

# 1 INTRODUCTION

## 1.1 About *FIRST*®

*FIRST*® (For Inspiration and Recognition of Science and Technology) was founded by inventor Dean Kamen to inspire young people's interest in science and technology. As a robotics community that prepares young people for the future, *FIRST* is the world's leading youth-serving nonprofit advancing STEM education. For 30 years, *FIRST* has combined the rigor of STEM learning with the fun and excitement of traditional sports and the inspiration that comes from community through programs that have a proven impact on learning, interest, and skill-building inside and outside of the classroom. *FIRST* provides programs that span a variety of age groups:

- *FIRST*® Robotics Competition for grades 9-12, ages 14-18
- *FIRST*® Tech Challenge for grades 7-12, ages 12-18
- *FIRST*® LEGO® League for grades Pre-K-8, ages 4-16
  - *FIRST*® LEGO® League Challenge for grades 4-8 (ages 9-16, ages vary by country)
  - *FIRST*® LEGO® League Explore for grades 2-4 (ages 6-10)
  - *FIRST*® LEGO® League Discover for grades Pre-K-1 (ages 4-6)

Please visit [the \*FIRST\* website](https://www.firstrobotics.org) for more information about *FIRST* and its programs.

## 1.2 In Memoriam

In October 2019, Dr. Woodie Flowers, an innovator in design and engineering education and a Distinguished Advisor to *FIRST* and supporter of our mission, passed away. As thousands of heartfelt tributes to Woodie have poured in from around the world, it is clear his legacy will live on indefinitely through the gracious nature of our community and our ongoing commitment to empowering educators and building global citizens.

Figure 1-1 Dr. Woodie Flowers, 1943-2019



## 1.3 *FIRST*® Robotics Competition

*FIRST*® Robotics Competition combines the excitement of sport with the rigors of science and technology. Teams of students are challenged to design, build, and program industrial-size robots and compete for awards, while they also create a team identity, raise funds, hone teamwork skills, and advance respect and appreciation for STEM within the local community.

Volunteer professional mentors lend their time and talents to guide each team. It's as close to real-world engineering as a student can get. Plus, high school students gain access to exclusive scholarship opportunities from colleges, universities, and technical programs.

Each January at an event known as "Kickoff," a new, challenging game is introduced. These exciting competitions combine the practical application of science and technology with the fun, intense energy, and excitement of a championship-style sporting event. Teams are encouraged to display *Gracious Professionalism*®, help other teams, and cooperate while competing. This is known as *Coopertition*®.

In 2022, *FIRST* Robotics Competition is projected to reach between 55,000 and 81,000 high-school students representing approximately 3,200 teams. Teams come from nearly every state in the United States, as well as many other countries.

*FIRST* Robotics Competition teams will participate in 59 Regional Competitions, 106 District Competitions, and 11 District Championships. In addition, approximately 450 teams will qualify to attend the *FIRST* Championship in April 2022.

This year's game, and this manual, were presented at the 2022 *FIRST* Robotics Competition Kickoff on Saturday, January 8, 2022.

At the Kickoff, all teams:

- saw the 2022 game, RAPID REACT<sup>SM</sup> presented by The Boeing Company, for the first time,
- learned about the 2022 game rules and regulations, and

Safety is always paramount, and many rules are intended to establish norms at each event that will mitigate injury risk to all participants.

Event staff have the final decision authority for all safety-related issues within a venue.

Please refer to [FIRST Robotics Competition District and Regional Event web page](#) for safety, conduct, etc. rules not specific to RAPID REACT or limited to MATCH play. As with all violations in this document, any event rules also carry the potential consequence of a YELLOW or RED CARD.

- received a Kickoff Kit that provides a starting point for ROBOT build.

## 1.4 *Gracious Professionalism*®, a *FIRST* Credo

*Gracious Professionalism*® is part of the ethos of *FIRST*. It's a way of doing things that encourages high quality work, emphasizes the value of others, and respects individuals and the community.

*Gracious Professionalism* is not clearly defined for a reason. It can and should mean different things to everyone.

Some possible meanings of *Gracious Professionalism* include:

- 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, and
- gracious professionals make a valued contribution in a manner pleasing to others and to themselves.

In the context of *FIRST*, this means that all teams and participants should:

- learn to be strong competitors, but also treat one another with respect and kindness in the process and
- avoid leaving anyone feeling as if they are excluded or unappreciated.

Knowledge, pride, and empathy should be comfortably and genuinely blended.

In the end, *Gracious Professionalism* is part of pursuing a meaningful life. When professionals use knowledge in a gracious manner and individuals act with integrity and sensitivity, everyone wins and society benefits.



*The FIRST spirit encourages doing high-quality, well-informed work in a manner that leaves everyone feeling valued. Gracious Professionalism seems to be a good descriptor for part of the ethos of FIRST. It is part of what makes FIRST different and wonderful.*

- Dr. Woodie Flowers, (1943 – 2019)  
Distinguished Advisor to FIRST

It is a good idea to spend time going over this concept with your team and reinforcing it regularly. We recommend providing your team with real-life examples of *Gracious Professionalism* in practice, such as when a team loans valuable materials or expertise to another team that they will later face as an opponent in competition. Routinely highlight opportunities to display *Gracious Professionalism* at events and encourage team members to suggest ways in which they can demonstrate this quality themselves and through outreach activities.

## 1.5 Coopertition®

At FIRST, *Coopertition*® is displaying unqualified kindness and respect in the face of fierce competition. *Coopertition* is founded on the concept and philosophy that teams can and should help and cooperate with one another even as they compete. *Coopertition* involves learning from teammates and mentors. *Coopertition* means competing always but assisting and enabling others when you can.

### Message from Woodie Flowers Award Recipients

*The Woodie Flowers Award is the most prestigious mentoring award in FIRST. The award recipients created an important message for all FIRST Robotics Competition teams to consider as we tackle each season.*

*Performing at your best is important. Winning is important. This is a competition.*

*However, winning with Gracious Professionalism and being proud of what you have accomplished and how you have accomplished it is more important. FIRST could create rules and penalties to cover almost any scenario or situation, but we prefer an understandable game with simpler rules that allow us to think and be creative in our designs.*

*We want to know that our partners and opponents are playing at their best in every match. We want to know they are playing with integrity and not using strategies based on questionable behaviors.*

*As you create your robots and award presentations, prepare for competition and MATCH play, create and implement game strategies, and live your daily lives, remember what Woodie said time and time again, and let's 'Make your Grandmother proud.'*

Woodie Flowers	Paul Copioli (3310, 217)	Lane Matheson (932)
Liz Calef (88)		Mark Lawrence (1816)
Mike Bastoni (23)	Rob Mainieri (812, 64, 498, 2735, 6833)	Eric Stokely (258, 360, 2557, & 5295)
Ken Patton (51, 65)	Dan Green (111)	Glenn Lee (359)
Kyle Hughes (27)	Mark Breadner (188)	Gail Drake (1885)
Bill Beatty (71)	John Novak (16, 323)	Allen Gregory (3847)
Dave Verbrugge (5110, 67)	Chris Fultz (234)	Lucien Junkin (118)
Andy Baker (3940, 45)	John Larock (365)	Matt Fagen (4253)
Dave Kelso (131)	Earl Scime (2614)	
	Fredi Lajvardi (842)	

## 1.6 Spirit of Volunteering

### **2022 Season Spirit of Volunteering: A Message from the Chief Volunteers to the FIRST Community**

*We know 2020 didn't go as planned and 2021 was a year unlike any other for the FIRST Community. The 2022 season is shaping up to be another non-traditional year. With that in mind, we think it's more important than ever to recognize the two phrases which drive and motivate the individuals that volunteer their time for FIRST: "Giving Back" and "Pay It Forward". This year will be a year where you can help create the best-ever experience for our mentors, coaches, students, and fellow volunteers.*

*Volunteering has enormous, lifelong impacts for everyone involved. Every student, teacher, event volunteer, mentor, coach, and family member learns and grows throughout the season as they interact with each other – via both in-person as well as virtual interactions. There are tremendous growth opportunities for all!*

*To our team members and mentors: Whether you are attending events remotely or hopefully in-person, remember that the volunteers you interact with are giving up their most precious asset - their time - to ensure that all teams have a fulfilling, fun, and memorable competition. Volunteers are the lifeblood of FIRST and without them, FIRST would not be where it is today. We encourage you to remember that Gracious Professionalism is part of the ethos of FIRST. It's a way of doing things that encourages high-quality work, emphasizes the value of others, and respects individuals and the community.*

*To our loyal volunteers – and everyone else that is considering volunteering - we want to encourage you to join us in whatever capacity that you can for the 2022 season. There's a lot to gain from volunteering and part of what makes it so much fun is:*

- *Seeing capable students learning and growing*
- *Making new friends with other awesome volunteers*
- *Being a part of the magic that makes an event happen*
- *Sharing FIRST with folks who didn't know about it*

- *Taking event experiences back to your team*
- *Learning how to communicate with people outside of your normal circle*

*Just as with so many other circumstances and situations in our lives these last couple of years, volunteering for FIRST Robotics Competition in 2022 will probably look a little different. We know a day will come when we will put this virus behind us. And we know that together, we will adapt, stay connected, engage our teams, and continue to move #FIRSTFORWARD.*

*To our FIRST alumni – We need you! You know the impact of FIRST in your life and the opportunity you’ve been given. We’re asking you to pay it forward and help the next generation have the same opportunity. The FIRST website has great resources for finding out how you can get involved by giving a few hours or more!*

*We look forward to welcoming you!*

*Chief Referees – Aidan Browne & Jon Zawislak*

*Chief Judge Advisors – Cindy Stong & Allen Bancroft*

*Chief Volunteer Coordinators – Laurie Shimizu & Sarah Plemmons*

*Chief Robot Inspectors – Al Skierkiewicz & Chuck Dickerson*

*Chief Field Supervisors – Scott Goering & Ayla DeLaat*

## 1.7 This Document & Its Conventions

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The *2022 Game Manual* is a resource for all FIRST Robotics Competition teams for information specific to the 2022 season and the RAPID REACT game. Its audience will find the following detail:

- a general overview of the RAPID REACT game,
- detail about the RAPID REACT playing FIELD,
- a description of how to play the RAPID REACT game,
- game rules (related to safety, conduct, game play, inspection, etc.), and
- a description of how teams advance at 2022 tournaments and throughout the season

All participants should also study the [Event Rules Manual](#) as it details event rules and expectations that perpetuate from season to season. That content complements, and carries the same weight as, this document.

The intent of this manual is that the text means exactly, and only, what it says. Please avoid interpreting the text based on assumptions about intent, implementation of past rules, or how a situation might be in “real life.” There are no hidden requirements or restrictions. If you’ve read everything, you know everything.

Specific methods are used throughout this manual to highlight warnings, cautions, key words, and phrases. These conventions are used to alert the reader to important information and are intended help teams in constructing a ROBOT that complies with the rules in a safe manner.

Links to other section headings in this manual and external articles appear in [blue underlined text](#). All rule references are also hyperlinks to the rule even though they do not appear as blue underlined text.

Key words that have a particular meaning within the context of the FIRST Robotics Competition and RAPID REACT are defined in the [Section 12 Glossary](#) section and indicated in ALL CAPS throughout this document.

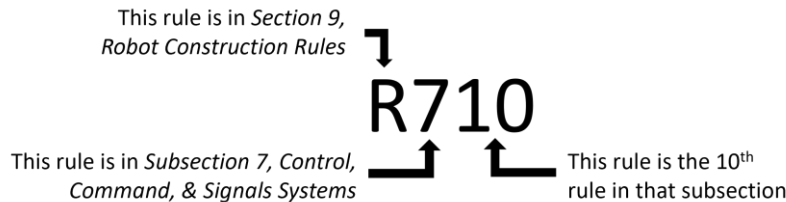
The rule numbering method indicates the section, subsection, and position of the rule within that subsection. The letter indicates the section in which the rule is published.



- G for [Section 7 Game Rules: ROBOTS](#)
- H for [Section 8 Game Rules: Humans](#)
- R for [Section 9 ROBOT Construction Rules](#)
- I for [Section 10 Inspection and Eligibility Rules](#)
- T for [Section 11 Tournaments](#)

The following digit(s) represents the subsection in which the rule can be found. The final digits indicate the rule's position within that subsection.

Figure 1-2 Rule numbering method



Warnings, cautions, and notes appear in blue boxes. Pay close attention to their contents as they're intended to provide insight into the reasoning behind a rule, helpful information on understanding or interpreting a rule, and/or possible "best practices" for use when implementing systems affected by a rule.

While blue boxes are part of the manual, they do not carry the weight of the actual rule (if there is an inadvertent conflict between a rule and its blue box, the rule supersedes the language in the blue box).

Imperial dimensions are followed by comparable metric dimensions in parentheses to provide metric users with the approximate size, weight, etc. Metric conversions for non-rules (e.g. dimensions) round to the nearest whole unit, e.g. "17 in. (~43 cm)" and "6 ft. 4 in. (~193 cm)." Metric conversions in rules round such that the metric dimension is compliant with the rule (i.e. maximums round down, minimums round up). The metric conversions are offered for convenient reference only and do not overrule or take the place of the imperial dimensions presented in this manual and the official drawings (i.e., dimensions and rules will always defer to measurements using imperial units).

Rules include colloquial language, also called headlines, in an effort to convey an abbreviated intent of the rule or rule set. There are two versions of headline formatting. Evergreen rules, or rules which are expected to go relatively unchanged from season to season, are indicated with a leading asterisk and their rule number and headline are presented in **bold green text**. "Relatively unchanged" means that the overall intent and presence of the rule from season to season is constant, but game specific terms may be updated as needed (e.g. changing Power Cells to CARGO in a rule about what COACHES may not contact during a MATCH). These rules also start their respective section, so their rule number is not expected to change from season to season. All other rule headlines use **bold blue text**. Any disagreement between the specific language used in the rules and the colloquial language is an error, and the specific rule language is the ultimate authority. If you discover a disparity, please let us know at [firstroboticscompetition@firstinspires.org](mailto:firstroboticscompetition@firstinspires.org) and we will correct it.

Team resources that aren't generally season specific (e.g., what to expect at an event, communication resources, team organization recommendations, ROBOT transportation procedures, and award descriptions) can be found on the [FIRST Robotics Competition website](#).

## 1.8 Translations & Other Versions

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The RAPID REACT manual is originally and officially written in English and is occasionally translated into other languages for the benefit of *FIRST* Robotics Competition teams whose native language may not be English.

A text-based English version can be provided only for use with assistive devices and not for redistribution. For more information, please contact the *FIRST* Robotics Competition Team Experience Specialist at [frcteamadvocate@firstinspires.org](mailto:frcteamadvocate@firstinspires.org).

In the event that a rule or description is modified in an alternate version of this manual, the English pdf version as published on the [RAPID REACT - Season Materials web page](#) is the commanding version.

## 1.9 Team Updates

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Team Updates are used to notify the *FIRST* Robotics Competition community of revisions to the official season documentation (e.g. the manual, drawings, etc.) or important season news. Team Update posts are scheduled as follows:

- each Tuesday and Friday, starting on the first Tuesday after Kickoff and ending on the Tuesday prior to Week 1 events
- each Tuesday, starting Week 1 and ending the week of the final District Championship events.

Team Updates are posted on the [RAPID REACT - Season Materials web page](#) and are generally posted before 5 pm, Eastern.

Generally, Team Updates follow the following convention:

- Additions are highlighted in yellow. **This is an example.**
- Deletions are indicated with a strikethrough. ~~This is an example.~~

## 1.10 Question and Answer System

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The [Question and Answer System](#) (Q&A) is a resource for clarifying the [2022 RAPID REACT Game Manual](#), [Awards webpages](#), [official FIELD drawings](#), and/or [FIRST Robotics Competition District and Regional Events web page](#) content. Teams can search for previously asked questions and responses or pose new questions. Questions can include examples for clarity or reference multiple rules to understand the relationships and differences between them.

The Q&A opens on January 12, 2022, 12:00 PM Eastern. Details on the Q&A can be found on the [RAPID REACT - Season Materials web page](#). The Q&A may result in revisions to the text in the official manuals (which are communicated using the process described in [Section 1.9 Team Updates](#)).

The responses in the Q&A do not supersede the text in the manual, although every effort will be made to eliminate inconsistencies between the two. While responses provided in the Q&A may be used to aid discussion at each event, per [Section 10 Inspection & Eligibility Rules](#) and [Section 11.2 REFEREE Interaction](#), REFEREES and INSPECTORS are the ultimate authority on rules. If you have concerns about enforcement trends by volunteer authorities, please notify *FIRST* at [firstroboticscompetition@firstinspires.org](mailto:firstroboticscompetition@firstinspires.org).

The Q&A is not a resource for firm predictions on how a situation will play out an event. Questions about the following will not be addressed:

- rulings on vague situations,
- challenging decisions made at past events, or
- design reviews of a ROBOT system for legality.

Weak questions are overly broad, vague, and/or include no rule references. Some examples of questions that will not be answered in the Q&A are:

- Is this part/design legal?
- How should the REFEREE have ruled when this specific game play happened?
- Duplicate questions
- Nonsense questions

Good questions ask generically about features of parts or designs, gameplay scenarios, or rules, and often reference one or more relevant rules within the question. Some examples of questions that will likely be answered in the Q&A are:

- A device we are considering using on the ROBOT comes with purple AWG 40 wire, does this comply with R?? and R??
- We're not sure how to interpret how Rule G?? applies if blue ROBOT A does X and red ROBOT B does Y, can you please clarify?
- If a ROBOT does this specific action, is it doing what this defined term is describing?

Questions from "FRC 99999" represent content asked by key volunteers (e.g., REFEREES, INSPECTORS, etc.), answered by *FIRST*, and are considered relevant to teams.

