ inches high off the FIELD surface, 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. The edge of the ZONE is defined by the lower edge of the BUMP nearest the ALLIANCE WALL; a collinear virtual line is drawn across the "mouth" of the TUNNEL to complete the edge of the ZONE where the BUMP structure is not in place.

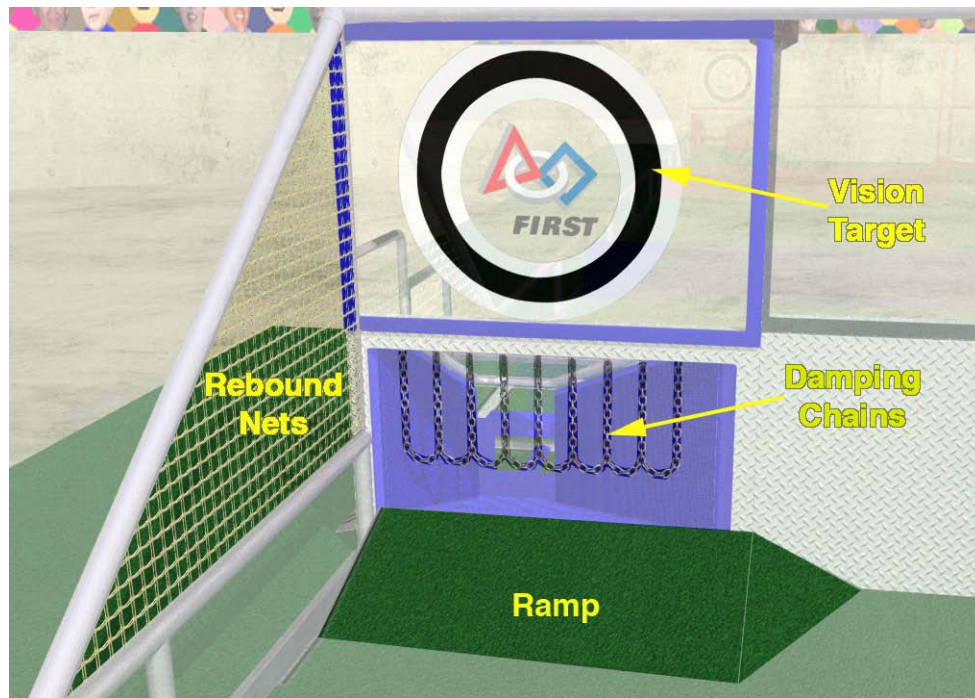


## 6.2.4 The TOWERS

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 approximately 41 inches wide by 32 inches deep, and is at a height of approximately 21 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 center 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 8-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 38 inches. Each white circle in the target is 2½ inches wide. The black circle is 5 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.

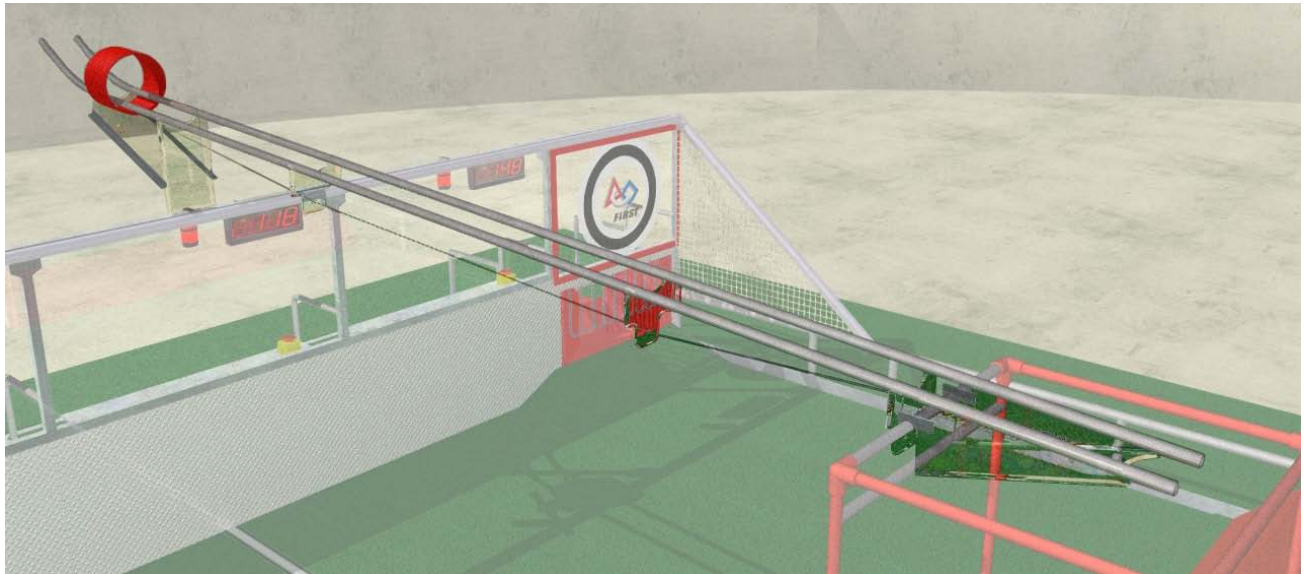
### 6.2.7 The CORRAL

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

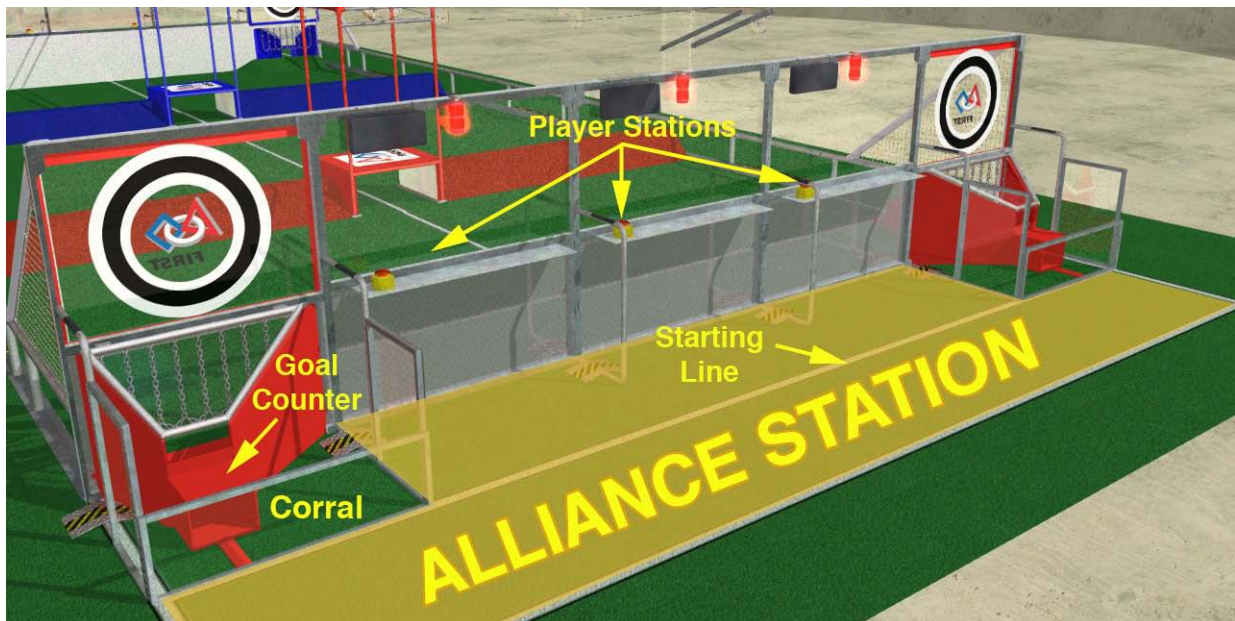
Two parallel pipes extend from above the center of the ALLIANCE STATION to above the nearest TOWER. The pipes, and their associated supports and stiffeners, comprise the BALL RETURN that is used to return BALLS to the FIELD. The higher end of the BALL RETURN (above the ALLIANCE STATION) passes through 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

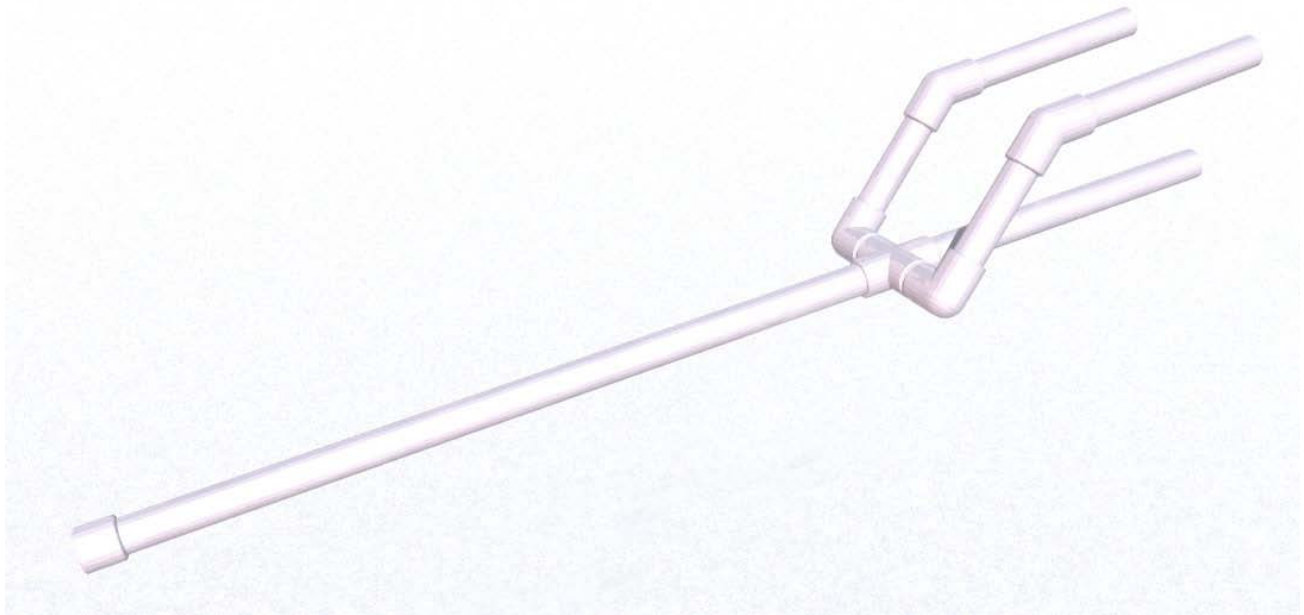
While playing *Breakaway*, ROBOTS manipulate BALLS to accomplish the objectives of the game. Each BALL is a standard Size 5 soccer ball. The BALL weighs between 14 and 16 ounces, has a circumference of 27 to 28 inches, and is inflated to a standard pressure of approximately 9psi. The specific ball that will be used in the official 2010 *Breakaway* competition events will be the “HS300, Size 5, Pearl White” ball from DTI 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 returned 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.



# THE GAME

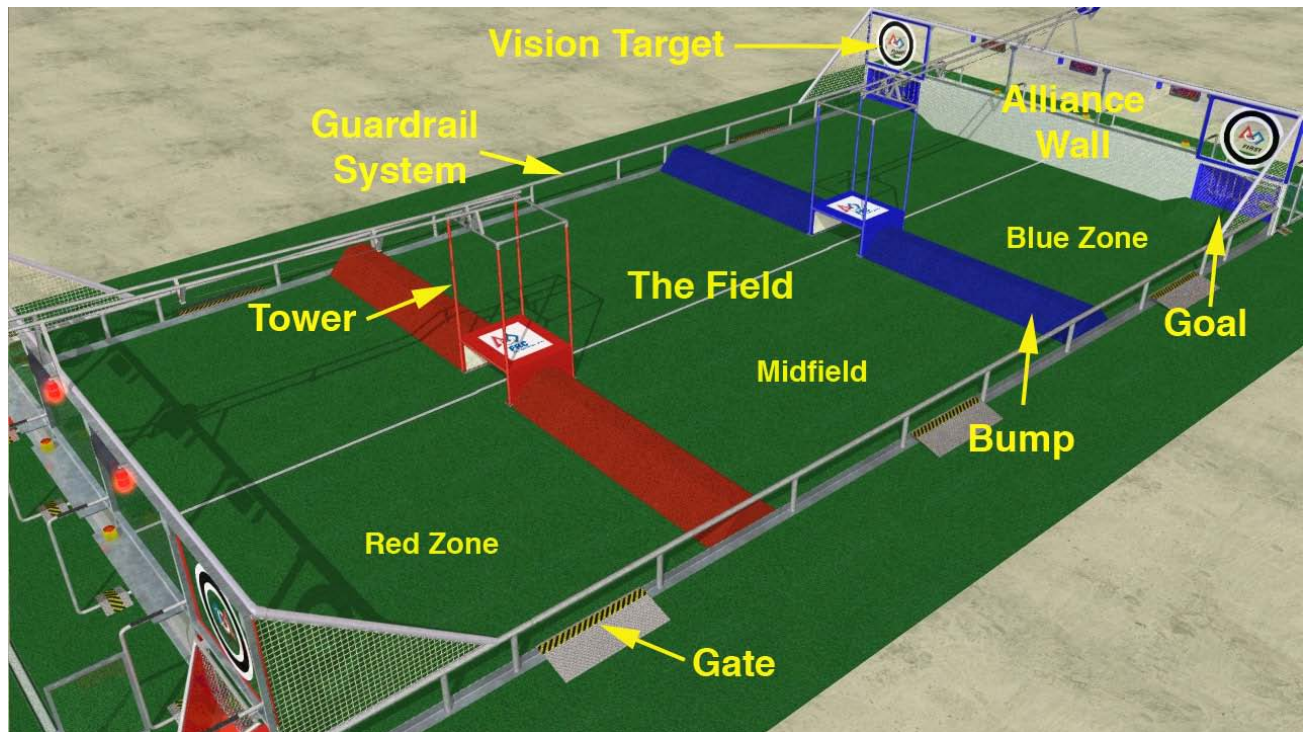
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## 7 THE GAME

### 7.1 OVERVIEW

*Breakaway* is a game played on the FIELD (illustrated in the figure below). Two ALLIANCES, one red and one blue, composed of three *FIRST* Robotics Competition (FRC) teams each, compete in each MATCH. The object of the game is to attain a higher score than your opponent by shooting BALLS into a GOAL, climbing on the ALLIANCE TOWER or PLATFORM, or by lifting an ALLIANCE ROBOT off the PLAYING SURFACE.



*Note: The illustrations in this section of the manual are for a general visual understanding of the Breakaway arena only. Please refer to the official drawings for exact dimensions and construction detail.*

#### 7.1.1 Match Format

A MATCH is 2 minutes and 15 seconds long. An AUTONOMOUS PERIOD starts each MATCH during which the ROBOTS are controlled by pre-programmed instructions. The AUTONOMOUS PERIOD is followed by the TELEOPERATED PERIOD during which the DRIVERS assume control of the robot. The ROBOTS continue to play the game until the TELEOPERATED PERIOD is over.

## 7.2 DEFINITIONS

**ALLIANCE:** A set of three FRC TEAMS that work together during a MATCH to play *Breakaway* against an opposing ALLIANCE. ALLIANCES are identified during the MATCH by their assigned color, either red or blue.

**CARRYING:** POSSESSING a BALL that is not in contact with the FIELD.

**ELEVATED:** A ROBOT that is completely above the plane of the PLATFORM and in contact with the TOWER shall be considered ELEVATED.

**FINALE:** The final 20 seconds of the match.

**MATCH:** A single iteration of play in which ALLIANCES attempt to complete the objectives of the *Breakaway* game during a competition.

**PENALTY:** A 1-point decrement in the ALLIANCE score assigned when a deserving violation of the game rules has been identified by a Referee.

**POSSESSION:** Controlling the position and movement of a BALL. A BALL shall be considered in POSSESSION if, as the ROBOT moves or changes orientation (e.g. backs up or spins in place), the BALL remains in approximately the same position relative to the ROBOT.

**RED CARD:** An indication of disqualification of a TEAM.

**SCORED:** A BALL is SCORED when it passes through the GOAL COUNTER.

**SUSPENDED:** A ROBOT only in contact with an ELEVATED ROBOT and/or a SUSPENDED ROBOT shall be considered SUSPENDED.

**TEAM:** Four representatives from a registered FRC team that interact with their ROBOT and their ALLIANCE partners to play *Breakaway*. Positions on the TEAM include:

**COACH:** A student or adult mentor designated as the team coach and advisor during the MATCH and identified as the person wearing the designated "COACH" pin or button. There is one COACH per TEAM.

**DRIVER:** A pre-college student team member responsible for operating and controlling the ROBOT. There are two DRIVERS per TEAM.

**HUMAN PLAYER:** A pre-college student team member responsible for properly returning BALLS to the FIELD. There is one HUMAN PLAYER per TEAM. The HUMAN PLAYER is the only TEAM MEMBER that may handle the TRIDENT.

**YELLOW CARD:** A warning of egregious ROBOT or team member behavior at the ARENA.

Warnings, cautions, and notes appear in blue boxes. These notes are intended to provide insight into the reasoning behind a rule, helpful information on understanding and interpreting a rule, and/or possible "best practices" for use when implementing systems affected by the rule. These notes are not part of the formal rules, and do not carry the weight of a rule (if there is an inadvertent conflict between a rule and a note, the rule applies). However, it is strongly recommended that you pay close attention to their contents.

## 7.3 RULES

### 7.3.1 Safety

- <S01>** Safe Operation and Design - If at any time a ROBOT'S operation or design is deemed unsafe, the ROBOT will be disabled for the remainder of the MATCH. If the safety violation is due to the ROBOT design, the Head Referee has the option to not allow the ROBOT back onto the FIELD until the design has been corrected. An example of unsafe operation would be uncontrolled motion that cannot be stopped by the DRIVERS. *Violation: PENALTY and Disablement.*
- <S02>** TEAM Member Safety – For reasons of personal safety, contact with ROBOTS and/or entering the FIELD are prohibited during a MATCH.
- TEAM members may not directly contact any ROBOT at any time during the MATCH. *Violation: PENALTY and Disablement.*
  - TEAM members may not extend any part of their body into the FIELD during the MATCH. *Violation: PENALTY.*
- <S03>** E-Stop - An Emergency Stop (E-Stop) button is located in each TEAM'S Player Station. Pressing an E-Stop button will cause the TEAM'S ROBOT to be disabled for the remainder of the MATCH. The E-Stop buttons are intended for remote shut down during a MATCH in the event of safety hazards and will not otherwise affect MATCH score or duration. Any TEAM member or referee may press the E-Stop button. *Violation: Inappropriate use of the E-Stop button (i.e. not for safety reasons) will result in a Red Card.*
- <S04>** Permitted ROBOTS - Any ROBOT used during a MATCH must be in compliance with all Robot Rules (as defined in Section 8). *Violation: PENALTY and potential YELLOW CARD.*

### 7.3.2 Game Periods

- <G02>** AUTONOMOUS PERIOD - The AUTONOMOUS PERIOD is the 15-second period at the start of the MATCH. DRIVER control of the ROBOT is not permitted at this time. During this period, the ROBOTS may react only to sensor inputs and commands programmed into the onboard control system. All ROBOT safety rules are still applicable during the AUTONOMOUS PERIOD. The AUTONOMOUS PERIOD ends when the arena timer displays zero seconds left in the period.
- <G03>** TELEOPERATED PERIOD – The TELEOPERATED PERIOD is the 2-minute period of game play immediately following the AUTONOMOUS PERIOD. At the beginning of the TELEOPERATED PERIOD the OPERATOR CONSOLE controls are activated and DRIVERS may remotely control their ROBOTS. The DRIVERS continue to teleoperate their ROBOTS for the remainder of the MATCH. The TELEOPERATED PERIOD ends when the arena timer displays zero seconds. This also indicates the end of the MATCH.

### 7.3.3 Scoring

- <G04>** Scoring - ALLIANCE scores are determined by a combination of the number of BALLS SCORED in the ALLIANCE GOALS during the MATCH and the number of ROBOTS in the following states at the conclusion of the MATCH, where:
- Each SCORED BALL is worth 1 point, and
  - Each ELEVATED ROBOT is awarded 2 points, or each SUSPENDED ROBOT is awarded 3 points.



**<G05> Scoring Determination** - Scores will be assessed after all objects in motion, when the ARENA timer displays zero seconds, come to rest, or 10 seconds after the timer displays zero seconds, whichever comes first. The final score of a MATCH is the total of points assigned under Rule <G04> less any assigned PENALTIES.

**<G06> Minimum Score** - The minimum final score is zero points.

### 7.3.4 Game Play

#### 7.3.4.1 Starting Conditions

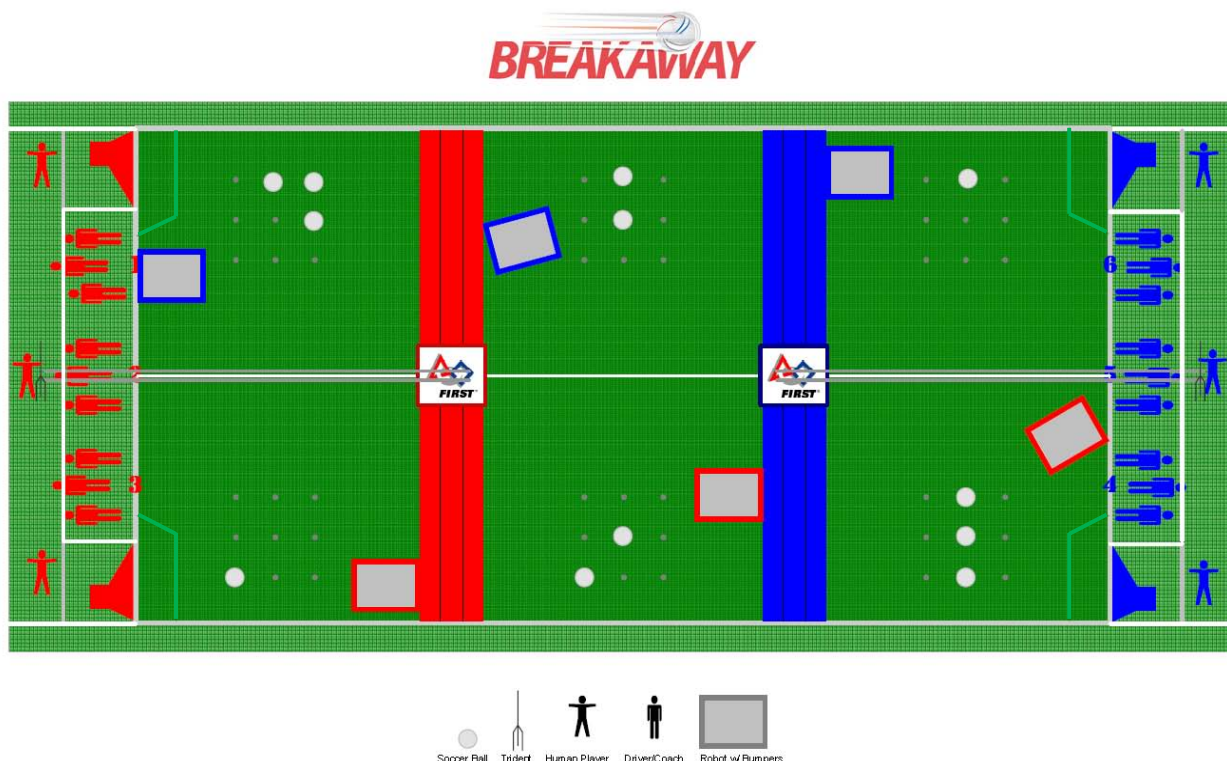
**<G07> TEAM Starting Positions** – Prior to the MATCH, all members of the TEAM must be standing behind the STARTING LINE and facing their Players Station.

**<G08> ROBOT Starting Positions** – Prior to the MATCH, each TEAM negotiates within their ALLIANCE to select one of the three starting areas for their ALLIANCE.

When the FIELD is viewed from the ALLIANCE STATION, the ROBOTS must be placed on the right side of the CENTER LINE in one of the following starting positions:

- In the far ZONE and in contact with the ALLIANCE STATION WALL and/or ramp.
- In the MIDFIELD and in contact with the farthest BUMP.
- In the near ZONE and in contact with the nearest BUMP.

**<G09> BALL Starting Positions** – Prior to the MATCH, each ALLIANCE is provided with six BALLS to be placed on the FIELD. The BALLS must be placed on a STARTING GRID location prior to the MATCH start. When the FIELD is viewed from the ALLIANCE STATION, the BALLS must be placed on the right side of the CENTER LINE, with one BALL in the near ZONE, two BALLS in the MIDFIELD, and three BALLS in the far ZONE. The BALLS must not be in contact with a ROBOT at the start of the MATCH.



Note: ROBOT and BALL positions are illustrative, not authoritative.

- <G10>** ROBOT Size – Prior to the MATCH, each ROBOT shall not exceed the NORMAL CONFIGURATION maximum weight or volume specified in Rule <R10>. The Head Referee may call for an inspector's recertification of the ROBOT size and weight prior to the start of any MATCH. *Violation (for ROBOTS prior to the match): Prohibition from participating in the MATCH.*
- <G11>** ROBOT Alignment Devices - Alignment devices (templates, tape measures, laser pointers, etc.) that are not part of the ROBOT may not be used to assist with positioning the ROBOT. *Violation: TEAMS that use external alignment devices to position their ROBOT will have their ROBOT arbitrarily repositioned by a referee before the start of the MATCH.*
- <G12>** FIELD Equipment - Other than the BALLS and competing ROBOTS, no other items shall be placed on the FIELD prior to or during the MATCH. *Violation: PENALTY and YELLOW CARD.*

#### 7.3.4.2 Penalties

- <G13>** Causing PENALTIES – The actions of an ALLIANCE shall not cause an opposing ALLIANCE to violate a rule and thus incur PENALTIES. Any rule violations committed by the affected ALLIANCE shall be excused, and no PENALTIES will be assigned.
- <G14>** ALLIANCE PENALTIES - Unless otherwise noted, all PENALTIES assigned by referees are applied to the entire ALLIANCE.

#### 7.3.4.3 Handling BALLS

- <G15>** BALL Handling – BALLS may be handled by any TEAM member when BALLS are in the CORRAL or ALLIANCE STATION. BALLS may not be handled until they have exited from the BALL COUNTER and are in the CORRAL. *Violation: PENALTY.*
- <G16>** BALL Return - HUMAN PLAYERS must place BALLS on the BALL RETURN using the TRIDENT. No other means are permitted for TEAMS to return BALLS to the FIELD. *Violation: Two PENALTIES and YELLOW CARD.*
- <G17>** BALL Return Timing - BALLS must be returned to the FIELD within a specified period of time to prevent delaying the game according to the following algorithm:

$$T_{\text{expire}} = T_{\text{score}} - [11 + (4 * n)]$$

- where  $T_{\text{expire}}$ , is the match time, in seconds, assigned to each individual BALL, at which point the Field Management System automatically assigns a PENALTY if a BALL is not passed through the BALL RETURN COUNTER,
- $T_{\text{score}}$  is the remaining match time, in seconds, on the match timer when the ball enters the BALL COUNTER, and
- $n$  is the number of balls that have passed through either BALL COUNTER of the ALLIANCE, but not yet passed through the BALL RETURN COUNTER.

*Violation: One initial PENALTY plus one additional PENALTY for every 2 seconds that a BALL is not returned.*

In general, this means that the team will have 11 seconds to return a BALL to the FIELD once it is SCORED, and an additional 4 seconds for each successive BALL in the ALLIANCE STATION, until all BALLS are returned to the FIELD. Once all BALLS are returned to the FIELD, the counter resets and the process begins again.

An expanded explanation of this formula is detailed in the document "Delay of Game Management Algorithm" (DOGMA), posted online at <http://www.usfirst.org/roboticsprograms/frc/content.aspx?id=452>.

**<G18>** BALLS Out of Bounds - BALLS that leave the FIELD or get dammed on the BALL RETURN will be replaced at the earliest safe opportunity. Out of Bounds BALLS will be returned to the approximate center of the MIDFIELD.

**<G19>** BALLS Out of Bounds (Intentional Actions) - BALLS may not be intentionally placed out of bounds. *Violation: PENALTY and YELLOW CARD.*

### 7.3.5 Robot Operations

#### 7.3.5.1 Robot Out Of Bounds

**<G20>** ROBOT Out of Bounds - ROBOTS may not touch anything outside of the FIELD boundary during the TELEOPERATED PERIOD. *Violation: Disablement.*

**<G21>** Grace Period after AUTONOMOUS - If a ROBOT should unintentionally touch anything outside of the FIELD boundary during the AUTONOMOUS PERIOD, it will have a 10 second "grace period" to return to the FIELD at the beginning of the TELEOPERATED PERIOD. *Violation: If the ROBOT is unable to correct the situation within the grace period, it will be disabled for the remainder of the MATCH. If at any time the Head Referee should determine that the attempts to recover from the situation constitute unsafe operations, Rule <S01> will take precedence.*

**<G22>** ROBOT Range - ROBOTS must remain within the FIELD perimeter and asymmetric funnels of the GOALS during a MATCH. *Violation: PENALTY.*

The combination of Rules <G20>, <G21>, and <G22> ultimately requires the ROBOT to remain inside the vertical projection of the FIELD borders at all times. If the ROBOT violates this vertical projection at any time during the MATCH, it will be assigned a PENALTY. If the ROBOT touches anything outside the FIELD during the Autonomous Period, the ROBOT will be given a grace period at the start of the Teleoperated Period to remedy the situation. If the grace period expires and the ROBOT is still out of compliance, the ROBOT will be disabled. If the ROBOT touches anything outside the FIELD during the Teleoperated Period, the ALLIANCE will receive a PENALTY (per <G22>) and the ROBOT will be disabled (per <G20>). Lastly, any time during the MATCH that the ROBOT violates the FIELD perimeter over the Alliance Station wall, it will receive a PENALTY and be disabled (per <G23>).

**<G23>** ALLIANCE WALL - ROBOTS may not extend over the ALLIANCE WALL. *Violation: PENALTY and Disablement.*



#### 7.3.5.2 Robot Actions

- <G24>** ARENA Interaction – With the exception of the BALL RETURN and RETURN BARS, ROBOTS may push or react against any elements of the ARENA, provided there is no damage or disruption of the ARENA elements. With the exception of the TOWER, ROBOTS may not grab, grasp, grapple, or attach to any ARENA structure. *Violation: A warning will be issued when a ROBOT violates this rule. If the referee determines that the TEAM is disregarding the warning, their ROBOT will be disabled for the remainder of the MATCH.*
- <G25>** ROBOT ARENA Entanglement - ROBOTS that become entangled in the ARENA elements will not be freed until after the MATCH has finished. *No PENALTY will be assigned.*
- <G26>** ARENA Damage - ROBOTS may not damage any part of the ARENA or BALLS. For ROBOTS that violate this rule, the TEAM may be required to take corrective action (such as eliminating sharp edges, removing the damaging MECHANISM, and/or re-inspection) before the ROBOT will be allowed to compete in subsequent MATCHES. *Violation: Potential Disablement if the Head Referee determines that further damage is likely to occur.*
- <G27>** Disabled ROBOTS and PENALTIES – If a ROBOT becomes unsafe (e.g. the ROBOT begins to smoke, the battery falls out, etc.), it may be disabled by pressing the E-Stop Button in the corresponding Player Station, per Rule <S03>. *ROBOTS that are disabled in this manner cannot incur further PENALTIES nor can they earn additional points.*
- <G28>** AUTONOMOUS PERIOD ROBOT Movement - During the AUTONOMOUS PERIOD, a ROBOT cannot completely cross the CENTER LINE. *Violation: Two PENALTIES; plus two PENALTIES and a YELLOW CARD if a BALL or ROBOT is contacted after completely crossing the CENTER LINE, and two additional PENALTIES for each additional BALL or ROBOT contacted.*
- <G29>** Defending ROBOT Restriction - Only one opposing ALLIANCE ROBOT is allowed in the opponent's ZONE. A ROBOT is considered in this ZONE if any part of the ROBOT is in contact with the ZONE's green carpet. *Violation: PENALTY; plus a RED CARD if effort to remedy is not immediate.*
- <G30>** ROBOT Volume – During a MATCH, no part of the ROBOT shall extend outside the vertical projection of the FRAME PERIMETER, except as follows:
- BALL Interaction Volume – Solely for the purposes of interacting with a BALL, MECHANISMS that are below the BUMPER may extend up to the BUMPER PERIMETER, for a period not exceeding two seconds. After returning inside the FRAMER PERIMETER, such MECHANISMS are not permitted to re-extend beyond the FRAME PERIMETER for at least two seconds.
  - ROBOT Righting Volume - ROBOTS attempting to right themselves or their ALLIANCE partners may expand up to the FINALE CONFIGURATION maximum volume while, and only while, performing the righting operation. While beyond the NORMAL CONFIGURATION volume and righting, ROBOTS may not actively interact with BALLS or opponent ROBOTS.
  - TOWER Contact ROBOT Volume - During a MATCH, ROBOTS in contact with their ALLIANCE TOWER may extend beyond their NORMAL CONFIGURATION volume but may not exceed the FINALE CONFIGURATION maximum volume.
  - FINALE ROBOT Volume - During the FINALE, ROBOTS may extend up to the limits of the FINALE CONFIGURATION maximum volume.
  - BUMPERS may extend outside the FRAME PERIMETER, within the constraints defined in Rule <R07>.

*Violation: PENALTY and YELLOW CARD.*

- <G31>** BALL RETURN and RETURN BARS Protection - ROBOTS may not contact the BALL RETURN or the RETURN BARS (black tape). *Violation: PENALTY for inadvertent contact; plus a RED CARD for obviously intentional contact or damaging contact.*
- <G32>** ROBOT Protection while Righting – Before the FINALE, ROBOTS attempting to right themselves or their ALLIANCE partners have one 10-second grace period per fallen ROBOT in which they may not be contacted by an opposing ROBOT. This protection continues for either 10 seconds or when the protected ROBOTS have completed the righting operation, whichever time comes first. *Violation: PENALTY for inadvertent contact; plus a RED CARD for obviously intentional contact.*
- <G33>** ROBOT Righting Limitations - During the grace period described in Rule <G32>, the protected ROBOTS may not actively interact with BALLS or opponent ROBOTS. *Violation: PENALTY.*
- <G34>** FINALE PERIOD ROBOT Protection - During the FINALE, ROBOTS in contact with their TOWER or in contact with an ELEVATED ALLIANCE partner may not be contacted by an opponent. *Violation: PENALTY for inadvertent contact; plus a RED CARD for obviously intentional contact.*
- <G35>** FINALE PERIOD TOWER Protection - During the FINALE, ROBOTS in may not contact the OPPONENT'S TOWER. *Violation: PENALTY for inadvertent contact; plus a RED CARD for obviously intentional contact.*
- <G36>** ROBOT to ROBOT Interaction - Strategies aimed solely at the destruction, damage, tipping over, or entanglement of ROBOTS are not in the spirit of the FRC and are not allowed. *Violation: YELLOW CARD*
- <G37>** Permitted ROBOT to ROBOT Contact - *Breakaway* is a highly interactive game. Robust construction of ROBOTS will be very important in this high-speed competition. ROBOTS should be designed to withstand the contact that will occur during the MATCH. Appropriate contact is allowed under the following guidelines for which no PENALTY will be assigned:
- a. High speed accidental collisions may occur during the MATCH and are an expected part of the game.
  - b. Incidental contact, both inside and outside the BUMPER ZONE, is to be expected and is generally acceptable.
  - c. Contact outside the BUMPER ZONE is an expected part of the game during the following scenarios:
    - i. for ROBOTS on a RAMP or BUMP,
    - ii. for ROBOTS that have been tipped and are not attempting to right themselves,
    - iii. for ROBOTS that have exceeded their NORMAL CONFIGURATION volume to right themselves or an ALLIANCE partner as permitted by Rule <G30> and have either exceeded the 10-second grace period permitted by Rule <G32> or completed the righting operation,
    - iv. for ROBOTS that have exceeded their NORMAL CONFIGURATION volume to interact with a BALL as allowed by Rule <G30-a>, and
    - v. for ROBOTS in the process of being ELEVATED or SUSPENDED prior to the FINALE.

Please note that a ROBOT that is ELEVATED before the FINALE is not protected from contact by opponent ROBOTS. Any FIELD damage or BALL RETURN damming caused by the ELEVATED ROBOT before the FINALE will be considered the fault of the ELEVATED ROBOT, regardless of whether or not the motion originated with an opponent ROBOT.

**<G38>** Prohibited ROBOT to ROBOT Contact - Except as permitted in Rule <G37>, contact is prohibited under the following conditions:

- a. Aggressive or intentional contact outside of the BUMPER ZONE. *Violation: PENALTY; plus a RED CARD if the offense is particularly egregious or if it results in substantial damage to another ROBOT.*
- b. A ROBOT may not intentionally attach to and/or climb onto an opposing ALLIANCE ROBOT. Obvious attempts to do so will be interpreted as an attempt to damage an opposing ROBOT. *Violation: PENALTY and RED CARD.*

ROBOTS should be designed to withstand the expected contact outside the BUMPER ZONE. For example, ROBOT designs should anticipate the scenario of a ROBOT coming off a BUMP and landing on a ROBOT on the green carpet.

**<G39>** Pinning - A ROBOT may not pin (inhibit the movement of another ROBOT that is in contact with a field element, border, or goal) for more than 5 seconds. If a ROBOT has been pinned for 5 seconds, the team with the pinning ROBOT will be signaled by a referee to release the pinned ROBOT and back away approximately 6 feet. Once the pinning ROBOT has backed off by 6 feet for 3 seconds, it may again attempt to pin its opponent, and if successful, the 5 second count will start over. *Violation: One PENALTY for each violation.*

**<G40>** ROBOT to ROBOT Entanglement – ROBOTS may not entangle other ROBOTS. The TEAM will be required to repair the entangling elements before the ROBOT will be permitted to participate in subsequent MATCHES. *Violation: Disablement if attempts to disengage are causing damage or a dangerous situation or if entanglement occurs repeatedly, plus a RED CARD if a ROBOT intentionally entangles an opposing ROBOT.*

**<G41>** Detaching MECHANISMS - ROBOTS may not intentionally detach parts or leave MECHANISMS on the FIELD. *Violation: PENALTY for each incident and potential RED CARD if an intentionally detached COMPONENT or MECHANISM impedes MATCH play.*

- a. Bumper covers must not detach, even unintentionally, from the ROBOT. *Violation: PENALTY.*

Bumper covers are expected to be just as robust as BUMPERS. It is in your team's best interest to insure that the covers remain securely in place despite exposure to rough play, field elements, etc. A loose bumper cover is likely to have several negative effects on an alliance. Examples of ways in which a loose bumper cover hurt an alliance are listed below, but note that it is illustrative and by no means an exhaustive list.

- if part of a cover is touching any part of the TOWER at the end of the MATCH, the ROBOT will not be considered SUSPENDED and thus will not receive the associated SUSPENDED bonus points.
- if part of a cover is hanging below the plane of the PLATFORM, the alliance will not receive bonus points for that ROBOT
- if part of a cover falls below the ROBOT'S BUMPER ZONE, the ROBOT will have violated <R07-A>
- if a cover gets caught in a dynamic part of its ROBOT, the ROBOT may be rendered useless
- if a cover is completely dislodged and left on field, the ROBOT will have violated Rule <G41>.
- if a cover is not secured, it may be considered an entanglement hazard and thus a violation of Rule <G25>.

That being said, there are a *whole bunch* of reasons why you want your bumper covers to stay securely on your ROBOT!

<G42> ARENA Reset Delay - ROBOTS must release any portions of the TOWER, PLATFORM, or ALLIANCE ROBOT without power after a MATCH. *Violation: YELLOW CARD.*

#### 7.3.5.3 Robot BALL Manipulation

<G43> ROBOT BALL POSSESSION - ROBOTS may POSSESS only one BALL at a time. *Violation: PENALTY.*

It is important to design your ROBOT so that it is impossible to inadvertently or intentionally POSSESS more than one BALL at a time.

To avoid severe restrictions on robot design, Rule <G43> does not disallow multiple "possession mechanisms." However, if you include more than one active BALL handling MECHANISM it's important to insure that they cannot POSSESS BALLS simultaneously. *Breakaway* would be a dramatically different game if ROBOTS were allowed to POSSESS multiple BALLS. Referees must strictly enforce single POSSESSION. Since referees may find it difficult to determine if additional BALLS in contact with the ROBOT are being herded or POSSESSED, it is imperative that teams avoid ambiguity.

<G44> BALL CARRYING – ROBOTS may not CARRY BALLS. *Violation: 2 PENALTIES for each CARRIED BALL.*

It is important to design your ROBOT so that it is impossible to inadvertently or intentionally CARRY a BALL.

**<G45>** Active BALL control - ROBOTS may not control BALL direction with active MECHANISMS above the BUMPER. *Violation: PENALTY.*

MECHANISMS are considered “active” if they are in motion relative to the ROBOT while in contact with the BALL. Resetting or moving MECHANISMS while not in contact with a BALL is permitted as the MECHANISMS are not considered “active.”

Note that portions of MECHANISMS that are designed to interact with the BALL below the BUMPER and are in compliance with Rule <G30> may extend above the level of the BUMPER, as long as the point of interaction with the BALL is below the level of the BUMPER.

**<G46>** BALL Penetration Restriction – The BALL must not extend more than 3 inches inside the FRAME PERIMETER as defined in Rule <R19>. *Violation: PENALTY for a basic infraction, plus a YELLOW CARD if no immediate attempt to remedy.*

A BALL trapped under a ROBOT, intentionally or unintentionally, will be considered POSSESSED until it is dislodged from the ROBOT. Teams are encouraged to design and drive with this in mind.

**<G47>** BALL RETURN Interference – Neither ROBOTS nor TEAM members may interfere with BALLS in contact with the BALL RETURN downstream of the BALL RETURN counter. *Violation: Two PENALTIES per affected BALL.*

It is important to consider this rule when designing mechanisms that interact with the TOWER. Be careful to make sure that your hanging apparatus doesn't dam the BALLS on the BALL RETURN.

### 7.3.6 Team Member Actions

**<G48>** TEAM Members in ARENA – Each ALLIANCE shall have no more than the four designated members of each of the three participating TEAMS in the ARENA during a MATCH. *Violation: Any ALLIANCE with additional personnel in the ARENA must have the additional personnel to leave the area before the MATCH may proceed.*

**<G49>** TEAM Positions during AUTONOMOUS PERIOD – During the AUTONOMOUS PERIOD, all TEAM members stand behind the STARTING LINE in their ALLIANCE ZONE. The HUMAN PLAYERS are permitted to reach into the CORRAL to retrieve BALLS. Any control devices worn or held by the DRIVERS must be disconnected from the OPERATOR CONSOLE, and not connected until after the AUTONOMOUS PERIOD. *Violation: One PENALTY for each violation (stepping outside the designated area, or stepping across the STARTING LINE). Exceptions will be allowed in cases involving personal or OPERATOR CONSOLE safety.*

HUMAN PLAYERS are expected to retrieve and re-enter BALLS into play during the AUTONOMOUS PERIOD, as detailed in Rule <G17>.

**<G50>** TEAM Positions during TELEOPERATED PERIOD - During the TELEOPERATED PERIOD, the DRIVERS, COACH and HUMAN PLAYER may travel anywhere within the ALLIANCE STATION, but they must stay within the ALLIANCE STATION boundaries, and not step outside the designated area. *Violation: One PENALTY for each violation. Exceptions will be allowed in cases involving TEAM member safety.*

- <G51>** DRIVERS Operating ROBOTS - During a MATCH, the OPERATOR CONSOLE shall be operated solely by the DRIVERS. *Violation: Disablement and RED CARD.*
- <G52>** Respect and Professional Demeanor - *FIRST* competitions promote respect and professional demeanor. While in the ARENA, including before and after a MATCH, TEAM members must be civil towards competition personnel, other TEAMS, and event attendees. *Violation: Potential RED CARD. TEAMS will not receive MATCH PENALTIES for off-field actions; however designated event personnel will hold them accountable for their off-field actions.*

### **7.3.7 Referee Interactions**

- <G53>** REFEREE Discussions - Any discussions regarding calls, rules, scores, or penalties must be between a pre-college student member of the TEAM and the Head Referee.
- <G54>** Information Sources - When making a ruling, the Head Referee may receive input from other sources, particularly Game Design Committee members, *FIRST* personnel, and technical staff that may be present at an event. However, the Head Referee's decision is final as stated in Rule <T03>.

# THE ROBOT

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# 8 THE ROBOT

## 8.1 OVERVIEW

This section of the 2010 *FIRST* Robotics Competition (FRC) manual provides rules applicable to the design and construction of the 2010 ROBOT. ROBOTS will be inspected at each FRC event to verify rules compliance before being allowed to compete.

**COMPLIANCE WITH ALL RULES IS MANDATORY**

### 8.1.1 Getting Started

Please be sure to thoroughly read and understand **Sections 4, 6, 7, 8, and 9** of this manual before designing your ROBOT. In particular, pay attention to **Section 8.3.1 - General Design & Safety Rules** and **Section 8.3 - Robot Rules** before proceeding. The following are just a few important points offered to help teams in getting started:

1. Evaluate the game's physical challenges and identify those that the robot will have to overcome.
  - Will it have to climb, pick and place items, push / pull objects or robots, possess a low profile, extend its height, lift items, hang, etc.?
  - What are the game's implications regarding the ROBOT'S center of gravity?
  - Are unique FIELD surface characteristics important when determining robot driving mechanism design?
  - Are there any particular offensive / defensive capabilities important to the ROBOT?
2. Inspect all items provided in the 2010 Kit Of Parts (KOP) (see **Section 10** and the **Kit Of Parts Checklist**) and review their basic features.
3. We recommend that you carefully read the documents listed in **Section 8.1.2, Related Documents & Resources**.
4. Look over the specifications and technical notes provided for the various KOP components.
5. Note all safety rules relating to the ROBOT'S design. They include:
  - The locations and ratings of circuit breakers where indicated in the wiring diagrams
  - Wire size
  - Stored energy guidelines
  - Attention to sharp corners and edges
  - Shields for moving parts and pinch points

### 8.1.2 Related Documents & Resources

In addition to this chapter, other sections in this manual and other documents should be reviewed before proceeding with the robot design process. Note that all referenced documents are available online at <http://www.usfirst.org/community/frc/content.aspx?id=452>.

- **Section 6: The Arena, Section 7: The Game and Section 9: The Tournament**



- Crate constraints and deadlines as listed in **Section 4: Robot Transportation**
- **Section 10: Kit Of Parts**
- *User Guide: AndyMark Inc Drive System* – Information to assemble chassis kit is included in the KOP and is also available at: <http://www.andymark.biz/>
- *FIRST 2010 Pneumatics Manual* - Valuable information about the pneumatic components and ordering processes are included.
- *FIRST 2010 Sensors Manual* – Helpful information regarding the application, assembly, and programming of the sensors included in the 2010 Kit Of Parts.
- 2010 Robot Power Distribution Diagram
- 2010 Robot Data Diagram
- *FIRST Official Robot Inspection Sheet* - it is strongly recommended that this be used as a guide to pre-inspect your ROBOT before it ships (this document will be posted in January, 2010)
- *2010 FIRST Robotics Competition Suggestions*

### 8.1.3 Conventions

Specific methods are used throughout this section to highlight warnings, cautions, key words or phrases. The intent is to alert the reader to important information designed to help teams in constructing a robot that complies with the rules in a safe and workmanlike manner.

Key words that have a particular meaning within the context of the 2010 FRC are defined in **Section 6**, **Section 7.2** and **Section 8.2**, and indicated in ALL CAPITAL letters throughout this text. References to other sections of the manual appear in ***bold italics***. References to specific rules within the manual are indicated with a bracketed reference to the rule (e.g. “Rule <S01>”). Operating keys, controls, buttons appear in bold capital letters (e.g. **OFF/ON** switch).

Warnings, cautions, and notes appear in blue boxes. These notes are intended to provide insight into the reasoning behind a rule, helpful information on understanding and interpreting a rule, and/or possible “best practices” for use when implementing systems affected by the rule. These notes are not part of the formal rules, and do not carry the weight of a rule (if there is an inadvertent conflict between a rule and a note, the rule applies). However, it is strongly recommended that you pay close attention to their contents.

## 8.2 DEFINITIONS

**BUMPERS** – Bumper assemblies designed to attach to the exterior of the ROBOT within the BUMPER ZONE, and constructed as specified in Rule <R07>. BUMPERS are excluded from the weight and volume calculations specified in Rule <R10>.

**BUMPER PERIMETER** – the polygon defined by the outer-most set of exterior vertices of the BUMPERS when they are attached to the ROBOT. To identify the BUMPER PERIMETER, wrap a string around the BUMPERS at the level of the BUMPER ZONE - the string describes the polygon.

**BUMPER ZONE** – the volume contained between two virtual horizontal planes, ten inches above the floor and sixteen inches above the floor.

**COMPONENT** – A ROBOT part in its most basic configuration, which can not be disassembled without damaging or destroying the part, or altering its fundamental function.

- Example 1: raw aluminum stock, pieces of steel, wood, etc., cut to the final dimensions in which they will be used on the ROBOT, would all be considered components. Bolting pieces of extruded aluminum together as a ROBOT frame would constitute a MECHANISM, and the collection of pieces would not be considered a COMPONENT.
- Example 2: a COTS (see immediately below) circuit board is used to interface to a sensor on the ROBOT, and it includes the circuit board and several electrical elements soldered to the board. The board is considered a COMPONENT, as this is the basic form in which it was purchased from the vendor, and removing any of the electrical elements would destroy the functionality of the board.

COTS – A “Commercial, Off-The-Shelf” COMPONENT or MECHANISM, in its unaltered, unmodified state. A COTS item must be a standard (i.e. not custom order) part commonly available from the VENDOR, available from a non-team source, and available to all teams for purchase.

- Example 1: a team orders two robot grippers from RoboHands Corp. and receives both items. They put one in their storeroom and plan to use it later. Into the other, they drill “lightening holes” to reduce weight. The first gripper is still classified as a COTS item, but the second gripper is now a “custom part” as it has been modified.
- Example 2: a team obtains openly available blueprints of a drive component commonly available from Wheels-R-Us Inc. and has local machine shop “We-Make-It, Inc.” manufacture a copy of the part for them. The produced part is NOT a COTS item, because it is not commonly carried as part of the standard stock of We-Make-It, Inc.
- Example 3: a team obtains openly available design drawings from a professional publication during the pre-season, and uses them to fabricate a gearbox for their ROBOT during the build period following kick-off. The design drawings would be considered a COTS item, and may be used as “raw material” to fabricate the gearbox. The finished gearbox itself would be a FABRICATED ITEM, and not a COTS item.

DRIVER STATION - The collection of the Classmate PC, FirstTouch I/O Module and breadboard provided in the KOP, and a USB hub (either the one provided in the KOP, or a team-supplied USB hub device).

FABRICATED ITEM – Any COMPONENT or MECHANISM that has been altered, built, cast, constructed, concocted, created, cut, heat treated, machined, manufactured, modified, painted, produced, surface coated, or conjured partially or completely into the final form in which it will be used on the ROBOT.

- Example 1: A piece of extruded aluminum has been ordered by the team, and arrives in a 20-foot length. To make it fit in their storage room, the team cuts it into two ten-foot lengths. These would not be considered FABRICATED ITEMS, as they have not been cut to the final length in which they will be used on the ROBOT.
- Example 2: A team designs an arm mechanism that uses gears with a half-inch face width. They order a 12-inch length of gear stock and cut it into precise half-inch slices. They do not bore out the mounting bores in the center of the gears. The slices are now considered FABRICATED ITEMS, as the final fabrication process has started, even though all the machining operations (the center bore) may not yet be completed.

FINALE CONFIGURATION - The physical configuration and orientation of the ROBOT while playing during the FINALE phase of the game (i.e. the last 20 seconds of the MATCH). This configuration is dynamic, and may change multiple times during the FINALE phase of a MATCH.

FRAME PERIMETER – the polygon defined by the outer-most set of exterior vertices on the ROBOT (without the BUMPERS attached) that are within the BUMPER ZONE. To determine the FRAME

PERIMETER, wrap a piece of string around the ROBOT at the level of the BUMPER ZONE - the string describes this polygon. Note: to permit a simplified definition of the FRAME PERIMETER and encourage a tight, robust connection between the BUMPERS and the FRAME PERIMETER, minor protrusions such as bolt heads, fastener ends, rivets, etc are excluded from the determination of the FRAME PERIMETER.

KIT OF PARTS (KOP) – The collection of items listed in the **2010 Kit Of Parts Checklist** (provided on line at <http://www.usfirst.org/community/frc/content.aspx?id=452>). For rookie teams, all of these items will be provided to them by *FIRST* at the FRC Kick-off. For veteran teams, some of these items will be provided by *FIRST* and some must be either retrieved from previous ROBOTS or purchased separately. For the purposes of these rules, the 2010 versions of all of the items listed in the **2010 Kit Of Parts Checklist** will be considered “in the 2010 Kit” regardless of the method of acquisition.

MECHANISM – A COTS or custom assembly of COMPONENTS that provide specific functionality on the ROBOT. A MECHANISM can be disassembled (and then reassembled) into individual COMPONENTS without damage to the parts.

NORMAL CONFIGURATION – The physical configuration and orientation of the ROBOT when the MATCH is started. This is the state of the ROBOT immediately before being enabled by the Field Management System, before the ROBOT takes any actions, deploys any mechanisms, or moves away from the starting location. This configuration is static, and does not change during a single MATCH (although it may change from MATCH to MATCH).

OPERATOR CONSOLE – the DRIVER STATION devices, and any associated equipment, control interfaces, display systems, structure, decorations, etc. used by the DRIVERS to operate the ROBOT.

REPLACEMENT PARTS – A COMPONENT or MECHANISM constructed as a functional duplicate of an existing part of the ROBOT, for the purpose of replacing a broken or defective part. REPLACEMENT PARTS may be either COTS items or FABRICATED ITEMS. They must be functionally identical to the original part but can be modified to provide more robust performance of the function.

- Example 1: A lever arm made of polycarbonate on your ROBOT breaks. You manufacture a REPLACEMENT PART made of aluminum plate, using the design drawings of the original. As the new part provides the same function as the broken part, the new part is a valid REPLACEMENT PART.
- Example 2: A sensor on the ROBOT is connected to the control system with 24 AWG single-strand wire, and runs across a hinged joint. The flexing of the wire causes it to break, and you want to replace it with 18 AWG multi-strand wire. If the new wire follows the same path as the original and connects only the same devices, then it is a valid REPLACEMENT PART (i.e. it has added robustness without changing function). But if the wire is then used to connect an additional sensor to the same circuit, it is providing a functionally different capability, and is no longer a “replacement.”

ROBOT - A FRC ROBOT is a remotely operated vehicle designed and built by a FRC team to perform specific tasks when competing in the 2010 competition “*Breakaway*.” The ROBOT must include all the basic systems required to be an active participant in the game – power, communications, control, mobility, and actuation. The ROBOT implementation must obviously follow a design approach intended to play the 2010 FRC game (e.g. a box of unassembled parts placed on the FIELD, or a ROBOT designed to play a different game, would not satisfy this definition).

SPARE PARTS – A COMPONENT or MECHANISM constructed as an identical duplicate of an existing part of the ROBOT, for the purpose of replacing a broken or defective part. SPARE PARTS may be

either COTS items or FABRICATED ITEMS, but they must be physically and functionally identical to the original part.

**UPGRADE PARTS** - A COMPONENT or MECHANISM intended to provide additional functionality not currently available on the ROBOT. UPGRADE PARTS may be COTS items or custom FABRICATED ITEMS, and may either add to or replace existing functionality.

- Example 1: A ROBOT is designed with a four-wheel drive system. The system works well on flat floors, but high-centers when trying to drive up the BUMPS. The team adds two more wheels on the centerline of the ROBOT to prevent this problem, and the wheels are identical to those already on the ROBOT. The new wheels would be considered UPGRADE PARTS even though they are the same as the ones already in place, as they alter the functionality of the ROBOT and provide new capability.

**VENDOR** – A legitimate business source for COTS items that satisfies all of the following criteria:

- A. The VENDOR must have a Federal Tax Identification number. The Federal Tax Identification number establishes the VENDOR as a legal business entity with the IRS, and validates their status as a legitimate business. In cases where the VENDOR is outside of the United States, they must possess an equivalent form of registration or license with the government of their home nation that establishes and validates their status as a legitimate business licensed to operate within that country.
- B. The VENDOR shall not be a “wholly owned subsidiary” of a team or collection of teams. While there may be some individuals affiliated with both a team and the VENDOR, the business and activities of the team and VENDOR must be completely separable.
- C. The VENDOR must be normally able to ship any general (i.e., non-*FIRST* unique) product within five business days of receiving a valid purchase request. It is recognized that certain unusual circumstances (such as 1,000 *FIRST* teams all ordering the same part at once from the same VENDOR) may cause atypical delays in shipping due to backorders for even the largest VENDORS. Such delays due to higher-than-normal order rates are excused.
- D. The business should maintain sufficient stock or production capability to fill teams orders within a reasonable period during the build season (less than 1 week). Note that this criterion may not apply to custom-built items from a source that is both a VENDOR and a fabricator. For example, a VENDOR may sell flexible belting that the team wishes to procure to use as treads on their drive system. The VENDOR cuts the belting to a custom length from standard shelf stock that is typically available, welds it into a loop to make a tread, and ships it to a team. The fabrication of the tread takes the VENDOR two weeks. This would be considered a FABRICATED ITEM, and the two weeks ship time is acceptable. Alternately, the team may decide to fabricate the treads themselves. To satisfy this criterion, the VENDOR would just have to ship a length of belting from shelf stock (i.e. a COTS item) to the team within five business days and leave the welding of the cuts to the team.
- E. The VENDOR makes their products available to all FRC teams. VENDORS must not limit supply or make a product available to just a limited number of FRC teams.

The intent of this definition is to be as inclusive as possible to permit access to all legitimate sources, while preventing *ad hoc* organizations from providing special-purpose products to a limited subset of teams in an attempt to circumvent the cost accounting rules. *FIRST* desires to permit teams to have the broadest choice of legitimate sources possible, and to obtain COTS items from the sources that provide them with the best prices and level of service available. Teams also need to protect against long delays in availability of parts that will impact their ability to complete their ROBOT. The FRC build season is brief, so the VENDOR must be able to get their product, particularly *FIRST* unique items, to a team in a timely manner. Ideally, chosen VENDORS should have national distributors (e.g. Home Depot, Lowe's, MSC, Radio Shack, McMaster-Carr, etc.) Remember, FRC events are not usually near home – when parts fail, local access to replacement materials is often critical.

**WITHHOLDING ALLOWANCE** – A limited amount of FABRICATED ITEMS that are withheld from the ROBOT shipping requirements (specified in **Section 4**) and retained by the team following the shipping deadlines. These items are then hand-carried to a competition event by the team. The OPERATOR CONSOLE is automatically included in the WITHHOLDING ALLOWANCE. Beyond that, the incoming material maximums specified in Rule <R38> limits the amount of FABRICATED ITEMS included in the WITHHOLDING ALLOWANCE.

## 8.3 ROBOT RULES

These rules establish the global ROBOT construction and performance constraints dictated by the characteristics of the provided KOP, along with the size and weight design limits. **Compliance with the rules is mandatory, and is the responsibility of every team! Any ROBOT construction not in compliance with the rules (as determined at inspection) must be rectified before a ROBOT will be allowed to compete.**

When constructing the ROBOT, the team is allowed to use the items in the **2010 KOP Checklist** and additional materials. Many of the rules listed below explicitly address what and how parts and materials may be used. There are many reasons for the structure of the rules, including safety, reliability, parity, creation of a reasonable design challenge, adherence to professional standards, impact on the competition, compatibility with the KOP, etc. When reading these rules, please use technical common sense (engineering thinking) rather than “lawyering” the interpretation and splitting hairs over the precise wording in an attempt to find loopholes. Try to understand the reasoning behind a rule.

One of the purposes of the *FIRST* Robotics Competition is to provide team members with the experience of conceiving, designing, and constructing their solution to the annual competition challenge. We want each student to have the experience of creating a new system each year. As the team considers the creation of their machine, this aspect of the program should be kept in mind. Solutions that merely bolt together a minimum number of externally-designed COTS subsystems may not offer the students the opportunity to understand the “why” or “how” of an item’s design. Likewise, solutions that are merely minor modifications of a design utilized for a previous competition does not offer the current students complete insight into the full design process. Purchasing optimization and design re-use are both important concepts, however teams must be cautious not to over-utilize them to the point that the student’s experience is compromised.

This intent is clearly met when a team obtains a MECHANISM or COTS items that was designed for non-*FIRST* purposes, and then modifies or alters it to provide functionality for the ROBOT. For

example, if a team obtains a gearbox from a power drill and modifies it to use on the ROBOT, they gain insight into the design of the original gearbox purpose, learn to characterize the performance of the original design, and implement the engineering design process to create their customized application for the gearbox.

However, COTS items that have been specifically designed as a solution to part of the FRC challenge may or may not fit within the FRC intent, and must be carefully considered. If the item provides general functionality that can be utilized in any of several possible configurations or applications, then it is acceptable (as the teams will still have to design their particular application of the item). However, COTS items that provide a complete solution for a major ROBOT function (e.g. a complete manipulator assembly, pre-built pneumatics circuit, or full mobility system) that require no effort other than just bolting it on to the ROBOT are against the intent of the competition, and will not be permitted.

In addition, another intent of these rules is to have all energy sources and active actuation systems on the ROBOT (e.g. batteries, compressors, motors, servos, cylinders, and their controllers) drawn from a well-defined set of options. This is to ensure that all teams have access to the same actuation resources, and to ensure that the inspectors are able to accurately assess the legality of a given part.

### 8.3.1 Safety & Damage Prevention

**<R01>** Energy used by FRC ROBOTS, (i.e., stored at the start of a MATCH), shall come only from the following sources:

- A. Electrical energy derived from the onboard 12V battery (see Rule <R40> for specifications and further details).
- B. Compressed air stored in the pneumatic system, stored at a maximum pressure of 120 PSI in no more than four Clippard Instruments tanks. Extraneous lengths of pneumatic tubing shall not be used to increase the storage capacity of the air storage system.
- C. A change in the altitude of the ROBOT center of gravity.
- D. Storage achieved by deformation of ROBOT parts.

Teams must be very careful when incorporating springs or other items to store energy on their ROBOT by means of part or material deformation. A ROBOT may be rejected at inspection if, in the judgment of the inspector, such items are unsafe

**<R02>** ROBOT parts shall not be made from hazardous materials, be unsafe, or cause an unsafe condition. Items specifically PROHIBITED from use on the ROBOT include (but are not limited to):

- A. Shields, curtains, or any other devices or materials designed or used to obstruct or limit the vision of any DRIVERS and/or COACHES and/or interfere with their ability to safely control their ROBOT
- B. Speakers, sirens, air horns, or other audio devices that generate sound at a level sufficient to be a distraction or hindrance affecting the outcome of a MATCH
- C. Any devices or decorations specifically intended to jam or interfere with the remote sensing capabilities of another robot, including vision systems, acoustic range finders, sonars, infra-red proximity detectors, etc. (e.g. including imagery on your robot that, to a reasonably astute observer, mimics the VISION TARGET)
- D. Exposed lasers of any type (COTS devices with completely enclosed integral lasers, such as a laser ring gyro, are permitted)
- E. Flammable gasses
- F. Any devices intended to produce flames or pyrotechnics

- G. Materials that off-gas noxious or toxic gasses
- H. Materials that produce hazardous inhalable particles
- I. Caustic chemicals
- J. Hydraulic fluids or hydraulic components

Teams should provide MSD Sheets for any materials they use that might be considered questionable during ROBOT inspection.

**<R03>** Custom circuits and COTS electronics are expressly PROHIBITED if they:

- A. Interfere with the operation of other ROBOTS.
- B. Directly affect any output devices on the ROBOT, such as by directly powering a motor, supplying a PWM signal directly to a speed controller or supplying a control signal directly to a relay module (see Rules <R63> and <R64> for the specific exception regarding CAN-bus devices).

**<R04>** Protrusions from the ROBOT shall not pose hazards to GAME PIECES or people. If the ROBOT includes protrusions that form the “leading edge” of the ROBOT as it drives, and are less than one square inch in surface area, it will invite detailed inspection. For example, forklifts, lifting arms, grapples, etc. may be carefully inspected for these hazards.

Note: inspectors will be looking for sharp corners and edges that could cause injury, pinch points, entanglement hazards, and impaling projections. Please mitigate all such hazards. This is for the protection of team members and field personnel as well as game equipment.

**<R05>** Exterior or exposed surfaces on the ROBOT shall not present undue hazards to the team members, event staff or GAME PIECES. Reasonable efforts must be taken to remove, mitigate, or shield any sharp edges, pinch points, entanglement hazards, projectiles, extreme visual/audio emitters, etc. from the exterior of the ROBOT. All points and corners that would be commonly expected to contact a Game Piece should have a minimum radius of 0.125 inches to avoid becoming a snag/puncture hazard. All edges that would be commonly expected to contact a Game Piece should have a minimum radius of 0.030 inches. All of these potential hazards will be carefully inspected.

**<R06>** MECHANISMS or COMPONENTS on the ROBOT shall not pose obvious risk of entanglement. If the structure of a COMPONENT permits easy penetration by an object less than four square inches in cross section, it will invite detailed inspection. Willful entanglement actions are addressed in Rule <G40>.

Note: Nets, loose rope or wire, voluminous sheets of fabric, etc. may be carefully inspected for these hazards. A 1/8" x 1/8" tight-mesh net (or very loose mesh fabric, depending on your point of view) may be a reasonable material that would not automatically pose an entanglement hazard. However, any flexible material has the potential to become an entanglement hazard if it is not firmly attached to an appropriate structure or left in a loose, voluminous configuration. Therefore, you must use your best judgment to determine if your particular use of the material will pose an entanglement hazard. However, actual performance on the playing field will determine if the potential for entanglement is significant or not.



**<R07>** Teams are required to use BUMPERS on their ROBOTS. BUMPERS have several advantages, such as reducing damage to ROBOTS when they contact other ROBOTS or ARENA elements, and being excluded from the calculation of ROBOT weight and volume constraints specified in Rule <R10>. The BUMPER location and design have been specified so that ROBOTS will make BUMPER-to-BUMPER contact during most collisions. If implemented as intended, a ROBOT that is pushed against a vertical wall in any NORMAL CONFIGURATION will always have the BUMPER be the first thing to contact the wall. To achieve this, BUMPERS must be constructed as described below and illustrated in Figure 8 – 1.

- A. BUMPERS must provide complete protection of the entire FRAME PERIMETER of the ROBOT (i.e. BUMPERS must wrap entirely around the ROBOT). The BUMPERS must be located entirely within the BUMPER ZONE when the ROBOT is standing normally on a flat floor, and must remain there (i.e. the BUMPERS must not be articulated or designed to move outside of the BUMPER ZONE).

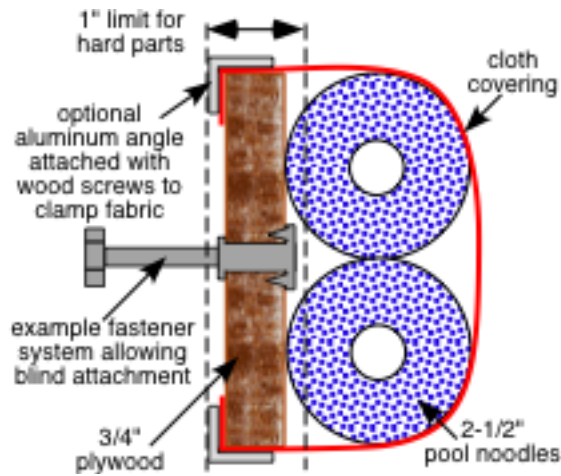
Under Rule <R07-A> whenever the ROBOT is on a flat floor, the BUMPERS must remain entirely within the BUMPER ZONE. But when the ROBOT is driving over a BUMP or RAMP and/or ELEVATED or SUSPENDED (or in the process of being ELEVATED or SUSPENDED) on the TOWER

- it is no longer constrained by Rule <R07-A>, and
- it is expected and allowed that the BUMPERS will travel outside (typically above) the BUMPER ZONE, and
- if the ROBOT is "frozen" (i.e. all moving parts halted) and placed on a flat surface, the BUMPERS do not have to be within the BUMPER ZONE.

Note that these effects are only in force when the ROBOT is actually driving over the BUMP or RAMP and/or ELEVATED or SUSPENDED (or in the process of being ELEVATED or SUSPENDED) on the TOWER (i.e. the body of the ROBOT must not be in its normal flat-floor attitude and elevation). Simply touching the BUMP, RAMP, or TOWER is not a sufficient condition to avoid violating Rule <R07-A>.

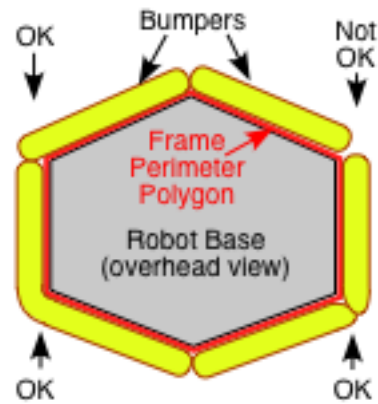
- B. BUMPERS must be built in segments, with a minimum length of six inches, and a maximum length that does not exceed the maximum horizontal dimension of the ROBOT (except for the soft cushion in the corner, as permitted by Rule <R07-L>).
- C. BUMPERS must use a stacked pair of 2½ inch "pool noodles" as the bumper cushion material.
- D. Each BUMPER segment must be backed by a piece of ¾-inch thick by 5-inch tall piece of plywood. Each piece of BUMPER backing must be a minimum of 6 inches long. Small clearance pockets and/or access holes in the BUMPER backing are permitted, as long as they do not significantly affect the structural integrity of the BUMPER.
- E. The BUMPERS must be covered with a rugged, smooth cloth (1000 denier Cordura Plus® strongly recommended). The cloth must completely enclose all exposed surfaces of the BUMPER backing (plywood) and cushion (pool noodle) material. It is recommended that lengths of aluminum angle be used to clamp the fabric in place.
- F. The fabric covering the BUMPERS must be solid red or solid blue in color. Visually, the red or blue must be as close to the corresponding color in the *FIRST* logo as reasonable (i.e. to a reasonably astute observer, they appear similar). The only markings permitted on the BUMPER fabric cover are the team number (see Rule <R15>).





**Cross-section View**

**Figure 8 – 1**



**Overhead View**

**Figure 8 – 2**

- G. Each set of BUMPERS (including any fasteners and/or structures that attach them to the ROBOT) must weigh no more than 20 pounds.
- H. BUMPERS must be designed for quick and easy installation and removal, to aid in weighing and inspection (as a guideline, BUMPERS should be removable by one person in less than ten minutes).
- I. BUMPERS must attach to the FRAME PERIMETER of the ROBOT with a rigid fastening system to form a tight, robust connection to the main structure/frame (e.g. not attached with Velcro). The attachment system must be designed to withstand vigorous game play – nut and bolt fasteners are recommended. All removable fasteners (e.g. bolts, locking pins, pip-pins, etc.) will be considered part of the BUMPERS.
- J. If a multi-part attachment system is utilized (e.g. interlocking brackets on the ROBOT and the BUMPER), then the elements permanently attached to the ROBOT will be considered part of the ROBOT, and the elements attached to the BUMPERS will be considered part of the BUMPER. Each element must satisfy all applicable rules for the relevant system.
- K. As part of the 100% coverage, BUMPERS must protect all exterior corners of the FRAME PERIMETER. For adequate protection, a full segment of BUMPER must be placed on each side of the corner (see Figure 8 - 2).
- L. Joints between BUMPER segments and the radial projections of corners must be filled with “soft” BUMPER materials. This may be done with short pieces of vertically oriented pool noodle, by wrapping the pool noodles around the corners, or by beveling the ends between adjacent segments so they form a tight and complete protective surface (see Figure 8 – 2).
- M. The entire length of the BUMPER backing must be supported by the structure/frame of the ROBOT (i.e. the backing material must not be in “free space” between or beyond attachment points) (see Figure 8 – 3).
- N. “Hard” parts of the BUMPER (i.e. plywood backing, fastening system, and clamping angles) may extend up to a maximum of one inch beyond the FRAME PERIMETER. “Soft” parts of the BUMPERS (i.e. pool noodles and cloth covering) may extend up to 3½ inches beyond the FRAME PERIMETER.

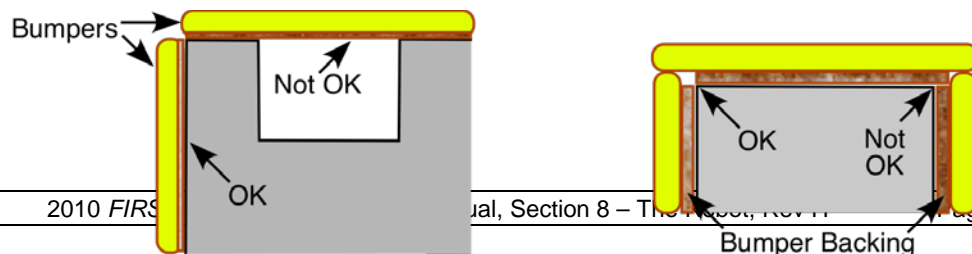


Figure 8 - 3

Figure 8 - 4

- O. The BUMPER backing must not extend beyond the “edge” of the ROBOT. The backing of adjacent BUMPER segments must not attach to each other if the attachment would require that the joint extend into the corner (see Figure 8 – 4).

Note: As bumper mounts are being designed, methods for carrying the ROBOT will have to be considered (BUMPERs typically do not make good handles!). Also, note that the use of BUMPERs may preclude the use of other technologies in their out-of-the-box configurations. Teams will need to carefully consider the interactions between BUMPER design options and other elements of their ROBOT design.

- <R08>** ROBOT wheels, tracks, and other parts intended to provide traction on the carpet may be purchased or fabricated (“traction devices” include all parts of the ROBOT that are designed to transmit any propulsive and/or braking forces between the ROBOT and the FIELD). In no case will traction devices that damage the carpet or other playing surfaces be permitted. Traction devices shall not have surface features such as metal, sandpaper, hard plastic studs, cleats, or other attachments. Anchors (i.e. devices that are deployed/used to keep one’s ROBOT in one place and prevent it from being moved by another ROBOT) shall not use metal in contact with the carpet to “stay put.” Gaining traction by using adhesives or Velcro-like fastener material is not allowed.

### 8.3.2 General Robot Design

- <R09>** Each registered FRC team can enter ONE (1) ROBOT into the 2010 FRC. That ROBOT shall fully comply with all rules specified in the 2010 FRC manual.
- <R10>** During the MATCH, the ROBOT will assume one of two operating configurations. When in each configuration, the ROBOT shall fit within the limits shown below (note: these limits are defined in reference to the ROBOT, not the FIELD).

	Maximum Horizontal Dimensions	Maximum Height	Maximum Weight
NORMAL CONFIGURATION	Rectangular space no more than 28 inches (71.12cm) by 38 inches (96.52cm)	60 inches (152.40cm)	120 pounds (54.43Kg)
FINALE CONFIGURATION	84 inch (213.4cm) diameter vertical right cylindrical volume	90 inches (243.8cm)	120 pounds (54.43Kg)

- A. Exception: solely for the purposes of determining compliance with the weight and volume limitations, these items are NOT considered part of the ROBOT and are NOT included in the weight and volume assessment:
- The 12V battery and its associated half of the Anderson cable quick connect/disconnect pair (including no more than 12 inches of cable per leg, the associated cable lugs, connecting bolts, and insulating electrical tape),
  - BUMPER assemblies (including BUMPER covers, if appropriate) that are in compliance with Rule <R07> and Rule <R12>.

- The OPERATOR CONSOLE.

- <R11>** The FRAME PERIMETER must be comprised of fixed, non-articulated structural elements of the ROBOT. The FRAME PERIMETER must remain a fixed, unchanging polygon throughout the MATCH.
- <R12>** The color of the BUMPERS will be used to identify the ALLIANCE to which the ROBOT has been assigned, red or blue. Therefore, each ROBOT must be able to display red BUMPERS and blue BUMPERS. This may be done via either of two acceptable methods:
- A. Each ROBOT may be built with two complete sets of interchangeable BUMPERS, one red and one blue. If this method is chosen, the BUMPERS must be identical except for the color of the covering fabric (see Rule <R07-F>).
  - B. Alternately, the ROBOT may use changeable BUMPER covers. The BUMPER covers
    - may be removable, reversible, or fixed
    - must completely enclose the BUMPERS
    - must show only a single color such that when the BUMPER covers are in use, only fabric of the assigned ALLIANCE color may be visible.
    - must be constructed solely of fabric and a fastening/restraining system to hold the cover in place. The fastening/restraining system must extend no further than one inch beyond the FRAME PERIMETER (i.e. no further than any other hard parts of the BUMPER - see Rule <R07-N>). Please note that the fastening/restraining system **MUST** be designed with robust performance in mind. The restraints must hold the ~~removable~~ cover in place during vigorous interactions with other ROBOTS and FIELD elements during the MATCH without allowing the cover to come off.
- <R13>** When determining weight, the basic ROBOT structure and all elements of all additional mechanisms that might be used in different configurations of the ROBOT shall be weighed together. Included in the weight limit are the robot control system, decorations, and all other attached parts.
- Example: A team has decided to design their ROBOT such that, before any given MATCH, they may change the configuration of the ROBOT based on perceived strengths or weaknesses of an opponent. The team accomplished this by constructing a basic drive train platform plus two versions of a GAME PIECE manipulator, each manipulator being a quick attach / detach device such that either one or the other (but not both) may be part of the ROBOT at the beginning of a MATCH. Their ROBOT platform weighs 107 lb, version A of the manipulator weighs 6 lb, and version B weighs 8 lb. Although only one version will be on the ROBOT during a MATCH, both manipulators (and all components of the manipulators that would be used during the MATCH) must be on the scale along with the ROBOT platform during weigh in. This would result in a **rejection** of the ROBOT because its total weight comes to 121 lb.
- <R14>** ROBOTS shall display their school name (or the name of the supporting youth organization, if appropriate), and primary sponsor name and/or logo whenever the ROBOT is on the FIELD, including practice sessions.

The support provided by the corporate sponsors and mentors on your team is important, and is to be acknowledged with the appropriate display of their names/logos on the exterior of the ROBOT.

- <R15>** Teams shall display their team number on the BUMPERS in four locations at approximately 90-degree intervals around the perimeter of the ROBOT. **The numerals must be at least 4 inches high, at least in 3/4-inch stroke width and in a contrasting color from its background.** Team Numbers must be clearly visible from a distance of not less than 100 feet, so that judges, referees, and announcers can easily identify competing ROBOTS.
- <R16>** During normal operation no part of the ROBOT shall extend outside the vertical projection of the FRAME PERIMETER, except as permitted by Rule <G30>.
- a) Exception: To facilitate a tight, robust connection between the BUMPERS and the FRAME PERIMETER, minor protrusions such as bolt heads, fastener ends, rivets, etc that are excluded from the determination of the FRAME PERIMETER and are within the BUMPER ZONE are permitted.
- Note: This means no “mushroom-bots.” If a ROBOT is designed as intended, in normal operation you should be able to push the ROBOT (with BUMPERS removed) up against a vertical wall, and the FRAME PERIMETER will be the only point of contact with the wall.
- <R17>** Any non-functional decorations included on the ROBOT must not affect the outcome of the MATCH, and must be in the spirit of “Gracious Professionalism.”
- <R18>** When positioned on the ROBOT, the primary battery must be secured so that it will not dislodge should the ROBOT be turned over or placed in any arbitrary orientation.
- Breakaway is a very vigorous game, with rapid changes in orientation as the ROBOTS cross the BUMPS and a potential for significant interaction among ROBOTS. There is a high probability that your ROBOT will be overturned at some point. Should that happen, your design must prevent the battery from falling out and damaging itself, your ROBOT, or other ROBOTS.
- <R19>** ROBOTS must be designed so that in normal operation BALLS cannot extend more than 3 inches inside
- a) the FRAME PERIMETER below the level of the BUMPER ZONE (see Figure 8-5),
  - b) a MECHANISM or feature designed or used to deflect BALLS in a controlled manner that is above the level of the BUMPER ZONE.

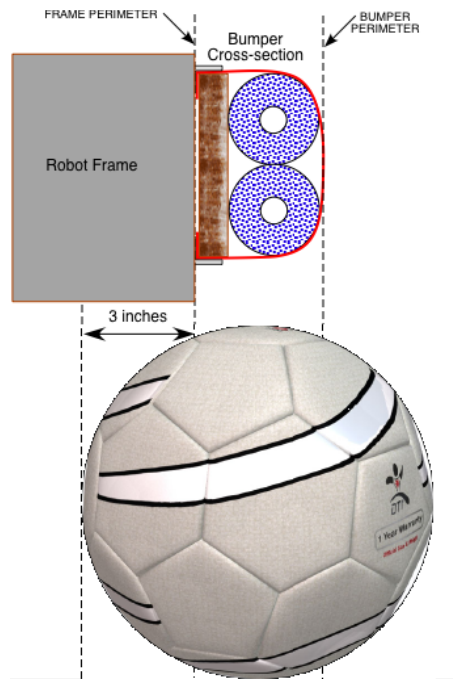


Figure 8-5

<R20> Field power to the ROBOTS will **not** be re-enabled after a MATCH. ROBOTS must be designed to permit removal of GAME PIECES from the ROBOT, and removal of the ROBOT from TOWERS and/or other ROBOTS without requiring activation of the ROBOT power system.

### 8.3.3 Budget Constraints

- <R21> All items and materials used in the construction of a ROBOT, and their associated costs, shall be recorded (in US dollars) in a consolidated Bill Of Materials (BOM). The BOM must use the *FIRST*-approved template available for download at <http://www.usfirst.org/community/frc/content.aspx?id=452>. Please refer to Rule <R89> in **Section 8.3.11 - Robot Inspection** for information regarding submission of the BOM.
- All KOP items used on the ROBOT must be included in the BOM. The source for each of the KOP items should be listed as "KOP" and the indicated cost should be listed as "\$0.00."
- <R22> The total cost of all non-KOP items shall not exceed \$3,500.00 USD.
- A. All costs are to be determined as explained in **Section 8.3.3.1 – Cost Determination of Additional Parts**
  - B. No individual item shall have a value of over \$400.00. The total cost of COMPONENTS purchased in bulk may exceed \$400.00 USD as long as the cost of an individual COMPONENT does not exceed \$400.00.
- <R23> The following items are EXCLUDED from the total cost calculation:
- A. All items provided in the 2010 KOP
  - B. The cost of any non-functional decorations
  - C. The cost of individual fasteners, adhesives, or lubricants, unless any one component exceeds \$1.00

- D. The costs of SPARE PARTS. A SPARE PART used as a direct replacement for a failed or defective ROBOT part (either KOP item or non-KOP item) that has already been included in the cost accounting is covered by the accounting for the original part
- E. All costs for the construction of the OPERATOR CONSOLE

<R24> Individual COMPONENTS or MECHANISMS retrieved from previous ROBOTS and used on 2010 ROBOTS must have their undepreciated cost included in the 2010 ROBOT cost accounting, and applied to the overall cost limits.

### **8.3.3.1 Cost Determination of Additional Parts**

The "cost" of each non-KOP item is calculated based on the following criteria, as applicable:

- A. The purchase price of a COTS item offered for sale by a VENDOR to any customer.
- B. The total cost (materials + labor) of an item you pay someone else to make.
  - Example: A team orders a custom bracket fabricated by a VENDOR to the team's specification. The VENDOR'S material cost and normally charged labor rate apply.
- C. The fair market value of an item obtained at a discount or as a donation. Fair market value is that price at which the supplier would normally offer the item to other customers. Also considered to be "fair market value" are the discounted prices offered to all teams by suppliers with established relations with *FIRST*.
  - Example: Special price discounts from National Instruments and Luminary Micro are being offered to all *FIRST* teams. The discounted purchase price of items from these sources would be used in the additional parts accounting calculations.
- D. The cost of raw material obtained by a team + the cost of non-team labor expended to have the material processed further. Labor provided by team members and/or by a recognized team sponsor whose employees are members of the team does not have to be included.
  - Example: A team purchases steel bar stock for \$10.00 and has it machined by a local machine shop. The machine shop is not considered a team sponsor, but donates two hours of expended labor anyway. The team must include the estimated normal cost of the labor as if it were paid to the machine shop, and add it to the \$10.00.
  - Example: A team purchases steel bar stock for \$10.00 and has it machined by a local machine shop that is a recognized sponsor of the team. The machinists are considered members of the team, so their labor costs do not apply. The total applicable cost for the part would be \$10.00.

Note: it is in the best interests of the teams and *FIRST* to form relationships with as many organizations as possible. Teams are encouraged to be expansive in recruiting and including organizations in their team, as that exposes more people and organizations to *FIRST*. Recognizing supporting companies as sponsors of, and members in, the team is encouraged - even if the involvement of the sponsor is solely through the donation of fabrication labor.

- E. The cost of items purchased in bulk or large quantities may be prorated on the basis of the smallest commonly available unit that satisfies the need for the item.
 

Example: A team purchases a 4' x 4' sheet of aluminum, but only uses a piece 10" x 10" on their ROBOT. The team identifies a source that sells aluminum sheet in 1' x 1' pieces. The team may cost their part on the basis of a 1' x 1' piece, even though they cut the piece from a larger bulk purchase. They do not have to account for the entire 4' x 4' bulk purchase item.
- F. Shipping costs of Non-Kit items are not counted.



- G. If the item is part of a modular system that can be assembled in several possible configurations or applications, then each individual module must fit within the price constraints defined in Rule <R22>. If the modules are designed to assemble into a single configuration, and the assembly is functional in only that configuration, then the total cost of the complete assembly including all modules must fit within the price constraints defined in Rule <R22>.

### 8.3.4 Fabrication Schedule

*FIRST* recognizes that it is the responsibility of each team to design and construct their ROBOT within the schedule constraints defined below. As compliance with these rules takes place outside of the competition venues, *FIRST* is not able to directly monitor compliance. One of the fundamental values of *FIRST* is the concept of “gracious professionalism.” We are relying upon the honor, integrity, and professional behavior of each team to recognize and abide by the fabrication schedule rules.

Note that schedule rules apply to both hardware and software development. Hardware and software design processes are thought-intensive activities, and team members are likely to continue to consider and analyze their designs long after the ROBOT is “completed.” Teams cannot be prevented from thinking about their hardware and software designs, and it is not our intention to do so. However, the timeline permitted for the development of the actual competition version of the ROBOT is intentionally restricted. Pondering software issues to be resolved, researching general case solutions, discussing solutions with teammates, collecting raw materials, sketching mechanisms, preparing tools, and outlining high-level descriptions of software algorithms are all reasonable activities before the scheduled build period. However, completing detailed dimensioned drawings of specific parts, and any actual fabrication of any hardware items intended to go on the actual competition ROBOT is prohibited outside of the approved fabrication periods. On the software side, writing actual lines of code, verification of syntax, final debugging, etc would all be considered development of the final software implementation, and must be completed during the approved fabrication periods.

**<R25>** Prior to the Kick-off: Before the formal start of the Robot Build Season, teams are encouraged to think as much as they please about their ROBOTS. They may develop prototypes, create proof-of-concept models, and conduct design exercises. Teams may gather all the raw stock materials and COTS COMPONENTS they want. But absolutely no final design, fabrication, or assembly of any elements intended for the final ROBOT is permitted prior to the Kick-off presentation.

- Example: A TEAM designs and builds a two-speed shifting transmission during the fall as a training exercise. When designing their competition ROBOT, they utilize all the design principles they learned. To optimize the transmission design for their ROBOT, they improve the transmission gear ratios and reduce the size, and build two new transmissions, and place them on the ROBOT. All parts of this process are permitted activities.
- Example: The same TEAM realizes that the transmission designed and built in the fall perfectly fits their need for a transmission to drive the ROBOT arm. They build an exact copy of the transmission from the original design plans, and bolt it to the ROBOT. This would be prohibited, as the transmission – although fabricated during the competition season – was built from detailed designs developed prior to kick-off.
- Example: A TEAM developed an omni-directional drive system for the 2008 competition. Over the summer of 2009 they refined and improved the control software (written in C) to add more precision and capabilities. They decided to use a similar system for the 2010 competition. They copied large sections of unmodified code over into the control software of the new ROBOT (also written in C). This would be a violation of the schedule constraint, and would not be allowed.

- Example: The same TEAM decides to use the LabView as their software environment for 2010. Following kickoff, they use the previously-developed C code as a reference for the algorithms and calculations required to implement their omni-directional control solution. Because they developed new LabView code as they ported over their algorithms, this would be permitted.
- Example: A different team develops a similar solution during the fall, and plans to use the developed software on their competition ROBOT. After completing the software, they post it in a generally accessible public forum and make the code available to all teams. Because they have made their software generally available, under the terms of Rule <R67> it is considered COTS software and they can use it on their ROBOT.

**<R26>** During the Build Season: During the period between the Kick-off and the ROBOT shipment deadline, teams are to design and fabricate all the COMPONENTS and MECHANISMS required to complete their ROBOT. They are encouraged to use all the materials, sources and resources available to them that are in compliance with the rules of the 2010 FRC. There is no limit to the amount of time that may be put into this effort, other than via the realities of the calendar. When the ROBOT shipment deadline arrives, all work on the ROBOT must cease and the ROBOT must be placed in a “hands-off” condition. The entire ROBOT (including all FABRICATED ITEMS intended for use during the competition in alternative configurations of the ROBOT) must be crated or bagged (as appropriate for your event), and out of team hands by the shipment deadline specified in **Section 4** (with the exception of the items covered by the WITHHOLDING ALLOWANCE).

- <R27>** During the period between ship date and the competitions: During this period, all teams may manufacture SPARE, REPLACEMENT, and UPGRADE PARTS, and develop software for their ROBOT at their home facility.
- A. Teams may manufacture all the SPARE, REPLACEMENT and UPGRADE PARTS they want.
  - B. There is no limit to the amount of time that may be put into this effort, other than via the realities of the calendar.
  - C. Teams may continue development of any items retained under the WITHHOLDING ALLOWANCE, continue to work on them during this period, and then bring them to the competition events.
  - D. The total weight of the FABRICATED ITEMS (SPARE, REPLACEMENT, and UPGRADE PARTS, plus all WITHHOLDING ALLOWANCE items) worked upon during this period and brought to the competition event(s) must not exceed the limits specified in Rule <R38>.
  - E. Teams attending 2-day events have unique rules governing ROBOT access. Please refer to **Section 4.8** for details.

The primary intent of this rule is to allow teams to withhold the ROBOT control system, the OPERATOR CONSOLE, and selected relevant subsystems, and access them after the shipping deadline. This will allow teams to have the maximum time possible prior to each competition event to develop and complete the software for their ROBOT while maximizing the potential capabilities provided by the control system.



- <R28>** At the competitions: Teams are allowed to repair, modify or upgrade their competition ROBOT while participating in a competition event. To support this, teams may bring SPARE, REPLACEMENT and UPGRADE PARTS and COTS items to the competitions (within the limits specified in Rule <R38>). Work can only be done on-site in the pits or at any facility made available to all teams at the event (e.g., in a team's repair trailer or a local team's shop offered to all teams to use). Fabrication may be done when the pit area is open for normal operations during the period starting with the opening of the pit area on the first day of the competition event and ending at 4:00PM on last day of the event. All work must be completed when the pit area closes each evening. Parts shall not be removed from the competition site and retained overnight after the pit area closes. At the conclusion of a regional competition event, the entire ROBOT (including all FABRICATED ITEMS intended for use during the competition in alternative configurations of the ROBOT) must be bagged or crated and out of team hands for shipping to the next event or back to the team.
- A. Exception: A limited amount of FABRICATED ITEMS (not to exceed the limits specified in Rule <R38>) may be retained as part of the WITHHOLDING ALLOWANCE and brought back to the team's home facility for continued development.
- <R29>** During the period between Regional Competition weekends, and between the Regional Competitions and the Championship: During these periods, all teams (not just those teams attending a Regional Competition) may utilize the same opportunities, and must operate under the same restrictions as specified in Rule <R27>.

### 8.3.5 Material Utilization

- <R30>** Robots entered into the 2010 FRC shall be fabricated and/or assembled from COMPONENTS, MECHANISMS and COTS items that are constructed from:
- A. Items provided in the KOP (or their exact REPLACEMENT PART)
- B. Additional parts and materials as permitted in these Rules, in quantities consistent with the Budget Constraint rules (found in **Section 8.3.3**). The use of non-KOP items or materials shall not violate any other robot design or fabrication rule.
- <R31>** Teams may replace lost or damaged KOP COMPONENTS only with identical COMPONENTS of the same material, dimensions, treatment, and/or part number.
- <R32>** COTS items that are generally available may be used on the ROBOT. The parts shall be generally available from suppliers such that any other *FIRST* team, if it so desires, may also obtain them at the same price. A specific device fabricated by a team from non-KOP materials for use by that team does not have to be available to others; however, the materials from which it is made must be available to other teams.
- <R33>** COTS items from ROBOTS entered in previous *FIRST* competitions or COTS items that are no longer commercially available may be used under the following conditions:
- A. The item must be functionally equivalent to the original condition as delivered from the VENDOR (e.g. a part that has non-functional label markings added would be permitted, but a part that has device-specific mounting holes added would be prohibited), and
- B. The item must satisfy ALL applicable 2010 FRC materials/parts use rules.

- <R34>** Parts custom-made for *FIRST* and provided to FRC teams in the Kit Of Parts for previous FRC competitions (e.g. 2006 FRC transmissions, custom-made motor couplers, custom sensor strips, FRC CMUcam II modules, etc.) may be used if the part is still functionally equivalent to the original condition and:
- A. The part is now generally available as a COTS item from an accessible source, or
  - B. All information required to fabricate the part (e.g. complete drawings, materials list, Gerber Files where appropriate, etc.) is openly available, such that any team could fabricate the part (or have it fabricated for them).
- Otherwise, such parts are prohibited from use in the 2010 competition.
- <R35>** FABRICATED ITEMS from ROBOTS entered in previous *FIRST* competitions shall not be used on ROBOTS in the 2010 competition.
- <R36>** Lubricants may be used only to reduce friction within the ROBOT. Lubricants shall not be allowed to contaminate the FIELD or other ROBOTS.
- <R37>** Teams may acquire and bring an unlimited amount of COTS items to the competitions to be used to repair and/or upgrade their ROBOT at the competition site.
- <R38>** Teams may bring a maximum of 40 pounds of custom FABRICATED ITEMS (SPARE PARTS, REPLACEMENT PARTS, and UPGRADE PARTS, plus all WITHHOLDING ALLOWANCE items) to each competition event to be used to repair and/or upgrade their ROBOT at the competition site. All other FABRICATED ITEMS to be used on the ROBOT during the competition shall arrive at the competition venue packed in the shipping crate or lockout bag with the ROBOT.
- A. Exception: the OPERATOR CONSOLE is not included in the incoming parts weight restriction.
  - B. Exception: Any competition legal 12V batteries and their associated half of the Anderson cable quick connect/disconnect pair (including no more than 12 inches of cable per leg, the associated cable lugs, connecting bolts, and insulating electrical tape) are not included in the incoming parts weight restriction.
- <R39>** Teams participating in the 2010 FRC that are located outside North America may not be able to acquire the exact part (as identified by specific part numbers) or materials of the specified dimensions as defined in these rules. In such situations, international teams must submit a request for approval of nearest-equivalent parts (e.g. nearest metric equivalent, etc.) to *FIRST* Headquarters (via e-mail request to [frcparts@usfirst.org](mailto:frcparts@usfirst.org)). *FIRST* will determine suitability of the part. If approved, a confirming e-mail will be sent to the team. The team must bring a copy of the e-mail to any competition event to verify that the use of an alternate part has been approved.

### 8.3.6 Power Distribution

- <R40>** The only legal primary source of electrical energy on the ROBOT during the competition is one MK ES17-12 12VDC non-spillable lead acid battery, OR one EnerSys NP 18-12 battery, as provided in the 2010 KOP. Teams may use other equivalent 12V batteries during development, testing and practice MATCHES. However, during competition MATCHES only one MK ES17-12 battery OR one EnerSys NP 18-12 battery can be used on the ROBOT.

**<R41>** An automatic battery charger rated for a maximum of 6 amperes must be used to charge the supplied batteries. When recharging the KOP batteries, either the charger provided by *FIRST* or an automatic charger with an equivalent charging current rating may be used.

**<R42>** Items specifically PROHIBITED from use on the ROBOT include:

- A. Any battery other than, or in addition to, the one primary battery permitted by Rule <R40>.
- B. Circuit breakers used on the Power Distribution Board that are different from the Snap Action breakers provided in the KOP,
- C. Power distribution panels and/or fuse panels different other than the single Power Distribution Board provided in the 2010 KOP,
- D. Motor speed controllers other than Innovation First, Inc. “Victor 884” speed controllers or Luminary Micro/Texas Instruments “Jaguar” (MDL-BDC or MDL-BDC24) speed controllers,
- E. Relay modules other than Innovation First, Inc. Spike relays,
- F. Aluminum or other non-copper wiring.

**<R43>** All wiring and electrical devices, including all control system components, shall be electrically isolated from the ROBOT frame. The ROBOT frame must not be used to carry electrical current (e.g. this is necessary due to polarity reversals that occur under certain operating conditions such as during motor direction reversals).

The chassis for the cRIO-FRC and the supplied KOP camera have grounded enclosures. Under this rule (and for their protection), it is REQUIRED that they be electrically isolated from the ROBOT frame when installed on the ROBOT.

**<R44>** The 12V battery, the main 120-amp circuit breaker, and the Power Distribution Board shall be connected as shown in Figure 8-6. In particular:

- A. The battery must be connected to the ROBOT power system through the use of the Anderson Power Products (APP) connector.
- B. The APP connector must be attached to the battery with either the copper lugs provided in the BURNDY Bag or appropriately-rated and -sized lug connectors.
- C. The battery terminals and the connecting lugs must be insulated with shrink tubing and/or electrical tape.
- D. The main 120-amp circuit breaker must be directly connected to the hot (+) leg of the ROBOT-side APP connector. Only one 120 amp main circuit breaker is allowed. This breaker must not be bypassed.
- E. The Power Distribution Board must be directly connected to the APP connector and main 120-amp circuit breaker. No other loads may be connected to the main 120-amp circuit breaker.
- F. Each primary power connection between the battery and Power Distribution Board must be made with 6 AWG red and black wire or larger
- G. The 120-amp circuit breaker must be quickly accessible from the exterior of the ROBOT. It is recommended that the 120-amp circuit breaker location be clearly and obviously labeled to permit it to be easily found by field personnel during a MATCH.
- H. The Power Distribution Board and all circuit breakers must be easily visible for inspection at each FRC event.

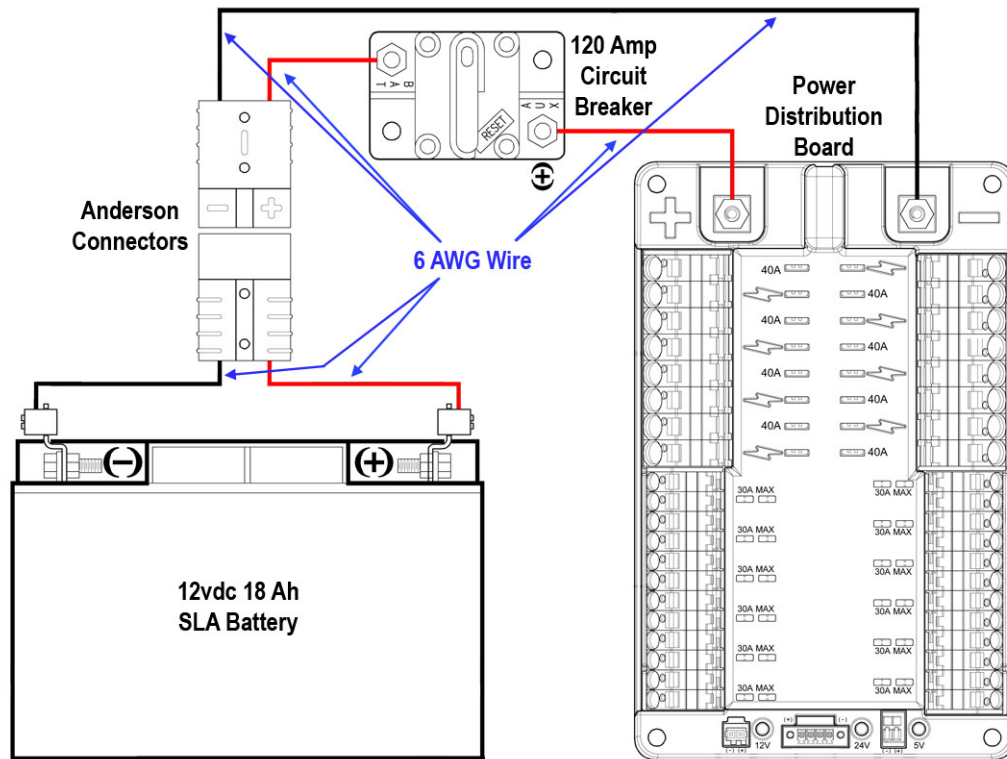


Figure 8 - 6

- <R45>** All electric power utilized by the ROBOT shall be distributed from the load terminals of the Power Distribution Board. Circuits may not bypass the Power Distribution Board to connect directly to the 120-amp loop.
- The cRIO-FRC power input must be connected to the 24 Vdc supply terminals on the Power Distribution Board. With the exception of one Solenoid Breakout Board, no other electrical load can be connected to these terminals.
  - The Linksys Wireless Bridge power feed must be connected to the marked 12 Vdc supply terminals located at the end of the Power Distribution Board (i.e. the terminals located between the indicator LEDs, and not the main WAGO connectors along the sides of the Power Distribution Board). No other electrical load can be connected to these terminals.
  - If a 5V camera is used (such as the KOP camera), the camera power feed must be connected to the 5 Vdc supply terminals on the Power Distribution Board.
  - All other branch circuits must connect to, and have power sourced solely by, a protected 12 Vdc WAGO connector pair on the Power Distribution Board.
  - Only one wire shall be connected to each WAGO connector on the Power Distribution Board. If multi-point distribution of circuit power is required (e.g. to provide power to the three KOP breakout boards via one 20-amp circuit), then all incoming wires must be appropriately spliced into the main lead, and only one lead inserted into the WAGO connector to connect the circuit.
  - Sensors and custom circuits may be connected to the 5 Vdc sources on the Analog Breakout boards or the Digital Sidecars. By being logically downstream from the Power Distribution Board, they are protected by the 20-amp breaker at the circuit root.

- G. Servos may be connected to the 6 Vdc sources on the Digital Sidecars (via the designated PWM connections, and with a “6Vdc enable” jumper in place for the corresponding port). By being logically downstream from the Power Distribution Board, they are protected by the 20-amp breaker at the circuit root. No other electrical load can be connected to these sources.

**<R46>** All active Power Distribution Board branch circuits shall be protected from overload with an appropriate value auto resetting Snap Action circuit breaker (from the KOP or identical equivalent).

- A. Each speed controller branch circuit must be protected by one and only one 20-amp, 30-amp, or 40-amp circuit breaker on the Power Distribution Board. No other electrical load can be connected to the breaker supplying this circuit.
- B. Each Spike relay module branch circuit must be protected with one and only one 20-amp circuit breaker on the Power Distribution Board. No other electrical load can be connected to the breaker supplying this circuit.
- C. Each Digital Sidecar branch circuit must be protected with one and only one 20-amp circuit breaker on the Power Distribution Board. No other electrical load can be connected to the breaker supplying this circuit.
- D. If the compressor is used, the Spike relay module branch circuit supplying the compressor must be protected with a 20-amp circuit breaker. No other electrical load can be connected to the breaker supplying this circuit.
- E. A single branch supply circuit may be spliced to supply power to one, two or three of the Analog/Solenoid Breakout Boards. This circuit must be protected with one and only one 20-amp circuit breaker on the Power Distribution Board. No other electrical load can be connected to the breaker supplying this circuit.
- F. Custom circuits and sensors powered via the cRIO-FRC or the Digital Sidecar are protected by the breaker on the circuit(s) supplying those devices. Power feeds to all other custom circuits must be protected with a dedicated 20-amp circuit breaker on the Power Distribution Board.
- G. In addition to the required branch power circuit breakers, smaller value fuses or breakers may be incorporated into custom circuits for additional protection.

**<R47>** All active Power Distribution Board branch circuits shall be wired with appropriately sized wire:

- A. **12 AWG (2.052mm) or larger** diameter wire must be used for all circuits protected by a 40A circuit breaker.
- B. **14 AWG (1.628mm) or larger** diameter wire must be used for all circuits protected by a 30A circuit breaker.
- C. **18 AWG (1.024mm) or larger** diameter wire must be used for all circuits protected by a 20A circuit breaker.
- D. **20 AWG (0.8128mm) or larger** diameter wire must be used for the power connection between the Power Distribution Board and the cRIO-FRC .
- E. **20 AWG (0.8128mm) or larger** diameter wire must be used for the power connection between the Power Distribution Board and the Linksys Wireless Bridge
- F. **20 AWG (0.8128mm) or larger** diameter wire must be used for the power connections between the Power Distribution Board and the Analog Breakouts and/or Solenoid Breakout if individual power feeds are used. **18 AWG or larger** diameter wire must be used if a common power feed is used for multiple breakouts.
- G. **24 AWG (0.5106mm) or larger** diameter wire must be used for providing power to pneumatic valves.

- <R48> All active Power Distribution Board branch circuit wiring with a constant polarity (i.e., except for relay module, speed controller, or sensor outputs) shall be color-coded as follows:
  - A. Use red, white, brown, or black with stripe wire for +24 Vdc, +12 Vdc and +5 Vdc connections.
  - B. Use black or blue wire for common (-) connections.
- <R49> Each power-regulating device (speed controller or relay module) shall control one and only one electrical load (motor, actuator or compressor).
  - A. Exception: Multiple low-load, pneumatic solenoid valves may be connected to a single relay module. This would allow one relay module to drive multiple pneumatic actions. No other electrical load can be connected to a relay module used in this manner.
- <R50> Custom circuits shall NOT directly alter the power pathways between the battery, Power Distribution Board, speed controllers, relays, motors, or other elements of the robot control system (including the power pathways to other sensors or circuits). Custom high impedance voltage monitoring or low impedance current monitoring circuitry connected to the ROBOT'S electrical system is acceptable, because the effect on the ROBOT outputs should be inconsequential.
- <R51> Decorations may draw power from the 12 Vdc electrical system as long as they are powered via a dedicated 20 amp circuit breaker on the Power Distribution Board, and do not affect the operation of other control system components.

### 8.3.7 Motors & Actuators

- <R52> Motors specifically permitted on 2010 FRC ROBOTS include:
  - A. All motors, actuators, and servos listed in the 2010 KOP,
  - B. An unlimited number of COTS servos with a maximum output torque of 55 oz-in and maximum rotational speed of 100 rpm at 6 Vdc (e.g. HITEC model HS-322HD or HS-325HB servos, as provided in the KOP),
  - C. An unlimited number of *FIRST* Tech Challenge (FTC) servos (HITEC HS-475HB servos),
  - D. One, two, or three additional 2½" CIM motors (part #FR801-001 and/or M4-R0062-12) in addition to those provided in the KOP. This means that up to five, and no more, 2½" CIM motors can be used on the ROBOT.
  - E. Identical one-to-one SPARE PARTS for motors, actuators, and servos provided in the 2010 KOP that may have failed or become damaged.
- <R53> Items specifically PROHIBITED from use on the ROBOT include:
  - A. Electric motors and/or servos different from, or in addition to, those in the KOP, with the exception of those specifically permitted by Rule <R52>.
  - B. Electric solenoid actuators (note: electric solenoid actuators are NOT the same as pneumatic solenoid valves – the latter are permitted, the former are not).
- <R54> So that the maximum power level of every ROBOT is the same, motors and servos used on the ROBOT **shall not be modified in any way**, except as follows:
  - A. The mounting brackets and/or output shaft/interface of the motors may be modified to facilitate the physical connection of the motor to the ROBOT and actuated part.

- B. The gearboxes for the Fisher-Price motors are not considered “integral” and may be separated from the motors.
  - C. The electrical input leads on the motors may be trimmed to length as necessary.
- The intent is to allow teams to modify mounting tabs and the like, not to gain a weight reduction by potentially compromising the structural integrity of any motor. The integral mechanical and electrical system of the motor is not to be modified. Note that *FIRST* will not provide replacements for modified parts.

- <R55>** All electrical loads (motors, actuators, compressors) must be supplied by an approved power regulating device (speed controller, relay module, or Digital Sidecar PWM port) that is controlled by the cRIO-FRC on the ROBOT.
- A. Each CIM motor and Fisher-Price motor must be connected to one and only one approved speed controller. These motors must not be connected to relay modules.
  - B. Servos must be directly connected to the PWM ports on the Digital Sidecar. They must not be connected to speed controllers or relay modules.
  - C. If used, the compressor must be connected to one and only one Spike relay module.
  - D. Each other electrical load (motor or actuator) must be supplied by one and only one approved speed controller, or one and only one relay module.

### 8.3.8 Control, Command & Signals System

The FRC robot control system has been designed to provide advanced capabilities for the ROBOTS. The system has been designed around an open architecture that will allow teams to easily develop custom software to control the ROBOT and add electronics and custom circuits to expand the functionality of the ROBOT. Custom circuits may be used to indirectly affect the robot outputs by providing enhanced sensor feedback to the cRIO-FRC to allow it to more effectively control the ROBOT.

Note that with increased capability comes increased responsibility. Teams are ultimately responsible for any software bugs introduced into the standard robot control software, or undesirable effects from added custom circuits. So, teams will have to exercise care to prevent these conditions. To assist with this, teams are encouraged to investigate, learn and practice industry-standard software Validation and Verification (V&V) techniques and develop thorough hardware testing plans.

The control system hardware is provided to rookie teams in the 2010 KOP. Veteran teams are required to reuse their 2009 FRC robots to recover the control system hardware provided in the 2009 KOP, or purchase exact SPARE PART equivalents for use on their 2010 FRC ROBOTS.

**<R56>** ROBOTS must be controlled via the programmable National Instruments cRIO-FRC (National Instruments part number 780406-01). Other controllers shall not be used.

**<R57>** The cRIO-FRC , Classmate PC, wireless bridge, and wireless router must be configured to correspond to the correct team number (assigned to the team by *FIRST*). The procedures for configuring these devices are contained in the FRC control system documentation.

**<R58>** One KOP wireless bridge (either model WGA600N or WET610N) is the only permitted mechanism for communicating to and from the ROBOT during the MATCH. The signal output from the wireless bridge must be directly connected to Port 1 of the cRIO-FRC with an Ethernet cable. All signals must originate from the OPERATOR CONSOLE and/or the Field Management System, and be transmitted to the ROBOT via the official ARENA hardware. No other form of wireless communications shall be used to communicate to, from or within the ROBOT (e.g. radio modems from previous *FIRST* competitions and Bluetooth devices are not permitted on the ROBOT during competition).

**<R59>** ROBOTS shall use the diagnostic Robot Signal Light provided in the KOP. It must be mounted on the ROBOT such that it is easily visible while standing three feet in front of the ROBOT in the NORMAL CONFIGURATION. The team has no direct control over the light and no programming is required.

- A. The Robot Signal Light must be connected to the “RSL” supply terminals on a Digital Sidecar (see the ***FRC Control System Manual, Section 3.5*** and the item bulletin online at <http://literature.rockwellautomation.com/idc/groups/literature/documents/in/41063-177-01.pdf> for connection details). These terminals provide power and control for the light.
- B. The Digital Sidecar must be connected to a NI 9403 module in Slot 4 of the cRIO-FRC. If it is connected through any other slot, the light will not function properly.
- C. The light must be wired for “solid light” operation, by placing a jumper between the La and Lb terminals on the light.

**<R60>** The control system is designed to allow wireless control of the ROBOTS. The Classmate PC, FirstTouch I/O module, cRIO-FRC, speed controllers, relay modules, wireless bridge, batteries, and battery charger shall not be tampered with, modified, or adjusted in any way (tampering includes drilling, cutting, machining, gluing, rewiring, disassembling, etc.), with the following exceptions:

- A. User programmable “dashboard” code in the Classmate PC may be customized.
- B. User programmable code in the cRIO-FRC may be customized.
- C. Dip switches on the cRIO-FRC may be set.
- D. Speed controllers may be calibrated as described in owner's manuals.
- E. The supplied fans attached to the Victor speed controllers may be powered from the Victor power input terminals.
- F. The fuse on the Spike relays may be replaced with a 20 Amp Snap-Action circuit breaker.
- G. The alligator clips on the battery charger leads may be replaced with Anderson Power Pole connectors (note: this is a recommended modification).
- H. Wires, cables, and signal lines may be connected via the standard connection points provided on the devices.
- I. Fasteners may be used to attach the device to the OPERATOR CONSOLE or ROBOT.
- J. Labeling may be applied to indicate device purpose, connectivity, functional performance, etc.
- K. Brake/Coast jumpers on speed controllers may be changed from their default location.
- L. If CAN-bus functionality is used, limit switch jumpers may be removed from a Jaguar speed controller and a custom limit switch circuit may be substituted (so that the cRIO-FRC may read the status of the limit switches).
- M. If CAN-bus functionality is used, the Jaguar firmware must be updated as required by *FIRST* (see Rule <R63-D>).
- N. If the FirstTouch I/O module is not used as part of the OPERATOR CONSOLE, the embedded software may be modified. If the First Touch I/O module is used as part of the OPERATOR CONSOLE, the default software image must be used.



- <R61>** Relay module outputs, speed controller outputs, or PWM outputs must not be connected to the analog/solenoid breakout boards or the Digital Sidecar. 12Vdc power must not be connected to any terminal on the analog/solenoid breakout boards or the Digital Sidecar except the designated 12Vdc input terminals. Doing so may damage or destroy components of the control system.
- <R62>** Every relay module, servo, and Victor speed controller shall be connected via PWM cable to the Digital Sidecar and be controlled by signals provided from the cRIO-FRC via the Digital Sidecar. They shall not be controlled by signals from any other source.
- <R63>** Each Jaguar speed controller must be controlled with signal inputs sourced from the cRIO-FRC and passed via either a connected PWM cable or a CAN-bus connection.
- A. The Jaguar must receive signals via either a PWM cable -OR- a CAN-bus connection. Both cannot be used simultaneously.
  - B. PWM configuration: If the Jaguar speed controller is controlled via PWM communications, the PWM port on the Jaguar speed controller must be connected directly to a PWM port on the Digital Sidecar with a PWM cable. No other devices may be connected to these PWM ports. No other devices may be connected to any other ports on the Jaguar speed controller.
  - C. CAN-bus configuration: If the Jaguar speed controller is controlled via CAN-bus communications, then each Jaguar speed controller must be connected to either the cRIO-FRC or another CAN-bus device with a CAN-bus cable.
  - D. If the CAN-bus configuration is used, the firmware on all Jaguar speed controllers must be updated to at least Version 86 of the official FIRST firmware.
- <R64>** If CAN-bus communications are used, the CAN-bus must be connected to the cRIO-FRC through either Ethernet Port 2 or the RS-232 DB-9 serial port connection. No other connections to the cRIO-FRC may be used by the CAN-bus.
- A. Ethernet-to-CAN convertors, serial-to-CAN convertors, serial-to-CAN cables, “black” Jaguars, or other network bridging devices may be used to connect the CAN-bus to the selected cRIO-FRC port.
  - B. If a “black” Jaguar (TI Model MDL-BDC24) is used as the serial-to-CAN bridge, the first Jaguar on the CAN-bus must be a “black” Jaguar. Any “grey” Jaguars (TI Model MDL-BDC) on the bus must be located downstream from the first “black” Jaguar.
  - C. Additional switches, sensor modules, custom circuits, third-party modules, etc. may also be placed on the CAN-bus.
  - D. No device that interferes with, alters, or blocks communications between the cRIO-FRC and the Jaguars will be permitted (tunneling packets for the purposes of passing them through an Ethernet-to-CAN convertor is acceptable as the commands are not altered).
- <R65>** Solenoid Breakout outputs shall be connected to pneumatic valve solenoids only. No other devices shall be connected to these outputs.
- <R66>** A National Instruments 9201 module must be installed in slot 1 of the cRIO-FRC. An analog breakout must be connected to this module. A jumper must be installed in the “Power” position (two outer pins) on the analog breakout. The analog breakout must be powered from the Power Distribution Panel. Please refer to Section 3.4 of the “FRC Control System Component Data Sheets” for information on these connections.

These connections enable monitoring of the battery charge by the team and the Field Management System. This is a required element of the ROBOT configuration.

- <R67>** For the purposes of the FRC, generally available software modules obtained from open sources (e.g. professional publications, commonly used FRC community-accessible web resources, industry source code repositories, etc.) that are not specifically affiliated with individual FRC teams shall be considered COTS items, and may be used.
- <R68>** All outputs from sensors, custom circuits and additional electronics shall connect to only the following:
- A. other custom circuits, or
  - B. additional COTS electronics, or
  - C. input ports on the Digital Sidecar, or
  - D. input ports on the Analog Breakout, or
  - E. the RS-232 DB-9 serial port on the cRIO-FRC, or
  - F. the Ethernet bus connected to Port 2 of the cRIO-FRC, or
  - G. the CAN-bus if and only if all Jaguar speed controllers on the CAN-bus are wired in full compliance with Rule <R63> and Rule <R64>, or
  - H. the sensor inputs on the Jaguar speed controller.

Custom circuits and additional electronics are allowed to utilize the Port 2 Ethernet bus and/or the CAN-bus to communicate between devices. Note however, that the ROBOT must be controlled by the cRIO-FRC (see Rule <R56>). Thus, any additional devices on the Ethernet or CAN-bus must not provide command signals that do not originate from the cRIO-FRC. It is our intent to incrementally open access to the full control system technologies in a controlled manner that reduces the risk of “unanticipated surprises” as we gain experience with the system.

- <R69>** A signal filter may be wired across motor leads or PWM leads. For the purposes of inspection and rules compliance, such filters will not be considered custom circuits, and will not be considered a violation of Rule <R54> or Rule <R68>. Acceptable signal filters are:
- A one microfarad (1  $\mu$ F) or less non-polarized capacitor may be applied across the power leads of any motor on your ROBOT (as close to the actual motor leads as reasonably possible)
  - A resistor may be used as a shunt resistor for the PWM control signal feeding a servo
- <R70>** Any decorations that involve broadcasting a signal to/from the ROBOT, such as remote cameras, must be cleared with *FIRST* Engineering (via e-mail to [frcteams@usfirst.org](mailto:frcteams@usfirst.org)) prior to the event and tested for communications interference at the venue. Such devices, if reviewed and approved, are excluded from Rule <R58>.

### 8.3.9 Pneumatic System

- <R71>** To satisfy multiple constraints associated with safety, consistency, robot inspection, and constructive innovation, no pneumatic parts other than those explicitly permitted by the Pneumatic System Rules may be used on the ROBOT.

- <R72>** In addition to the items included in the KOP, pneumatic system items specifically permitted on 2010 FRC ROBOTS include the following items. All included items must be “off the shelf” pneumatic devices rated by their manufacturers for pressure of at least 125psi, and used in their original, unaltered condition (except as required for assembly with other components).
- A. One or two additional Clippard air storage tanks (Clippard Part Number AVT-32-16), equivalent to those provided in the kit. This means that up to four, and no more, Clippard air storage tanks can be used on the ROBOT.
  - B. Pneumatic pressure vent plug valves functionally equivalent to those provided in the KOP (Parker Part Number PV609-2).
  - C. Solenoid valves. All such valves must have a maximum 1/8” NPT port diameter, and a maximum Cv of 0.32 (if non-KOP valves are used, the team will be required to provide part documentation validating that the valves meet these constraints). Solenoid valves that are rated for a maximum pressure that is less than 125psi rating mandated above are permitted, however if employed, an additional pressure relief valve must be added to the low pressure side of the main regulator. The additional relief valve must be set to a lower pressure than the maximum pressure rating for the solenoid valve.
  - D. In addition to the pneumatic cylinders provided in the KOP and the “free” pneumatic cylinders available for order through the Free Pneumatic Components Order Form, additional air cylinders or rotary actuators may be used. Cylinders may be of any configuration, and may be of any size up to a maximum of 24-inch stroke and 2-inch diameter.
  - E. Additional 0.160” inch inside diameter pneumatic tubing functionally equivalent to that provided in the KOP, with the pressure rating clearly factory-printed on the exterior of the tubing (note: alternate tubing colors are acceptable).
  - F. Pressure transducers, pressure gauges, and connecting fittings.
  - G. Pressure regulators with a maximum bypass pressure of no more than 60psi.
  - H. For the purposes of the *FIRST* competition, a device that creates a vacuum is not considered to be a pneumatic device and are not subject to the pneumatic rules (although they must still satisfy all other appropriate rules). These include, but are not limited to, venturi-type vacuum generators and off-the-shelf vacuum devices (as long as they are powered by provided or permitted motors).
  - I. For the purposes of the *FIRST* competition, closed-loop COTS pneumatic (gas) shocks are not considered pneumatic devices, and are not subject to the pneumatic rules (although they must still satisfy all other appropriate rules).
  - J. For the purposes of the *FIRST* competition, air-filled (pneumatic) wheels are not considered pneumatic devices, and are not subject to the pneumatic rules (although they must still satisfy all other appropriate rules).

**<R73>** Items specifically PROHIBITED from use on the ROBOT include:

- A. Any pneumatic part or component rated for less than 125psi.
- B. Any pneumatic part or component that has been altered, modified, machined, coated, or changed from its original “out of the box” condition, except as required for normal assembly with other components. The only acceptable modifications are:
  - Tubing may be cut.
  - Wiring for pneumatic devices may be modified to interface with the control system.
  - Assembling and connecting pneumatic components using the pre-existing threads, mounting brackets, quick-connect fittings, etc.
  - Removing the mounting pin from a pneumatic cylinder, provided the cylinder itself is not modified.
  - Labeling applied to indicate device purpose, connectivity, functional performance, etc.

Do not, for example, file, machine, or abrasively remove any part of a pneumatic cylinder – this would cause the part to become a prohibited item. Consider pneumatic components sacred.

**<R74>** If pneumatic components are used on the ROBOT, the pneumatic system on the ROBOT must contain as a minimum the following components, connected in accordance with this section.

- Pressure gauges to display the “stored” and “working” air pressure (see Rule <R76>),
- A pressure relief valve, calibrated and set to release at 125psi (see Rule <R77>),
- A pressure switch, calibrated and connected to the ROBOT control system (see Rule <R78>),
- An easily visible and accessible pressure vent plug valve to manually relieve the stored pressure (see Rule <R79>).

**<R75>** Compressed air for the pneumatic system on the ROBOT must be provided by one and only one compressor. This compressor may be either the Thomas Industries compressor from the KOP, or an equivalent compressor that does not exceed any of the KOP compressor performance specifications (specifically: 12v, 0.8cfm flow rate, 120psi continuous pressure, 120psi maximum pressure compressor). Note: if an alternative compressor is used, during inspection the team may be required to provide documentation to show compliance with the performance specifications. Compressed air shall not come from any other source. The compressor may be mounted on the ROBOT, or it may be left off the ROBOT and used to pre-charge compressed air in the storage tanks prior to bringing the ROBOT onto the FIELD. Off-board compressors must be controlled and powered by the ROBOT.

The only difference between an on- and off-board compressor is that the off-board compressor is physically removed from the ROBOT. The intent of this rule is to permit teams to take advantage of the weight savings associated with keeping the compressor off-board. However, using the compressor off-board of the ROBOT does NOT permit non-compliance with any other applicable rules.

**<R76>** “Working” air pressure on the ROBOT must be no greater than 60psi. All working air must be provided through one primary Norgren adjustable pressure regulator.

- A. All “working” pneumatic components (e.g. valves, cylinders, rotary actuators, etc.) must be downstream from this regulator.
- B. Only the compressor, relief valve, pressure switch, pressure vent plug valve, pressure gauge, storage tanks, tubing, and connecting fittings may be in the high-pressure pneumatic circuit upstream from the regulator.
- C. Pressure gauges must be placed in easily visible locations upstream and downstream of the regulator to display the “stored” and “working” pressures.
- D. If the compressor is not included on the ROBOT (under the provisions of Rule <R75>), the regulator may be located on-board or off-board, provided all other pneumatic rules are satisfied. Note that if the regulator is kept off-board the ROBOT with the compressor, then only low-pressure (60psi or less) “working” air can be stored on the ROBOT.

**<R77>** The relief valve must be attached directly to the compressor. **Teams are not allowed to adjust the 125-psi relief valve.** The valve has been calibrated prior to shipping.

- <R78> The Nason pressure switch must be connected to the high-pressure side of the pneumatic circuit (i.e. prior to the pressure regulator) to sense the “stored” pressure of the circuit. The two wires from the pressure switch must be connected directly to a digital input and ground port on the Digital Sidecar, and the cRIO-FRC must be programmed to sense the state of the switch and operate the relay module that powers the compressor to prevent over-pressuring the system.
- <R79> The Parker pressure vent plug valve must be connected to the pneumatic circuit such that, when manually operated, it will vent to the atmosphere to relieve all stored pressure. The valve must be placed on the ROBOT so that it is visible and easily accessible. If the compressor is not used on the ROBOT, then an additional vent valve must be obtained and connected to the high-pressure portion of the pneumatic circuit off board the ROBOT with the compressor (see Rule <R74>).

### 8.3.10 Operator Console

- <R80> The DRIVER STATION provided in the KOP is the only system permitted to collate driver/operator inputs and communicate them to the ROBOT. Operator Interfaces and devices from previous *FIRST* competitions shall not be used.
- <R81> The OPERATOR CONSOLE designed by the team must fit on the 60” wide by 12” deep shelf in the ALLIANCE STATION (excluding any items that are held or worn by the DRIVERS during the MATCH).
- <R82> Teams are permitted to connect a portable computing device (Laptop computer, PDAs, etc.) to the DRIVER STATION for the purpose of displaying feedback from the ROBOT while participating in competition MATCHES. Portable computing devices may only connect to the DRIVER STATION through one of the USB ports or through the First Touch I/O module (or a carrier board for the First Touch I/O module) – they shall not connect to the DRIVER STATION through any other port. Portable computing devices may only connect to the DRIVER STATION – they must not directly connect to any ARENA ports or equipment. Please note that **AC power will not be available at the PLAYERS STATIONS so these devices will have to run on internal batteries or be self-powered.**
- <R83> The Classmate PC must be positioned within the OPERATOR CONSOLE so that the screen display can be clearly seen during inspection and during operation in a MATCH. The Ethernet port on the OPERATOR CONSOLE must be easily and quickly accessible. This will greatly facilitate installation and removal of the OPERATOR CONSOLE from the ARENA, and analysis by field personnel in case of problems during the competition.
- <R84> During competition MATCHES, the ARENA Ethernet cable must connect directly to the Ethernet port on the Classmate PC (making a direct connection via a “pigtail” cable is permitted). Only the Classmate PC may connect to the competition cable – no direct connection of team-provided portable computers, PDAs, or alternate devices is permitted.
- <R85> The Classmate PC must be configured with current software images prior to a team competing in a MATCH. The Field Management System will verify that the DRIVER STATION software is correct before it will permit a ROBOT to operate on the FIELD.

- <R86> Other than the system provided by the ARENA, no other form of wireless communications shall be used to communicate to, from or within the OPERATOR CONSOLE (e.g. active wireless network cards and Bluetooth devices are not permitted in the OPERATOR CONSOLE).
- <R87> The wireless router and the E-Stop button provided in the KOP shall not be included as part of the OPERATOR CONSOLE during competition MATCHES. Competition versions of these devices are included in the ARENA, and the KOP versions are duplicative.

### 8.3.11 Robot Inspection

- <R88> At the time of inspection, the ROBOT must be presented with **all** MECHANISMS (including **all** COMPONENTS of each MECHANISM) **and configurations** that will be used on the ROBOT during the entire competition event. It is acceptable, however, for a ROBOT to play MATCHES with a **subset** of the MECHANISMS that were present during inspection. Only MECHANISMS that were present during the inspection may be added, removed or reconfigured between MATCHES. If subsets of MECHANISMS are changed between MATCHES, the reconfigured ROBOT must still meet all inspection criteria.
- <R89> At the time of inspection, teams must submit an electronic copy of their Bill Of Materials (BOM) of all items used in the construction of their ROBOT, and their associated costs, to the inspector (see Rule <R21>). BOMs must be transferred to inspectors at the event via USB drive (inspector or team provided).
- <R90> The ROBOT will be inspected for compliance with the dimension constraints specified in Rule <R10> while in its NORMAL CONFIGURATION, by being placed within a *FIRST* Sizing Device that has inside surface dimensions consistent with the rule. Other than resting on the floor of the Sizing Device, no part of the ROBOT can break the plane of the sides or top of the Sizing Device during size inspection. The ROBOT must be self-supporting while in the Sizing Device.
- <R91> All decorations must be on the ROBOT at the time of final inspection.
- <R92> Any ROBOT construction technique or element that is not in compliance with the Robot Rules (Rule <R01> through Rule <R96>) must be rectified before a ROBOT will be allowed to compete or continue competing.
- <R93> ROBOTS will normally be allowed to participate in scheduled practice MATCHES prior to passing inspection. However, the lead inspector and/or head referee may determine at any time that the ROBOT is unsafe, and may prohibit further participation in practice MATCHES until the condition is corrected and the ROBOT passes inspection.
- <R94> If a ROBOT is rejected by inspectors due to a safety issue or concern related to the team's method of storing energy (see Rule <R01>), the concerned items must be disabled or removed from the ROBOT before it can compete in a MATCH. The team bears the burden of proof that such a rejection is not valid. Teams should be prepared to provide justifiable test data or calculations during inspection to support their design.

<R95> If a ROBOT is modified after it has passed inspection, that ROBOT must be re-inspected.

If an observation is made that another team's ROBOT may be in violation of the robot rules, please approach *FIRST* officials to review the matter in question. This is an area where "Gracious Professionalism" is very important

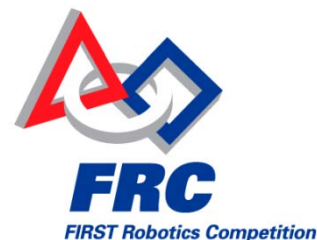
<R96> *FIRST* Officials may randomly re-inspect ROBOTS participating in competition MATCHES to assure compliance with the rules.

<R97> For the safety of all those involved, inspections must take place with the ROBOT powered off, pneumatics unpressurized, and springs or other stored energy devices in their lowest potential energy states (i.e. battery removed). Power should only be enabled on the ROBOT during those portions of the inspection process where it is absolutely required to validate certain system functionality and compliance with specific rules (firmware check, etc). Inspectors may allow the ROBOT to be powered up beyond the parameters above if both criteria below are met.

- The ROBOT design requires power or a charged stored energy device in order to confirm that the ROBOT meets volume requirements **AND**
- the team has included safety interlocks that prevent unexpected release of such stored energy.



# THE TOURNAMENT



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## 9 THE TOURNAMENT

### 9.1 OVERVIEW

Each 2010 FRC Regional or District Competition and the 2010 FRC Championship will be played in a tournament format. Each tournament will consist of three sets of matches called “practice matches,” “qualification matches,” and “elimination matches.” The purpose of the practice matches is to provide each team a chance to run its ROBOT on the playing field prior to the start of the competition matches. The purpose of the qualifying matches is to allow each team to earn a seeding position that may qualify them for participation in the elimination matches. The purpose of the elimination matches is to determine the event Champions.

### 9.2 PRACTICE ROUNDS

#### 9.2.1 Schedule

The practice rounds will be played on the first day of each competition. The practice round schedule will be available on the morning of the first day. Practice rounds will be randomly assigned with each team being assigned an equal number of rounds. At some events, additional rounds may be available on a standby basis. Each practice round will consist of two MATCHES in which teams may operate their ROBOT on the field.

- MATCH A: The first MATCH of each practice round is intended to be a somewhat “free-form” session, in which the ROBOTS may be exercised to evaluate operational characteristics, gain driver experience, determine system robustness, etc. During this MATCH robots should avoid unnecessary robot-to-robot interaction to allow all teams to evaluate their performance without interference.
- MATCH B: The MATCH of each practice round will be conducted as a “competition match” with approximately two minutes for set up, two minutes and fifteen seconds of regular game play (including operations), and one minute to clear the field.

### 9.3 QUALIFICATION MATCHES

#### 9.3.1 Schedule

The qualification matches will consist of a series of matches, with an ARENA reset between each MATCH. The qualification match schedule will be available as soon as possible, but no later than 1 hour before qualification matches are scheduled to begin.

#### 9.3.2 Match Assignment

The Field Management System will assign each team two ALLIANCE partners for each qualifying match played using a predefined algorithm. The algorithm employs the following list of criteria:

- A. Maximum time (in number of matches) between each match played for all teams
- B. Minimum possible number of times a team plays opposite any team
- C. Minimum possible number of times a team is allied with any team
- D. Minimize the use of surrogates.
- E. Even distribution of matches played on Blue and Red Alliance (without sacrificing A, B, C and D)

All teams will play the same number of qualifying matches **except** if the number of team appearances (number of teams multiplied by number of rounds) is not divisible by six; in that case the Field Management System will randomly select some teams to play an extra MATCH. For

purposes of seeding calculations, those teams will be designated as SURROGATES for the extra MATCH. If teams play a MATCH as a SURROGATE, it will be indicated on the match schedule, and it will always be their third match.

### **9.3.3 Earning Points**

At the conclusion of each MATCH, each participating TEAM will earn seeding points. Seeding points will be accumulated during the tournament, and will be totaled into the seeding score. The Field Management System will use the seeding score to continuously determine the seeding of TEAMS during the qualification matches. The ranking information will be displayed in the pit area.

### **9.3.4 Match Seeding Points**

All teams on the winning ALLIANCE will receive a number of seeding points equal to the penalized score (the score with any assessed penalties) of the winning ALLIANCE.

All teams on the losing ALLIANCE will receive a number of seeding points equal to un-penalized score (the score without any assessed penalties) of the winning ALLIANCE.

In the case of a tie, all participating teams will receive a number of seeding points equal to their ALLIANCE score (with any assessed penalties).

### **9.3.5 Coopertition™ Bonus**

All teams on the winning ALLIANCE will receive a coopertition bonus: a number of seeding points equal to twice the un-penalized score (the score without any assessed penalties) of the losing ALLIANCE.

In the case of a tie, all participating teams will receive a coopertition bonus of a number of seeding points equal to twice their ALLIANCE score (with any assessed penalties).

### **9.3.6 Seeding Point Exceptions**

A SURROGATE TEAM will receive zero seeding points and zero coopertition bonus.

A TEAM is declared a no-show if no member of the team is in the ALLIANCE ZONE at the start of the MATCH; a no-show team will receive a RED CARD for that MATCH.

During the qualification matches, TEAMS can individually receive RED CARDS. A RED CARDED TEAM will receive zero seeding points and zero coopertition bonus.

In the very unlikely case that all three TEAMS on an ALLIANCE receive RED CARDS, all three TEAMS on the winning ALLIANCE would get their own ALLIANCE score as their seeding points for that MATCH.

### **9.3.7 Seeding Score**

The total number of seeding points (Match Seeding Points plus Coopertition Bonuses) earned by a TEAM throughout their qualification matches will be their seeding score.

### **9.3.8 Highest Coopertition Bonus**

The Field Management System will keep track of the highest coopertition bonus earned by each TEAM during the qualification matches. This value will be available on the Pit Display and the

### 9.3.9 Qualification Seeding

All TEAMS in attendance will be seeded during the qualification matches. If the number of TEAMS in attendance is 'n', they will be seeded '1' through 'n', with '1' being the highest seeded team and 'n' being the lowest seeded TEAM.

The Field Management System will use the following seeding method:

- TEAMS will be seeded in decreasing order by seeding score.
- Any TEAMS having identical seeding scores will then be seeded in decreasing order by their highest coopertition bonus.
- Any TEAMS having identical seeding scores and highest coopertition bonus will then be seeded in decreasing order by cumulative ELEVATED/SUSPENDED points earned by their ALLIACES throughout the Qualification Matches.
- Any TEAMS also having identical highest coopertition bonuses will then be seeded based on a random sorting by the Field Management System.

## 9.4 ELIMINATION MATCHES

At the end of the qualification matches, the top eight seeded TEAMS will become the Alliance Leads. The top seeded ALLIANCES will be designated, in order, Alliance One, Alliance Two, etc., down to Alliance Eight. Using the alliance selection process described below, each team will choose two other teams to join their ALLIANCE.

### 9.4.1 Alliance Selection Process

Each TEAM will choose a student Team Representative who will proceed to the ARENA at the designated time (typically before the lunch break on the final day of the Competition) to represent their TEAM. The Team Representative for each Alliance Lead is called the ALLIANCE CAPTAIN.

The alliance selection process will consist of two rounds during which each ALLIANCE CAPTAIN will invite a TEAM seeded below them in the standings to join their ALLIANCE. The invited team must not already have declined an invitation.

Round 1: In descending order (Alliance One to Alliance Eight) each ALLIANCE CAPTAIN will invite a single TEAM. The invited Team Representative will step forward and either accept or decline the invitation.

If the TEAM accepts, it is moved into that ALLIANCE.

- If an invitation from a top eight ALLIANCE to another Alliance Lead is accepted, all lower Alliance Leads are promoted one spot and the next highest seeded unselected TEAM will move up to become Alliance Eight.

If the TEAM declines, that TEAM is not eligible to be picked again and the ALLIANCE CAPTAIN extends another invitation to a different TEAM.

- If an invitation from a top eight ALLIANCE to another Alliance Lead is declined, the declining TEAM may still invite teams to join their ALLIANCE, however, it cannot accept invitations from other ALLIANCES.

The process continues until Alliance Eight makes a successful invitation.

Round 2: The same method is used for each ALLIANCE CAPTAIN'S second choice except the selection order is reversed, with Alliance Eight picking first and Alliance One picking last. This process will lead to eight ALLIANCES of three TEAMS.

#### **9.4.2 Backup Teams**

Of the remaining eligible TEAMS, the highest seeded TEAMS (up to eight) shall remain on standby and be ready to play as a BACKUP TEAM. If a ROBOT from any TEAM in an elimination match becomes inoperable the ALLIANCE CAPTAIN may have the highest seeded BACKUP TEAM join the ALLIANCE. The resulting ALLIANCE would then be composed of four TEAMS, but only three TEAMS will be permitted to continue with tournament play. The replaced TEAM remains part of the ALLIANCE for awards but cannot play, even if their ROBOT is repaired.

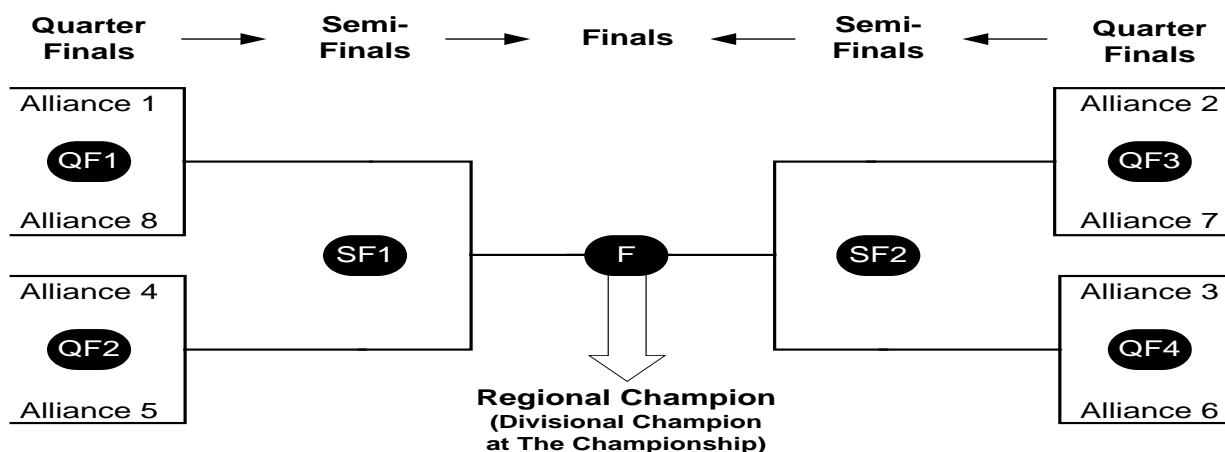
The original three-team ALLIANCE shall only have one opportunity to draw from the BACKUP TEAMS. If a second ROBOT from the ALLIANCE becomes inoperable, then the ALLIANCE must play the following matches with only two (or even one) ROBOTS. It is in the best interest of all teams to construct their ROBOTS to be as robust as possible to prevent this situation.

- Example: Three TEAMS, A, B and C, form an ALLIANCE going into the elimination matches. The highest seeded team NOT on one of the eight ALLIANCES is Team D. During one of the elimination matches, Team C's ROBOT becomes inoperable. The ALLIANCE CAPTAIN decides to bring up Team D to replace Team C. Team C and their ROBOT may not play in any subsequent elimination matches.

In the case where a BACKUP TEAM is called up onto the winning ALLIANCE, there will be a four-TEAM Champion Alliance.

### 9.4.3 Elimination Match Ladder

The elimination matches will take place on the third afternoon in a ladder format as follows:



In order to allow equal time between matches for all ALLIANCES, the order of play will be:

QF1-1, QF2-1, QF3-1, QF4-1,  
Then QF1-2, QF2-2, QF3-2, QF4-2,  
Then QF1-3\*, QF2-3\*, QF3-3\*, QF4-3\*  
Then any QF replays due to ties\*  
Then SF1-1, SF2-1, SF1-2, SF2-2, SF1-3\*, SF2-3\*  
Then any SF replays due to ties\*  
Then F-1, F-2, F-3\*  
Then any F replays due to ties\*

(\* - if required)

### 9.4.4 Elimination Scoring

In the elimination matches, TEAMS do not earn seeding points; they earn a win, loss or tie. Within each bracket of the elimination match ladder, the first ALLIANCE to win two MATCHES will advance.

## 9.5 TOURNAMENT RULES

### 9.5.1 Safety Rules

<T01> All competition attendees must wear safety glasses while in the ARENA.

<T02> Radio control mode of ROBOT operation is not permitted in areas anywhere outside the ARENA. ROBOTS must only be operated by tether when not within the ARENA.

### 9.5.2 Referee Interaction Rules

<T03> The Head Referee has the ultimate authority in the ARENA during the competition. THE HEAD REFEREE RULINGS ARE FINAL! The referee will not review recorded replays under **any** circumstances.

**<T04>** If a TEAM needs clarification on a ruling or score, a pre-college student from that team should address the Head Referee after a field reset has been signaled. Depending on timing, the Head Referee may postpone any requested discussion until the end of the subsequent MATCH.

### **9.5.3 Yellow and Red Card Rules**

- <T05>** The Head Referee may assign a YELLOW CARD as a warning of egregious ROBOT or team member behavior at the ARENA. A YELLOW CARD will be indicated by the Head Referee standing in front of the TEAM'S PLAYER STATION and holding a yellow card in the air after the completion of the MATCH. In the first MATCH that a TEAM receives a YELLOW CARD, it acts as a warning.
- <T06>** Once a TEAM receives a YELLOW CARD, its team number will be colored yellow on the audience screen at the beginning of all subsequent MATCHES as a reminder to the team, the referees, and the audience that they have been issued a YELLOW CARD.
- <T07>** A TEAM will be issued a RED CARD (disqualification) in any subsequent MATCH that they receive an additional YELLOW CARD. This will occur after the completion of the MATCH. A RED CARD will be indicated by the Head Referee standing in front of the TEAM'S PLAYER STATION and holding a yellow card and red card in the air simultaneously. The TEAM will still carry their YELLOW CARD into subsequent matches.
- <T08>** If the behavior is particularly egregious, a RED CARD may be issued without being preceded by a YELLOW CARD, at the Head Referee's discretion. The TEAM will still carry a YELLOW CARD into subsequent matches.
- <T09>** YELLOW CARDS do not carry forward between qualification matches and elimination matches. All TEAMS move into the elimination matches with a clean slate.
- <T10>** If a TEAM is disqualified during a MATCH for a reason other than receiving an additional YELLOW CARD, they will receive a RED CARD. This will occur after the completion of a MATCH and will be indicated by the Head Referee standing in front of the TEAM'S PLAYER STATION and holding a red card in the air.
- <T11>** During the qualification matches, a TEAM that receives a RED CARD will receive zero seeding points and zero coopertition bonus. The rest of the TEAMS in their ALLIANCE will still receive the earned seeding points and coopertition bonus.
- <T12>** During the elimination matches, a TEAM receiving a RED CARD will cause the disqualification of their entire ALLIANCE for that MATCH.

### **9.5.4 Field Reset Rules**

- <T13>** At the conclusion of a MATCH, all players shall remain in their assigned locations until the Head Referee issues the "field-reset" signal. Once the Head Referee issues this signal, the 3-minute "match-reset" period will begin. The ARENA must be cleared of ROBOTS from the MATCH just ended, and the ROBOTS and OPERATORS CONSOLES for the following MATCH must be placed in position and ready to start before the expiration of the "match-reset" period. Field Attendants will reset the ARENA elements during this time.
- <T14>** TEAM members must release and remove ROBOTS from the TOWERS only under the direction of a referee. Violation: YELLOW CARD.



<T15> TEAM members may not carry ROBOTS over BUMPS or the GUARDRAIL SYSTEM due to numerous safety concerns. A gate has been provided to allow entrance/egress from the MIDFIELD. *Violation: YELLOW CARD.*

At the end of a MATCH, ROBOTS may be in a potentially hazardous loading condition. TEAMS must exercise extra caution when removing ROBOTS from the FIELD.

<T16> Field power to the ROBOTS will not be re-enabled after a MATCH.

<T17> The qualification match schedule will indicate ALLIANCE partners and match pairings. It will also indicate the ALLIANCE color assignment, “red” or “blue,” for each MATCH. Before queuing for a match, the ALLIANCE members must choose which TEAM will occupy each of the three possible locations for each of the ROBOTS and HUMAN PLAYERS.

<T18> If, in the judgment of the Head Referee, an “ARENA fault” occurs that affects either the play or the outcome of the MATCH, the MATCH will be replayed. Example ARENA faults include broken field elements, power failure to a portion of the field, improper activation of the field control system, errors by field personnel, etc.

### 9.5.5 Timeout and Backup Team Rules

<T19> There are no time-outs in the qualifying rounds. If a ROBOT cannot report for a MATCH, the queuing manager must be informed and at least one member of the TEAM should report to the field for the MATCH to avoid receiving a RED CARD.

<T20> During the elimination rounds, if circumstances require an ALLIANCE to play in back-to-back MATCHES, they will be granted an additional minute of set-up time to reset and allow their ROBOTS to cool down.

<T21> In the elimination matches, each ALLIANCE will be allotted one TIMEOUT of up to 6 minutes. If an ALLIANCE wishes to call for a TIMEOUT, they must submit their TIMEOUT coupon to the Head Referee within two minutes of the Head Referee issuing the arena reset signal preceding their MATCH. When this occurs, the Time-out Clock will count down the six minutes starting with the expiration of the arena reset period. Both ALLIANCES will enjoy the complete 6-minute window. In the interest of tournament schedule, if an ALLIANCE completes their repairs before the Time-out Clock expires, the ALLIANCE CAPTAIN is encouraged to inform the Head Referee that they are ready to play and remit any time remaining in the TIMEOUT. If ALLIANCES are ready before the 6-minute window, the next MATCH will start. There are no cascading time-outs. An opposing ALLIANCE may not offer their unused TIMEOUT to their opponent.

<T22> If during a TIMEOUT an ALLIANCE CAPTAIN determines that they need to call up a BACKUP TEAM, they must submit their BACKUP TEAM coupon to the Head Referee while there is still at least two minutes remaining on the Time-out Clock. After that point, they will not be allowed to utilize the BACKUP TEAM. Alternatively, an ALLIANCE CAPTAIN may choose to call up a BACKUP TEAM without using their TIMEOUT by informing the Head Referee directly within two minutes of the Head Referee issuing the Field Reset Signal preceding their match.

<T23> In the case where the ALLIANCE CAPTAIN’S team is replaced with the BACKUP TEAM, the ALLIANCE CAPTAIN is allowed in the ALLIANCE STATION as a thirteenth ALLIANCE member so they can serve in an advisory role to their ALLIANCE.

- <T24> In any case where a HEAD REFEREE has to stop an ELIMINATION MATCH (e.g. due to ARENA fault or a safety issue), it will be replayed immediately. ALLIANCES do not have the option to request either a TIMEOUT or BACKUP TEAM. The sole exception is if the replay is due to an ARENA fault that rendered a ROBOT inoperable.
- <T25> In the case of an ELIMINATION MATCH is replayed per <T18>, the Head Referee has the option of calling a TIMEOUT without charging any TEAM with a TIMEOUT.

### 9.5.6 Special Equipment Rules

- <T26> The only equipment that may be brought on to the ARENA is the OPERATOR CONSOLE, reasonable decorative items, and special clothing and/or equipment required due to a disability. Other items, particularly those intended to provide a competitive advantage for the TEAM, are prohibited.
- <T27> Devices used solely for the purpose of planning or tracking strategy of game play are allowed inside the ALLIANCE STATION, if they meet ALL of the following conditions:
- Do not connect or attach to the OPERATOR CONSOLE
  - Do not connect or attach to the FIELD or ARENA
  - Do not connect or attach to another ALLIANCE member
  - Do not communicate with anything or anyone outside of the ARENA.
  - Do not include any form of enabled wireless electronic communication (e.g. radios, walkie-talkies, cell phones, Bluetooth communications, WiFi, etc.)
  - Do not in any way affect the outcome of a MATCH, other than by allowing team members to plan or track strategy for the purposes of communication of that strategy to other alliance members.

## 9.6 CHAMPIONSHIP ADDITIONS

For the 2010 FRC Championship, teams will be split into four divisions. Each division will play exactly like a Regional Event and produce the Division Champions. Those four ALLIANCES will then proceed to the Championship Playoffs to determine the 2010 FRC Champions.

Procedures in Sections 9.1-9.5 apply during the Championship, with the following additions:

### 9.6.1 Championship Pit Crews

During the elimination matches, extra team members are often needed to move the team ROBOT from the team's pit area to the queuing area and into the ARENA. For this reason, each team is permitted to have three (3) additional "pit crew" members who can also help with needed ROBOT repairs/maintenance. We suggest that all TEAMS assume they may be chosen for an ALLIANCE and think about the logistics of badge distribution and set a plan prior to the pairings. It is each ALLIANCE CAPTAIN'S responsibility to get the TEAM'S badges to the TEAM pit crew members.

Only TEAM members wearing proper badges are allowed on the ARENA floor. *FIRST* will distribute these badges to the ALLIANCE CAPTAINS during the ALLIANCE CAPTAIN meeting, which takes place on the division fields. These badges will provide the necessary access to the ARENA for pit crew members.

### 9.6.2 Championship Backup Teams

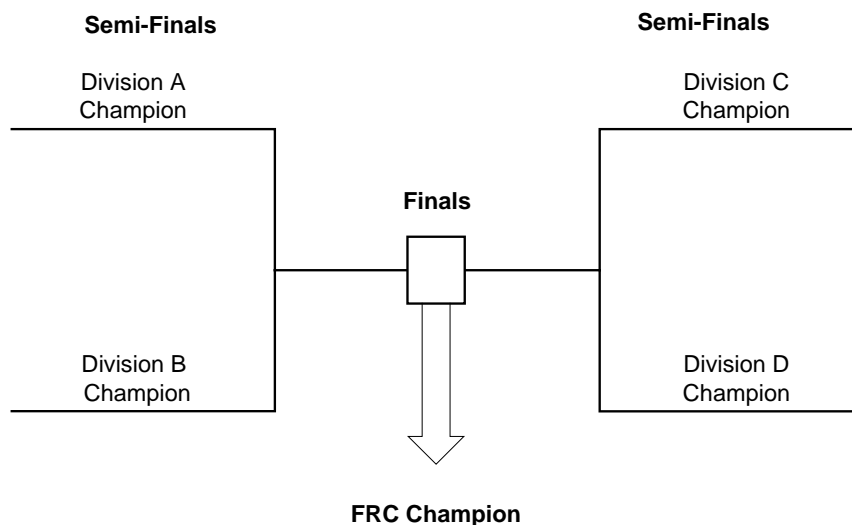
If an ALLIANCE has not previously brought in a BACKUP TEAM, and a ROBOT becomes disabled during the Championship Playoffs and can not continue, the ALLIANCE may request a BACKUP TEAM. The ALLIANCE CAPTAIN will be presented the option of having one of the three lead Division Finalist TEAMS, chosen randomly, from their division join the ALLIANCE as a BACKUP TEAM.

If an ALLIANCE has won their division with a BACKUP TEAM and moved on to the FRC Championship Playoffs, the BACKUP TEAM continues to play for the ALLIANCE in the Championship Playoffs.

As noted in Section 9.4.2, the original three-team ALLIANCE shall only have one opportunity to draw from the BACKUP TEAMS. If the ALLIANCE has brought in a BACKUP TEAM during the division elimination matches or the Championship Playoffs, they cannot bring in a second BACKUP TEAM. If a second ROBOT from the ALLIANCE becomes inoperable during the Championship Playoffs, then the ALLIANCE must play the following matches with only two (or even one) ROBOTS.

In either case, the replaced TEAM remains part of the ALLIANCE for awards but can not rejoin tournament play, even if their ROBOT is repaired. If the ALLIANCE wins the Championship Playoffs, the FRC Champions will be all three original members of the Division Champion ALLIANCE and the BACKUP TEAM.

### 9.6.3 FRC Championship Match Ladder



The FRC Championship matches will play exactly like the Semi-Finals and Finals of the elimination matches.



# THE KIT OF PARTS

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## 10. THE KIT OF PARTS

### 10.1 THE KIT OF PARTS - GENERAL

*FIRST* provides a Kit Of Parts (KOP) to each FRC team. The items listed on the *2010 Kit Of Parts Checklist* (<http://www.usfirst.org/community/frc/content.aspx?id=452>) are considered Kit Parts. Some Kit Parts may legally be used in additional quantities as described in *Section 8 The Robot* of the FRC Manual. Additional quantities of these parts are considered to be “Additional Parts” and not “Kit Parts”.

*Section 10 The Kit Of Parts* is dedicated to important information about specific kit items. For instructional tips, please refer to the *2010 FRC Recommendations* document posted on the *FIRST* website off of the manual landing page, <http://www.usfirst.org/community/frc/content.aspx?id=452>.

Some of the exciting and important additions found in the 2010 KOP include the following items:

- Redesigned Driver Station (Classmate PC, USB Hub, E-stop button, USB Restoration Key, FirstTouch I/O module, and breadboard)
- 2010 slick/stick wheel combination
- One-pitch chain links
- Custom-order Gates belting and sprockets
- Magnetic encoder set with magnets
- Java download and associated libraries
- Serial cable
- Fluke digital multimeter for Rookie teams
- Expanded Autodesk software available for download

The FRC 2010 KOP is provided in multiple containers. They consist of the following packages:

- 1 – Red large black plastic tote for pickup at Kickoff
- 1 – Blue large black plastic tote for pickup at Kickoff
- 1 – AndyMark, Inc. drive train kit for pickup at Kickoff
- 1 – Panel Signal device from Rockwell Automation for pickup at Kickoff
- 1 – Brass bag from Parker for pickup at Kickoff
- 1 – Norgren regulator for pickup at Kickoff
- 1 – Double solenoid valve from FESTO for pickup at Kickoff
- 2 – Pairs of safety gloves (1 medium, 1 large)
- 1 – Regulator/bracket set from Monnier for pickup at Kickoff
- 1 – Rookie box for pickup at Kickoff (distributed to 2010 Rookie teams only)
- 1 or 2 – Batteries box from EnerSys for pickup at Kickoff (Rookies receive 2 batteries, Veterans receive 1 battery).
- 1 – Bag & Tag set (1 per team per Bag & Tag event)

### 10.1.1 Replacement Parts Requests

Use the *2010 Kit of Parts Checklist* provided at <http://www.usfirst.org/community/frc/content.aspx?id=452> to inventory your KOP. The inventory must be completed within 48 hours of receiving the kit in order to determine that all items are present.

The first column on the checklist should be marked when the item and quantities are correct. Photos are included in the checklist in case you are not sure what a particular part looks like.

If you find that certain Kit Parts are missing or damaged, you will need to submit a "Replacement Parts Request" by 11:59pm (EST), January 13, 2010. The Replacement Parts Request link will be posted on the Team Information Management System (TIMS) after the Kickoff event. Replacement parts will be shipped only via this online request system.

The steps required to submit a Replacement Parts Request (after the kickoff) are as follows:

- Log into TIMS with your Logon ID and Password
- Click on the "Submit a Replacement Parts Request" link on right side of the Team Summary page
- Follow TIMS instructions to complete a Replacement Parts Request. Please be specific when describing the issue with the part (missing, damaged, etc).

Please remember that this is a **time limited, one-time only** opportunity to submit your Replacement Parts Request. Make sure that your request is both accurate and complete prior to pressing the "Submit Request" button. Once the request is submitted you cannot make any changes to it. Please note that the system will not allow teams to request a quantity of parts higher than the number originally sent with the kit. This system is also not to be used to order additional and/or purchased parts.

**Any kit irregularities must be reported by 11:59pm (EST),  
Wednesday, January 13, 2010 per the instructions in this document.**

Replacement Parts Requests will be processed daily and shipped during the next open shipping window. Items will be shipped to the shipping contact listed in your team's TIMS record.

For teams that have their kits shipped directly to them at their expense, you must email [frcparts@usfirst.org](mailto:frcparts@usfirst.org) within 48 hours of KOP receipt. Please be sure to include your team number, part name, description, quantity required, and description of the reason for the request (missing, damaged, etc).

### 10.1.2 Obtaining Additional or Spare Parts

Depending on what parts are left over after kitting and replacement parts shipments, FRC will provide spare parts at the Regional events. The items included in this limited group will be posted before the Event season. If your robot uses parts that are not included on this list, and there is a reasonable possibility that the part could be damaged or broken during competition, it is recommended that you bring the appropriate SPARE PARTS with you to events in accordance with *Section 8.3.5*.

If, at any event, your team needs to borrow a cRIO-FRC, Driver Station component, Power Distribution Board, Digital Sidecar, or Analog/Solenoid Breakout, additional collateral will be required and defined closer to the Event season.

Some Kit Parts will be available to teams that wish to purchase more. The resources available vary by part. Details will be published on the *FIRST* website at <http://www.usfirst.org/community/frc/content.aspx?id=452>.

## 10.2 PART INFORMATION

This section of the manual provides additional information about *some* of the parts included in your KOP. For a complete list of the 2010 KOP contents, please refer to the 2010 KOP Checklist located on the *FIRST* homepage (<http://www.usfirst.org/community/frc/content.aspx?id=452>).

### 10.2.1 Control System Components

Please refer to the FRC website for details about the components included in the 2010 FRC Control System, including the new Driver Station (<http://www.usfirst.org/roboticsprograms/frc/content.aspx?id=14532>).

Robot Radio - The Robot Radio, WGA600N, has been discontinued by the manufacturer and will likely not be available to teams as spares or replacements. *Section 8* does allow teams to use the alternate gaming adapter, the WET610N, in the competition. Please note that while permitted, the device does not have reverse polarity protection and link time is significantly longer (~1 minute).

Breakout Board mounting hardware – The hardware for use in securing the breakout boards of the cRIO modules have been packaged with the analog breakout board. Please be sure to double check the analog breakout board packaging before reporting these screws missing.

USB Restoration Key – The USB restoration key included in the KOP is for use in restoring your Classmate PC in the event it has been corrupted, etc. While the images is stored on a 4GB “thumb drive,” it is not intended to be a general use USB drive and should be used only for Classmate restoration purposes.

### 10.2.2 Drive Train kit

Please refer to the AndyMark, Inc. website for details about the C-base chassis kit included in the 2010 FRC KOP ([www.andymark.biz](http://www.andymark.biz)).

### 10.2.3 Motors

FisherPrice Motors - Unlike in the 2009 KOP, the FisherPrice motors provided in the 2010 KOP are not already assembled to the plastic gearboxes. For the motor curve, please refer to [www.usfirst.org/community/frc/content.aspx?id=482](http://www.usfirst.org/community/frc/content.aspx?id=482).

### 10.2.4 The Drive Train

Wheels - The wheels supplied in the 2010 KOP are a combination of slick and sticky treads. The slick tread material is Celcon M90, and has the following coefficients of friction on white, rippled fiberglass plastic sheet

- Inline, static: 0.06
- Inline, dynamic: 0.05
- Transverse, static: 0.14
- Transverse, dynamic: 0.10

There are no explicit prohibitions on wheels for the 2010 season, however please refer to Section 8 regarding wheel usage and rules.



## 10.2.5 Electrical Components

**Batteries** - The batteries supplied in the 2010 KOP are different from those provided in the 2009 KOP, EnerSys part number NP18-12. EnerSys NP18-12 and MK Battery ES17-12s are the only permitted batteries in the *FIRST* Robotics Competition. Please refer to *Section 8* for details on power supply.



Please remember that if you plan to ship your batteries in your crate, it's important to save the box and the rest of the packaging for transport!

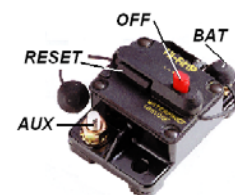
**FCI Burndy Battery terminal lugs** - FCI Burndy Products has donated two types of lugs for connecting your quick-disconnect battery connectors to your battery terminals. The mechanical lugs, PN YAZV6CTC14FX, should only be used if you have the appropriate crimp tool. Lugs with part number KPA4CUNPL are screw lugs, and no crimp tool is required. Details about these parts are posted on the *FIRST* website at <http://www.usfirst.org/roboticsprograms/frc/content.aspx?id=452>.

**Quick Disconnect Battery Connector** - Each 2010 KOP contains four quick-disconnect battery connectors. They are assembled from Delphi red and black 6 AWG wire and Anderson Power Products (APP) quick-disconnect connector, SB-50. The datasheet for the connector can be found on APP website at [www.andersonpower.com/products/multipole-sb.html](http://www.andersonpower.com/products/multipole-sb.html).



**120A Circuit Breaker** - The 120A main circuit breaker/disconnect switch functions as the Main Power **ON/OFF** switch for the robot and as a Safety current overload protection device.

To power down the robot power manually, push the Red **OFF** button on the breaker. To reset Robot Power to ON, push the **RESET** lever back into its nested position.



120 Amp CB Layout

The Positive (Red) wire on the output side of the Anderson connector should have a ¼" Ring lug crimped/soldered on and then be connected directly to the **BAT** post of the 120A main circuit breaker. Tighten the nut. Finish by fully pushing the rubber-insulating cap back down over the nut. This will assure that all power from the 12v battery now flows directly to the 120A breaker. Do not connect anything other than the 120A main circuit breaker/disconnect switch directly to the 12v battery's positive (+) terminal.

A fully charged 12Vdc battery can deliver current in excess of 200 Amps for a sustained period of time (minutes) in a short circuit situation. This amount of current can make wires smoke, melt through insulation in a fraction of a second, start a fire, cause the battery to leak highly corrosive acid or explode, and result in serious burns or other injuries. Always make sure that the 120A main circuit breaker/disconnect switch is wired in series with the 12v battery positive (+) terminal and can break the circuit when necessary.

Battery Connector Plugs - The battery plugs included in your kit are to help protect the contacts of the Anderson connectors when not in use. They can also be used to indicate the charge state of a battery.

### **10.2.6 Sensing**

Sensor Panel - The 2010 Kit of Parts contains a sensor panel including a gyro and accelerometer. For details about these devices, please reference the *2010 Sensors Manual* which will be posted on the *FIRST* website at <http://www.usfirst.org/community/frc/content.aspx?id=452>.

Optical Encoder - Details for the optical encoders found in the kit can be found on the US Digital website at <http://www.usdigital.com/products/encoders/incremental/rotary/kit/e4p/>.








Magnetic Encoder - Details for the magnetic encoders found in the kit can be found on the austriamicrosystems website at [www.austriamicrosystems.com](http://www.austriamicrosystems.com).

Axis 206 Camera - Details about the Axis 206 camera found in the kit can be found on the Axis website at [http://www.axis.com/products/cam\\_206/index.htm](http://www.axis.com/products/cam_206/index.htm).








### **10.2.7 Pneumatic Components**

Please refer to the *2010 Pneumatics Manual*, which will be posted on the *FIRST* website at <http://www.usfirst.org/community/frc/content.aspx?id=452> for details about the 2010 pneumatic kit items.

## 2010 Kit of Parts - Checklist

Container		Part Name, Description, & Number	Qty	Photo
<input type="checkbox"/>	<b>AndyMark Kit</b>  AndyMark C-Base Kit 1	Corner Connect  PN: am-0212	8	
<input type="checkbox"/>	<b>AndyMark Kit</b>  AndyMark C-Base Kit 2	Angle Bracket  PN: am-0442	2	
<input type="checkbox"/>	<b>AndyMark Kit</b>  AndyMark C-Base Kit 2	T-Brace  PN: am-0443	2	
<input type="checkbox"/>	<b>AndyMark Kit</b>  AndyMark C-Base Kit 3	3/8 x 3 1/2" hex head screw  PN: am-1122	4	
<input type="checkbox"/>	<b>AndyMark Kit</b>  AndyMark C-Base Kit 3	3/8-18 Nylock Nut  PN: am-1054	4	
<input type="checkbox"/>	<b>AndyMark Kit</b>  AndyMark C-Base Kit 3	370 x 375 Spacer  PN: am-0440	4	
<input type="checkbox"/>	<b>AndyMark Kit</b>  AndyMark C-Base Kit 3	985 x 375 Spacer  PN: am-0441	4	

## 2010 Kit of Parts - Checklist

	Container	Part Name, Description, & Number	Qty	Photo
<input type="checkbox"/>	<b>AndyMark Kit</b>  AndyMark C-Base Kit 4	1/4-20 nylock nut  <b>PN:</b> am-1015	<b>48</b>	
<input type="checkbox"/>	<b>AndyMark Kit</b>  AndyMark C-Base Kit 4	1/4-20 x 1.75 SHCS  <b>PN:</b> am-1058	<b>32</b>	
<input type="checkbox"/>	<b>AndyMark Kit</b>  AndyMark C-Base Kit 4	1/4-20 x 5/8" SHCS  <b>PN:</b> am-1053	<b>16</b>	
<input type="checkbox"/>	<b>AndyMark Kit</b>  AndyMark C-Base Kit 4	1/4" Washer  <b>PN:</b> am-1027	<b>8</b>	
<input type="checkbox"/>	<b>AndyMark Kit</b>  AndyMark Sprocket Kit	#10 screw, self-tapping  <b>PN:</b> am-1123	<b>12</b>	
<input type="checkbox"/>	<b>AndyMark Kit</b>  AndyMark Sprocket Kit	765 x 500 Spacer  <b>PN:</b> am-0452	<b>2</b>	
<input type="checkbox"/>	<b>AndyMark Kit</b>  AndyMark Sprocket Kit	S35-15DHE, output sprocket, 15-tooth #35, double sprocket  <b>PN:</b> am-0421	<b>2</b>	

<b>2010 Kit of Parts - Checklist</b>				
<b>Container</b>		<b>Part Name, Description, &amp; Number</b>	<b>Qty</b>	<b>Photo</b>
<input type="checkbox"/>	<b>AndyMark Kit</b>  AndyMark Sprocket Kit	S35-22LE, wheel sprocket, 22-tooth #35, #10 mntg holes in a 1.875" D circle, 1.1" bore  <b>PN:</b> am-0245	<b>4</b>	
<input type="checkbox"/>	<b>AndyMark Kit</b>  AndyMark Toughbox Kit 1	Output shaft  <b>PN:</b> am-0153	<b>2</b>	
<input type="checkbox"/>	<b>AndyMark Kit</b>  AndyMark Toughbox Kit 1	Small Hex Shaft 1/Toughbox x 2 Toughboxes/FRC kit = 2 total  <b>PN:</b> am-0152	<b>2</b>	
<input type="checkbox"/>	<b>AndyMark Kit</b>  AndyMark Toughbox Kit 2	CIM Gear 2/Toughbox x 2 Toughboxes/FRC kit = 4 total  <b>PN:</b> am-0034	<b>4</b>	
<input type="checkbox"/>	<b>AndyMark Kit</b>  AndyMark Toughbox Kit 2	Large Output Gear 1/Toughbox x 2 Toughboxes/FRC kit = 2 total  <b>PN:</b> am-0150	<b>2</b>	
<input type="checkbox"/>	<b>AndyMark Kit</b>  AndyMark Toughbox Kit 3	Large Cluster Gear 1/Toughbox x 2 Toughboxes/FRC kit = 2 total  <b>PN:</b> am-0149	<b>2</b>	
<input type="checkbox"/>	<b>AndyMark Kit</b>  AndyMark Toughbox Kit 3	Small Cluster Gear 1/Toughbox x 2 Toughboxes/FRC kit = 2 total  <b>PN:</b> am-0151	<b>2</b>	

## 2010 Kit of Parts - Checklist

Container		Part Name, Description, & Number	Qty	Photo
<input type="checkbox"/>	<b>AndyMark Kit</b>  AndyMark Toughbox Kit 4	1/4-20 nylock nut 4/Toughbox x 2 Toughboxes/FRC kit = 8 total  <b>PN:</b> am-1015	8	
<input type="checkbox"/>	<b>AndyMark Kit</b>  AndyMark Toughbox Kit 4	1/4-20 x 1/2 BHCS 1/Toughbox x 2 Toughboxes/FRC kit = 2 total  <b>PN:</b> am-1039	2	
<input type="checkbox"/>	<b>AndyMark Kit</b>  AndyMark Toughbox Kit 4	1/4-20 x 2" SHCS 4/Toughbox x 2 Toughboxes/FRC kit = 8 total  <b>PN:</b> am-1012	8	
<input type="checkbox"/>	<b>AndyMark Kit</b>  AndyMark Toughbox Kit 4	1/4" washer 1/Toughbox x 2 Toughboxes/FRC kit = 2 total  <b>PN:</b> am-1027	2	
<input type="checkbox"/>	<b>AndyMark Kit</b>  AndyMark Toughbox Kit 4	#10-32 x 5/8" SHCS w/ nylon 4/Toughbox x 2 Toughboxes/FRC kit = 8 total  <b>PN:</b> am-1120	8	
<input type="checkbox"/>	<b>AndyMark Kit</b>  AndyMark Toughbox Kit 5	FR6ZZ bearing 3/Toughbox x 2 Toughboxes/FRC kit = 6 total  <b>PN:</b> am-0028	6	
<input type="checkbox"/>	<b>AndyMark Kit</b>  AndyMark Toughbox Kit 5	FR8ZZ bearing 1/Toughbox x 2 Toughboxes/FRC kit = 2 total  <b>PN:</b> am-0030	2	



## 2010 Kit of Parts - Checklist








Container		Part Name, Description, & Number	Qty	Photo
<input type="checkbox"/>	<b>AndyMark Kit</b>  AndyMark Toughbox Kit 6	1/8" machine key 1/Toughbox x 2 Toughboxes/FRC kit = 2 total  <b>PN:</b> am-1043	2	
<input type="checkbox"/>	<b>AndyMark Kit</b>  AndyMark Toughbox Kit 6	#10-32 x 1/2" SHCS 2/Toughbox x 2 Toughboxes/FRC kit = 4 total  <b>PN:</b> am-1002	4	
<input type="checkbox"/>	<b>AndyMark Kit</b>  AndyMark Toughbox Kit 6	2 x 2 x 10mm key 2/Toughbox x 2 Toughboxes/FRC kit = 4 total  <b>PN:</b> am-1121	4	
<input type="checkbox"/>	<b>AndyMark Kit</b>  AndyMark Toughbox Kit 6	5/16" washer 4/Toughbox x 2 Toughboxes/FRC kit = 8 total  <b>PN:</b> am-1009	8	
<input type="checkbox"/>	<b>AndyMark Kit</b>  AndyMark Toughbox Kit 6	8mm Ring 2/Toughbox x 2 Toughboxes/FRC kit = 4 total  <b>PN:</b> am-0033	4	
<input type="checkbox"/>	<b>AndyMark Kit</b>  AndyMark Toughbox Kit 6	E-Clip 1/Toughbox x 2 Toughboxes/FRC kit = 2 total  <b>PN:</b> am-0206	2	
<input type="checkbox"/>	<b>AndyMark Kit</b>  AndyMark Toughbox Kit 6	Encoder mount 1/Toughbox x 2 Toughboxes/FRC kit = 2 total  <b>PN:</b> am-0208	2	










## 2010 Kit of Parts - Checklist

Container		Part Name, Description, & Number	Qty	Photo
<input type="checkbox"/>	AndyMark Kit  AndyMark Toughbox Kit 6	Grease pack  1/Toughbox x 2 Toughboxes/FRC kit = 2 total  PN: am-0448	2	
<input type="checkbox"/>	AndyMark Kit  Loose	C-Channel  PN: am-0202	6	
<input type="checkbox"/>	AndyMark Kit  Loose	1614ZZ, Wheel bearings  Double Shielded, ID: 0.375", OD: 1.125", Width: 0.375"  PN: am-0209	8	
<input type="checkbox"/>	AndyMark Kit  Loose	2010 FIRST wheel, plastic tread 8" Diameter, "slick"  PN: am-0494	2	
<input type="checkbox"/>	AndyMark Kit  Loose	2010 FIRST wheel, rubber tread 8" Diameter, "stick"  PN: am-0420	2	
<input type="checkbox"/>	AndyMark Kit  Loose	Battery Plug  PN: AM-0122	4	
<input type="checkbox"/>	AndyMark Kit  Loose	Extrusion cover 1/Toughbox x 2 Toughboxes/FRC kit = 2 total  PN: am-0260	2	








<b>2010 Kit of Parts - Checklist</b>				
<b>Container</b>	<b>Part Name, Description, &amp; Number</b>	<b>Qty</b>	<b>Photo</b>	
<input type="checkbox"/> <b>AndyMark Kit</b>  Loose	Wheel Bracket  PN: am-0450	4		
<input type="checkbox"/> <b>AndyMark Kit</b>  Toughbox kit	Mount Plate  PN: am-0155	2		
<input type="checkbox"/> <b>AndyMark Kit</b>  Toughbox kit	Shaft Plate  PN: am-0261	2		
<input type="checkbox"/> <b>Battery Box</b>  Loose	Battery ( <u>ROOKIE</u> ) 12 volt, 18 AH, Non-Spillable  PN: NP18-12	2		
<input type="checkbox"/> <b>Battery Box</b>  Loose	Battery ( <u>VETERAN</u> ) 12 volt, 18 AH, Non-Spillable  PN: NP18-12	1		
<input type="checkbox"/> <b>Blue Tote</b>  Breaker Bag	20Amp circuit breaker auto-reset  PN: VB3-A20-F57	5		
<input type="checkbox"/> <b>Blue Tote</b>  Breaker Bag	30Amp circuit breaker auto-reset  PN: VB3-A30-F57	2		

2010 Kit of Parts - Checklist				
Container	Part Name, Description, & Number		Qty	Photo
<input type="checkbox"/> Blue Tote Breaker Bag	40Amp circuit breaker auto-reset  PN: MX5-A40		4	
<input type="checkbox"/> Blue Tote Included w/ Analog Breakout	Breakout mounting hardware, 4-40 x 0.75" <u>These are wrapped up with the Analog Breakout Boards!</u>  PN: 92196A113		6	
<input type="checkbox"/> Blue Tote Loose	Autodesk packet Flyer  PN:		1	
<input type="checkbox"/> Blue Tote Loose	IEC Rotary Limit Switch  PN: AAP2T51Z11		2	
<input type="checkbox"/> Blue Tote Loose	Terminal blocks 12 pole w/ wire protector  PN: BM-M092CS		2	
<input type="checkbox"/> Blue Tote Loose	FirstTouch I/O Module  PN: CY8CKIT-003		1	
<input type="checkbox"/> Blue Tote Loose	Wire, 10AWG, Black 10' length  PN:		1	








2010 Kit of Parts - Checklist				
Container	Part Name, Description, & Number		Qty	Photo
<input type="checkbox"/> Blue Tote Loose	Wire, 10AWG, Red 10' length  PN:		1	
<input type="checkbox"/> Blue Tote Loose	Wire, 14AWG, Black 10' length  PN:		1	
<input type="checkbox"/> Blue Tote Loose	Wire, 14AWG, Red 10' length  PN:		1	
<input type="checkbox"/> Blue Tote Loose	Analog Breakout  PN: A003266 / am0267		1	
<input type="checkbox"/> Blue Tote Loose	Digital SideCar  PN: A003333 / am-0266		1	
<input type="checkbox"/> Blue Tote Loose	Power Distribution Board 8 40A outputs, 12 20/30A outputs, 5V, 12V, & 24V regulated outputs  PN: A003206 / am-0265		1	
<input type="checkbox"/> Blue Tote Loose	Compact Fan (Large) 12 Vdc  PN: 4212		2	

2010 Kit of Parts - Checklist				
Container	Part Name, Description, & Number		Qty	Photo
<input type="checkbox"/>	Blue Tote  Loose	Compact fan (mini) 12 Vdc  PN: 412	6	
<input type="checkbox"/>	Blue Tote  Loose	E-Stop Button  PN: am-0515	1	
<input type="checkbox"/>	Blue Tote  Loose	Terminal Lug (bag of 8) 6-14 ga solderless lug, mechanical  PN: KPA4CUNPL	1	
<input type="checkbox"/>	Blue Tote  Loose	Terminal Lugs (bag of 8) 6-14 ga solderless lug, compression, copper  PN: YAZV6CTC14FX	1	
<input type="checkbox"/>	Blue Tote  Loose	Tie wraps, 4" UNIRAP, 4", 100 ct  PN: CT18075C	1	
<input type="checkbox"/>	Blue Tote  Loose	Tie wraps, 8" UNIRAP, 8", 100 ct  PN: CT50175C	1	
<input type="checkbox"/>	Blue Tote  Loose	Pneumatic tubing (1/4 OD x 0.160 ID) x 50' length  PN: 1J-151-48P-FW	1	

## 2010 Kit of Parts - Checklist

Container		Part Name, Description, & Number	Qty	Photo
<input type="checkbox"/>	Blue Tote  Loose	Gates free parts notice Flyer  PN:	1	
<input type="checkbox"/>	Blue Tote  Loose	Teflon tape roll, 1/4" x 520'  PN:	1	
<input type="checkbox"/>	Blue Tote  Loose	Classmate PC 16G Flash, Clamshell  PN: NBC2GO89A	1	
<input type="checkbox"/>	Blue Tote  Loose	Latex Tubing 0.125" ID x 0.094" thickness x 5' L  PN:	1	
<input type="checkbox"/>	Blue Tote  Loose	Speed Controller (Jaguar) Stellaris Brushed DC motor  PN: MDL-BDC	2	
<input type="checkbox"/>	Blue Tote  Loose	Blue Tote  PN:	1	
<input type="checkbox"/>	Blue Tote  Loose	FRC Software Bundle LabVIEW for FRC, WindRiver  PN:	1	



<b>2010 Kit of Parts - Checklist</b>				
<b>Container</b>		<b>Part Name, Description, &amp; Number</b>	<b>Qty</b>	<b>Photo</b>
<input type="checkbox"/>	<b>Blue Tote</b>  Loose	2-wire jumper cable 24"  PN: 03203	5	
<input type="checkbox"/>	<b>Blue Tote</b>  Loose	Scholarship Packet 2 brochures & 2 posters  PN:	1	
<input type="checkbox"/>	<b>Blue Tote</b>  Loose	Servo Y-splitter cable 12"  PN: 788 (modified, plastic covers removed)	2	
<input type="checkbox"/>	<b>Blue Tote</b>  Loose	PTC Sticker <a href="http://www.ptc.com/go/frcregistration">http://www.ptc.com/go/frcregistration</a>  PN:	1	
<input type="checkbox"/>	<b>Blue Tote</b>  Loose	RC Extension cable 36", 22AWG wire, male/female  PN: RC-218FJ36 (mod'd, keys & covers removed)	8	
<input type="checkbox"/>	<b>Blue Tote</b>  Loose	Java Postcard Flyer  PN:	1	
<input type="checkbox"/>	<b>Blue Tote</b>  Loose	USB 4-port hub  PN: ACH63US	1	



<b>2010 Kit of Parts - Checklist</b>				
<b>Container</b>		<b>Part Name, Description, &amp; Number</b>	<b>Qty</b>	<b>Photo</b>
<input type="checkbox"/>	<b>Blue Tote</b>  Loose	Circuit Breaker 120A, Automotive style  PN: CB3-SM-120	1	
<input type="checkbox"/>	<b>Blue Tote</b>  Loose	Breadboard 2.14" x 6.5"  PN: TW-E40-1020	1	
<input type="checkbox"/>	<b>Blue Tote</b>  US Digital Bag	4-pin encoder connector 26AWG wire  PN: CA-MIC4-W4-NC-1	2	
<input type="checkbox"/>	<b>Blue Tote</b>  US Digital Bag	Encoder - Codewheel 360 CPR  PN: E4P-360-250-S4149	2	
<input type="checkbox"/>	<b>Blue Tote</b>  US Digital Bag	Encoder - Cover 360 CPR  PN: E4P-360-250-S4149	2	
<input type="checkbox"/>	<b>Blue Tote</b>  US Digital Bag	Encoder - Installation Tool 360 CPR  PN: E4P-360-250-S4149	1	
<input type="checkbox"/>	<b>Blue Tote</b>  US Digital Bag	Encoder -Base 360 CPR  PN: E4P-360-250-S4149	2	

2010 Kit of Parts - Checklist				
Container	Part Name, Description, & Number		Qty	Photo
<input type="checkbox"/>	Red Tote CablesToGo bag	standoff, male/female (for DS and DSC) 4-40, 0.187' long  PN: 219-1048	2	
<input type="checkbox"/>	Red Tote CablesToGo bag	Magnetic encoder, board  PN: AS5030	2	
<input type="checkbox"/>	Red Tote CablesToGo bag	Magnetic encoder, magnet  PN:	2	
<input type="checkbox"/>	Red Tote CablesToGo bag	DB37 Extension Cable 3ft, beige, Male/Female  PN: 02688	1	
<input type="checkbox"/>	Red Tote CablesToGo bag	Power connector, Wago 2-pole  PN: 734-102	4	
<input type="checkbox"/>	Red Tote CablesToGo bag	Sensor panel accelerometer/gyro sensor boards  PN:	1	
<input type="checkbox"/>	Red Tote CablesToGo bag	Jumper female, 2-pin shunt, black or white  PN: 68786-102LF	4	

<b>2010 Kit of Parts - Checklist</b>				
<b>Container</b>		<b>Part Name, Description, &amp; Number</b>	<b>Qty</b>	<b>Photo</b>
<input type="checkbox"/>	<b>Red Tote</b>  CablesToGo bag	FisherPrice assy hardware 12VDC w/ 16 tooth pinion, -9015 motor  PN:	4	
<input type="checkbox"/>	<b>Red Tote</b>  CablesToGo bag	Microswitch  PN: V7-2B17D8-048	2	
<input type="checkbox"/>	<b>Red Tote</b>  CablesToGo bag	Power connector, cRio female, 4 poles  PN: CTF040V8	2	
<input type="checkbox"/>	<b>Red Tote</b>  CablesToGo bag	Master Link for Chain #35 Link  PN:	4	
<input type="checkbox"/>	<b>Red Tote</b>  CablesToGo bag	One-pitch link #35 Link  PN:	4	
<input type="checkbox"/>	<b>Red Tote</b>  CablesToGo bag	Quick Disconnect, female 10-12ga, .250d, FASTON  PN: 4-520448-2	20	
<input type="checkbox"/>	<b>Red Tote</b>  CablesToGo bag	Quick Disconnect, female 16-14ga, .250d, FASTON  PN: 3-520408-2	10	





<b>2010 Kit of Parts - Checklist</b>				
<b>Container</b>		<b>Part Name, Description, &amp; Number</b>	<b>Qty</b>	<b>Photo</b>
<input type="checkbox"/>	<b>Red Tote</b>  CablesToGo bag	Quick Disconnect, male 12-10ga, .250d  PN: 4-521098-2	<b>10</b>	
<input type="checkbox"/>	<b>Red Tote</b>  igus bag	DryLin N Linear Guide System  PN: NK02-40-2-610	<b>1</b>	
<input type="checkbox"/>	<b>Red Tote</b>  igus bag	DryLin S Aluminum Shaft 24" Hard Anodized  PN: AWI-10	<b>2</b>	
<input type="checkbox"/>	<b>Red Tote</b>  igus bag	Energy Chain Cable Carrier 1 meter  PN: 05-4-038-0	<b>1</b>	
<input type="checkbox"/>	<b>Red Tote</b>  igus bag	Energy Chain Mounting Bracket Set  PN: 050-20-12	<b>1</b>	
<input type="checkbox"/>	<b>Red Tote</b>  igus bag	iglide bearing  PN: JSI-1012-08	<b>4</b>	
<input type="checkbox"/>	<b>Red Tote</b>  igus bag	iglide bearing  PN: JFI-1012-08	<b>4</b>	

## 2010 Kit of Parts - Checklist

Container		Part Name, Description, & Number	Qty	Photo
<input type="checkbox"/>	Red Tote igus bag	iglide bearing  PN: MTI-10	4	
<input type="checkbox"/>	Red Tote igus bag	iglide bearing  PN: MCI-06-02	4	
<input type="checkbox"/>	Red Tote igus bag	igubal Flange Bearing  PN: EFOI-10	2	
<input type="checkbox"/>	Red Tote igus bag	igubal Rod End Bearing  PN: EBRI-10R	2	
<input type="checkbox"/>	Red Tote Loose	Quick-Disconnect Battery Connector #6 wire pair, red & black, 12" tail  PN: 6331G1	4	
<input type="checkbox"/>	Red Tote Loose	Accumulator Volume tank, 2" bore by 6" long  PN: AVT-32-16	2	
<input type="checkbox"/>	Red Tote Loose	Wire, 6AWG, Black, 5' 5', #6 AWG, Black  PN: M3391-101	1	

2010 Kit of Parts - Checklist				
Container		Part Name, Description, & Number	Qty	Photo
<input type="checkbox"/>	Red Tote  Loose	Wire, 6AWG, Red, 5' 5', #6 AWG, Red  PN:	1	
<input type="checkbox"/>	Red Tote  Loose	Window Motor - Left 12V DC  PN: 262100-3040	2	
<input type="checkbox"/>	Red Tote  Loose	Window Motor - Right 12V DC  PN: 262100-3030	2	
<input type="checkbox"/>	Red Tote  Loose	FisherPrice Gearbox 12VDC w/ 16 tooth pinion, -9015 motor  PN:	2	
<input type="checkbox"/>	Red Tote  Loose	FisherPrice Motor 12VDC w/ 19 tooth pinion, -9015 motor  PN:	2	
<input type="checkbox"/>	Red Tote  Loose	Relay Module (Spike) 12V, 20A Max  PN: SPIKE-RELAY-H	1	
<input type="checkbox"/>	Red Tote  Loose	Lead Screw w/ nut  PN: BZ8M16 X 15"	1	









2010 Kit of Parts - Checklist				
Container	Part Name, Description, & Number		Qty	Photo
<input type="checkbox"/>	Red Tote  Loose	Serial Cable #4 screw size  PN:	1	
<input type="checkbox"/>	Red Tote  Loose	Cable Assembly, Ethernet crossover 5ft, pink  PN:	1	
<input type="checkbox"/>	Red Tote  Loose	Mabuchi motor  PN: RS555SH-2670	1	
<input type="checkbox"/>	Red Tote  Loose	Mabuchi motor  PN: RS555VC-3754	1	
<input type="checkbox"/>	Red Tote  Loose	Chain, #35, 20ft length #35, 20' length  PN:	1	
<input type="checkbox"/>	Red Tote  Loose	Pressure Switch Opens 115psi, Closes 95psi  PN: SM-2B-115R/443	1	
<input type="checkbox"/>	Red Tote  Loose	Main Regulator Mounting Kit Bracket and Nut  PN: 18-025-003	1	




2010 Kit of Parts - Checklist				
Container	Part Name, Description, & Number		Qty	Photo
<input type="checkbox"/>	Red Tote  Loose	Pressure Gauge 1/8" NPT, 0 - 160 psi  PN: 18-013-212	1	
<input type="checkbox"/>	Red Tote  Loose	Relief Valve 120 psi relief valve  PN: 16-004-011	1	
<input type="checkbox"/>	Red Tote  Loose	Coupler, Denso motor black, injection molded plastic, 6 tooth  PN: Denso-6	4	
<input type="checkbox"/>	Red Tote  Loose	Restoration Key (USB) 4GB SanDisk Cruiser preloaded w/ 2010 Classmate image  PN: SDCZ6-4096-A11	1	
<input type="checkbox"/>	Red Tote  Loose	Cable Assembly, Ethernet 2ft, gray  PN: 219241-2	1	
<input type="checkbox"/>	Red Tote  Loose	Wire, 18AWG, Black 5' length  PN:	1	
<input type="checkbox"/>	Red Tote  Loose	Wire, 18AWG, Red 5' length  PN:	1	

## 2010 Kit of Parts - Checklist

Container		Part Name, Description, & Number	Qty	Photo
<input type="checkbox"/>	Red Tote  Loose	2.5" CIM Motor 12V DC, 2.5" diameter  PN: FR801-001	2	
<input type="checkbox"/>	Red Tote  N/A	Red Tote  PN:	1	
<input type="checkbox"/>	Rookie Kit  Camera Bracket Kit	Axis Case  PN: MI-00016	1	
<input type="checkbox"/>	Rookie Kit  Camera Bracket Kit	Base  PN: MI-00015	1	
<input type="checkbox"/>	Rookie Kit  Camera Bracket Kit	Pan Plate  PN: MI-00013	1	
<input type="checkbox"/>	Rookie Kit  Camera Bracket Kit	Servo Brace  PN: MI-00014	1	
<input type="checkbox"/>	Rookie Kit  cRIO kit	Analog Input Module 8 analog inputs, $\pm 10$ V input range, 500 kS/s aggregate sampling rate, 12-bit resolution  PN: 9201	2	

## 2010 Kit of Parts - Checklist








Container	Part Name, Description, & Number	Qty	Photo
<input type="checkbox"/> Rookie Kit cRIO Kit	compactRIO  PN: cRIO-FRC	1	
<input type="checkbox"/> Rookie Kit cRIO Kit	Digital I/O Module 32-channel digital I/O, 5 V/TTL, sinking/sourcing digital I/O, 1000 Vrms transient isolation, $\pm 30$ V  PN: 9403	2	
<input type="checkbox"/> Rookie Kit cRIO Kit	Digital Sourcing Module 8-channel, 100 $\mu$ s digital output, 6 to 30 V range, sourcing digital output  PN: 9472	1	
<input type="checkbox"/> Rookie Kit Loose	Camera, Axis 206 206 color camera, MJPEG, 16MB RAM, 4MB Flash, 4mm lens, F2.0  PN: 288635	1	
<input type="checkbox"/> Rookie Kit Loose	Battery Charger 12V, 6Amp automatic  PN: SC-600A	1	
<input type="checkbox"/> Rookie Kit Loose	DB37 Extension Cable 3ft, beige, Male/Female  PN: 02688	1	
<input type="checkbox"/> Rookie Kit Loose	Analog Breakout  PN: A003266 / am-0267	1	

<b>2010 Kit of Parts - Checklist</b>				
<b>Container</b>		<b>Part Name, Description, &amp; Number</b>	<b>Qty</b>	<b>Photo</b>
<input type="checkbox"/>	<b>Rookie Kit</b>  Loose	Digital SideCar  PN: A003333 / am-0266	1	
<input type="checkbox"/>	<b>Rookie Kit</b>  Loose	Solenoid Breakout  PN: A003265 / am-0268	1	
<input type="checkbox"/>	<b>Rookie Kit</b>  Loose	CD - Basic Electronic Measurement  PN:	1	
<input type="checkbox"/>	<b>Rookie Kit</b>  Loose	Digital Multimeter  PN: 2100135D	1	
<input type="checkbox"/>	<b>Rookie Kit</b>  Loose	Air Compressor 12VDC  PN: 405ADC38/12	1	
<input type="checkbox"/>	<b>Rookie Kit</b>  Loose	Servo 42 oz./in. peak torque, 0.19 sec./60°  PN: HS-322HD	2	
<input type="checkbox"/>	<b>Rookie Kit</b>  Loose	Relay Module (Spike) 12V, 20A Max  PN: SPIKE-RELAY-H	1	








<b>2010 Kit of Parts - Checklist</b>				
<b>Container</b>		<b>Part Name, Description, &amp; Number</b>	<b>Qty</b>	<b>Photo</b>
<input type="checkbox"/>	<b>Rookie Kit</b>  Loose	Speed Controller (Victor 884) VICTOR-884-12-12  PN: FR-VIC884	1	
<input type="checkbox"/>	<b>Rookie Kit</b>  Loose	Radio, Driver Station WRT160N  PN: WRT160N	1	
<input type="checkbox"/>	<b>Rookie Kit</b>  Loose	Speed Controller (Jaguar) Stellaris Brushed DC motor  PN: MDL-BDC	2	
<input type="checkbox"/>	<b>Rookie Kit</b>  Loose	NI Rookie packet #4 screw size  PN:	1	
<input type="checkbox"/>	<b>Rookie Kit</b>  Loose	Joystick, Attack 3 11 programmable buttons, USB, symmetrical handle  PN: 963291-0403	2	
<input type="checkbox"/>	<b>Rookie Kit</b>  Loose	Radio, Robot Dual-Band Wireless-N Gaming Adapter (includes adapter, ethernet cable, etc)  PN: WGA600N	1	
<input type="checkbox"/>	<b>Rookie Kit</b>  Rookie Hardware	standoff, male/female (for DS and DSC) 4-40, 0.187' long  PN: 219-1048	2	





<b>2010 Kit of Parts - Checklist</b>				
<b>Container</b>		<b>Part Name, Description, &amp; Number</b>	<b>Qty</b>	<b>Photo</b>
<input type="checkbox"/>	<b>Rookie Kit</b>  Rookie Hardware	Power connector, Wago 2-pole  <b>PN: 734-102</b>	<b>2</b>	
<input type="checkbox"/>	<b>Rookie Kit</b>  Rookie Hardware	Nut, bracket assembly 4-40, keps  <b>PN: 1137403</b>	<b>16</b>	
<input type="checkbox"/>	<b>Rookie Kit</b>  Rookie Hardware	Nut, camera pivot 8-32, nylock  <b>PN: 1170856</b>	<b>1</b>	
<input type="checkbox"/>	<b>Rookie Kit</b>  Rookie Hardware	Screw, camera pivot 8-32, 3/8"  <b>PN: 1172396</b>	<b>1</b>	
<input type="checkbox"/>	<b>Rookie Kit</b>  Rookie Hardware	Screw, hex, servo mount 4-40, 1/2", low profile  <b>PN: 0170662</b>	<b>4</b>	
<input type="checkbox"/>	<b>Rookie Kit</b>  Rookie Hardware	Screw, horn/bracket assembly 4-40, 3/8"  <b>PN: 1172482</b>	<b>8</b>	
<input type="checkbox"/>	<b>Rookie Kit</b>  Rookie Hardware	Screw, servo mounting 4-40, 3/4"  <b>PN: 1128667</b>	<b>4</b>	



<b>2010 Kit of Parts - Checklist</b>				
<b>Container</b>	<b>Part Name, Description, &amp; Number</b>		<b>Qty</b>	<b>Photo</b>
<input type="checkbox"/>	<b>Rookie Kit</b>  Rookie Hardware	Nylon spacer 1/4"  PN: 252805	<b>4</b>	
<input type="checkbox"/>	<b>Rookie Kit</b>  Rookie Hardware	spring lock washer #4 screw size  PN: 91102A720	<b>4</b>	
<input type="checkbox"/>	<b>Separate</b>	Double solenoid valve 24V DC solenoid double valve  PN: VUVG-L10-B52-T-M5-1P3-566458	<b>1</b>	
<input type="checkbox"/>	<b>Separate</b>	Gloves, pair, Large Leather Palm, Suede Cowhide, Cotton Back, Straight Thumb, Elastic Wrist, Rubberized Cuff  PN: 2AL54	<b>1</b>	
<input type="checkbox"/>	<b>Separate</b>	Gloves, pair, Medium Leather Palm, Suede Cowhide, Cotton Back, Straight Thumb, Elastic Wrist, Rubberized Cuff  PN: 2BC74	<b>1</b>	
<input type="checkbox"/>	<b>Separate</b>	Secondary Regulator  PN: 101-3002-1	<b>1</b>	
<input type="checkbox"/>	<b>Separate</b>	Secondary Regulator Bracket Mounting bracket  PN: 13536	<b>1</b>	



2010 Kit of Parts - Checklist				
Container	Part Name, Description, & Number		Qty	Photo
<input type="checkbox"/>	Separate	Main Regulator, adjustable  PN: R07-100-RNEA	1	
<input type="checkbox"/>	Separate	Brass bag  PN: PKT12326	1	
<input type="checkbox"/>	Separate	Panel signal device 12V Light  PN: 855PB-B12ME522	1	
<input type="checkbox"/>	Virtual	Altium Designer The 12-month license from Altium Designer, is available at <a href="http://www.altium.com/frc2010/">http://www.altium.com/frc2010/</a>  PN:	1	
<input type="checkbox"/>	Virtual  N/A	Autodesk Software Tools <a href="http://www.autodesk.com/first">www.autodesk.com/first</a>  PN:	1	
<input type="checkbox"/>	Virtual  N/A	Bimba Cylinders - custom order The order form for the cylinders/rotary actuators is at <a href="http://www.bimba.com">www.bimba.com</a> .  PN:	3	
<input type="checkbox"/>	Virtual  N/A	Gates belting - custom order Gates will provide up to 3 belts per team. The order form is available at <a href="http://www.gates.com/FIRST">www.gates.com/FIRST</a>  PN:	1	

<b>2010 Kit of Parts - Checklist</b>				
<b>Container</b>		<b>Part Name, Description, &amp; Number</b>	<b>Qty</b>	<b>Photo</b>
<input type="checkbox"/>	<b>Virtual</b>  N/A	Gates sprockets - custom order  Gates will provide up to 4 sprockets & 1 idler assembly. Order online at <a href="http://www.gates.com/FIRST">www.gates.com/FIRST</a>  PN:	1	
<input type="checkbox"/>	<b>Virtual</b>  N/A	Mathcad  <a href="http://www.ptc.com/go/frcregistration">http://www.ptc.com/go/frcregistration</a>  PN:	1	
<input type="checkbox"/>	<b>Virtual</b>  N/A	Pro/ENGINEER  <a href="http://www.ptc.com/go/frcregistration">http://www.ptc.com/go/frcregistration</a> (for creating CAD models)  PN:	1	
<input type="checkbox"/>	<b>Virtual</b>  N/A	ProductView  <a href="http://www.ptc.com/go/frcregistrationfor">http://www.ptc.com/go/frcregistrationfor</a> (visualizing your robot design)  PN:	1	
<input type="checkbox"/>	<b>Virtual</b>  N/A	Windchill  <a href="http://www.ptc.com/go/frcregistration">http://www.ptc.com/go/frcregistration</a> (for team collaboration)  PN:	1	