

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.firstinspires.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 2024, *FIRST* Robotics Competition is projected to reach approximately 90,000 high-school students representing approximately 3,600 teams. Teams come from nearly every state in the United States, as well as many other countries.

FIRST Robotics Competition teams will participate in 61 Regional Competitions, 97 District Competitions, and 11 District Championships. In addition, approximately 600 teams will qualify to attend the *FIRST* Championship in April 2024.

This year's game, and this manual, were presented at the 2024 *FIRST* Robotics Competition Kickoff on Saturday, January 6, 2024.

At the Kickoff, all teams:

- saw the 2024 game, *CRESCENDO*SM presented by Haas, for the first time,
- learned about the 2024 game rules and regulations, and
- received a set of game specific materials.

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.

Figure 1-2 Dr. Woodie Flowers, Gracious Professionalism advocate and exemplar



“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
Liz Calef (88)
Mike Bastoni (23)
Ken Patton (51, 65)
Kyle Hughes (27)
Bill Beatty (71)
Dave Verbrugge (5110,
67)
Andy Baker (3940, 45)
Dave Kelso (131)
Paul Copioli (3310, 217)

Rob Mainieri (812, 64, 498,
2735, 6833)
Dan Green (111)
Mark Breadner (188)
John Novak (16, 323)
Chris Fultz (234)
John Larock (365)
Earl Scime (2614)
Fred Lajvardi (842)
Lane Matheson (932)
Mark Lawrence (1816)

Eric Stokely (258, 360,
2557, & 5295)
Glenn Lee (359)
Gail Drake (1885)
Allen Gregory (3847)
Lucien Junkin (118)
Matt Fagen (4253)
Christine Sapio (2486)
Mark Buckner (4265)

1.6 Spirit of Volunteering

Message from the Chief Volunteers

There are two phrases which drive and motivate the individuals that volunteer their time for FIRST: "Giving Back" and "Pay It Forward." Each year, you have the extraordinary opportunity to help create the best-ever experience for our fellow volunteers, mentors, coaches, and students by becoming a FIRST volunteer.

Why Volunteer?

Witness capable students learning and growing

Forge meaningful friendships with other awesome volunteers

Be part of the magic that brings events to life

Share the wonders of FIRST with those who are yet to discover it

Bring invaluable event experiences back to your team

Hone your communication skills beyond your usual circles

For Our Alumni

To our FIRST alumni: We need you! You know the profound impact of FIRST in your life and the opportunities it has provided. We're asking you to "Give Back" and help the next generation experience the same life-changing opportunities. The FIRST website has [great resources](#) for finding out how you can get involved by giving a few hours or more!

Remember Gracious Professionalism

To our team members and mentors: remember that the volunteers you interact with are dedicating 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 urge 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. We strive to train each volunteer to exhibit Gracious Professionalism at all times - we hope we can work together to create an environment where all feel safe and welcome.

Join us for the 2024 season and be a part of the incredible journey that is FIRST Robotics Competition! Your involvement is key to our collective success. We look forward to welcoming you.

With gratitude and excitement for what lies ahead, your Chief Volunteers:

Chief Referees – Aidan Browne & Jon Zawislak
Chief FIELD Supervisors – Scott Goering & Ayla DeLaat
Chief Volunteer Coordinators – Laurie Shimizu & Sarah Plemmons
Chief Judge Advisors – Cindy Stong & Allen Bancroft
Chief Robot INSPECTORS - Al Skierkiewicz & Chuck Dickerson
Chief Scorekeepers – Alex Herreid & Andrea “Duckie” Tribo
Chief FTAs - James Cerar & Mark McLeod

1.7 This Document & Its Conventions

The 2024 Game Manual is a resource for all FIRST Robotics Competition teams for information specific to the 2024 season and the CRESCENDOSM presented by Haas game. Its audience will find the following detail:

- a general overview of the CRESCENDO game,
- detail about the CRESCENDO playing FIELD,
- a description of how to play the CRESCENDO game,
- rules (related to safety, conduct, game play, inspection, event, etc.), and
- a description of how teams advance at 2024 tournaments and throughout the season

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, external articles, and rule references appear in [blue underlined text](#).

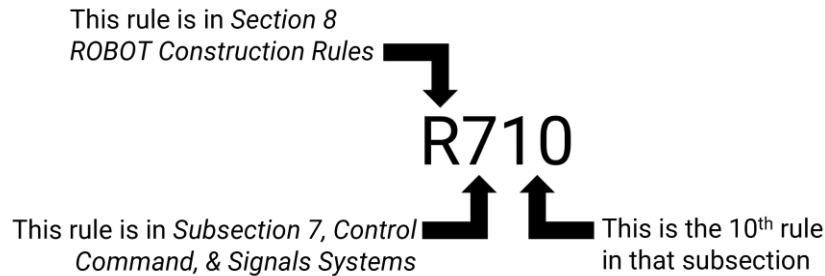
Key words that have a particular meaning within the context of the FIRST Robotics Competition and CRESCENDO are defined in [Section 14 Glossary](#) and indicated in ALL CAPS throughout this document.

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.

- Q for [Section 6.7.1 Question Box](#)
- G for [Section 7 Game Rules](#)
- R for [Section 8 ROBOT Construction Rules](#)
- I for [Section 9 Inspection & Eligibility](#)
- T for [Section 10 Tournaments](#)
- C for [Section 12 FIRST Championship Tournament](#)
- E for [Section 13 Event Rules](#)

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 1-3 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, mass, 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 version 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 NOTES 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 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

The CRESCENDO 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. These assets are posted on the [Translated Manuals page](#).

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.

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 [CRESCENDO - Season Materials web page](#) is the commanding version.

1.9 Team Updates

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 [CRESCENDO - 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

The [Question and Answer System \(Q&A\)](#) is a resource for clarifying the [2024 CRESCENDO 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 10, 2024, 12:00 PM Eastern. Details on the Q&A can be found on [the CRESCENDO - 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 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 9 Inspection & Eligibility](#) and [Section 6.7 Head REFEREE and FTA 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.

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.

