

4



The Robot

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Section 4 - The Robot

4.1 - Overview

This section provides rules and requirements for the design and construction of your robot. A *FIRST* Tech Challenge robot is a remotely operated vehicle designed and built by a registered *FIRST* Tech Challenge student team to perform specific tasks when competing in *FIRST Face Off!*. Prior to competing at each event, all robots will have to pass an inspection. Refer to Section 9 for the Robot Inspection Guidelines and Inspection Checklist.

4.2 - Robot Rules

There are specific rules and limitations that apply to the design and construction of your robot. Please ensure that you are familiar with each of these robot rules before proceeding with robot design.

<R1> Only ONE robot will be allowed to compete per team in the *FIRST* Tech Challenge. Though it is expected that teams will make changes to their robot at the competition, a team is limited to only ONE robot.

- a. It is against the intent of this rule to compete with one robot while a second is being modified or assembled.
- b. It is against the intent of this rule to switch back and forth between multiple robots during a competition.

<R2> Every robot will be required to pass a full inspection before being cleared to compete. This inspection will ensure that all FTC robot rules and regulations are met. Initial inspections will take place during team registration/practice time.

- a. If significant changes are made to a robot, it must be re-inspected before it will be allowed to compete.
- b. All robot configurations must be inspected before being used in competition.
- c. Teams may be requested to submit to random spot-inspections by event personnel. Refusal to submit will result in disqualification.
- d. Referees or inspectors may decide that a robot is in violation of the rules. In this event, the team in violation will be disqualified and the robot will be barred from the playing field until it passes re-inspection.

For further information on the inspection process please refer to Section 9, Robot Inspection Guidelines

<R3> The following types of mechanisms and components are NOT allowed:

- a. Those that could potentially damage playing field components.
- b. Those that could potentially damage other competing robots.
- c. Those that pose an unnecessary risk of entanglement.
- d. Those that are designed to flip or tip over goals or other robots.

<R4> At the beginning of any match, the maximum allowed size of a robot is 18" x 18" x 18".

- a. During inspections, robots will be placed into a "sizing box" which has interior dimensions matching the above size constraints. To pass inspection, a robot must fit within the box without exerting ANY force on the box walls or ceiling (i.e., if the robot cannot be held inside the constraints by the box itself).
- b. Robots may expand beyond their starting size constraints after the start of a match.
- c. Any restraints used to maintain starting size (i.e. zip ties, rubber bands, string, etc.) MUST remain attached to the robot for the duration of the match.

<R5> Robot construction is constrained to the following:

- a. Any part included in the Official FTC competition kit may be used (except as limited below).
 - Only one (1) NXT Controller
 - Up to four (4) 12V DC drive Motors
 - Up to six (6) Servos
 - Up to three (3) NXT motors
 - Only one (1) 12 VDC NiMH may be used to power the *Robot*. This battery must be identical to those supplied in the kit of parts. (Note: the TETRIX™ battery is custom designed with an internal 20 amp protection circuit. Use of any other battery could result in permanent damage to the NXT components and is not allowed).
 - One (1) NXT rechargeable battery pack or six (6) AA batteries (any type).
 - The packaging, manual binders, Styrofoam, cardboard, plastic bags, etc. from the kits are NOT included and CANNOT be used for robot construction. Only the TETRIX and LEGO® parts themselves are allowed.
- b. The following additional components may also be used:
 - One additional Logitech Gaming Controller
 - Any Vex® structural metal and fasteners (except the Linear Slide Pack, Vex part Number: LINEAR-SLIDE-PK-2)
 - Any LEGO® approved NXT sensor
 - Any NXT compatible sensor from HiTechnic, including the NXT Touch Sensor Multiplexer and the NXT prototype boards (both solderable and solderless)
 - Any part from the TETRIX system except for the R/C controller
 - One additional FTC controller (servo or DC motor controller)
 - One piece of polycarbonate plastic, 12" x 24" x not greater than .1" thick
 - One piece of aluminum, 12" x 24" x 1/16" thick
 - 1/8" Rope, any length
 - 12" x 15" of Non-Slip Pad
 - Universal Security Clips to hold PWM connections together, such as those found at <http://www.maxxprod.com/mpi/mpi-3.html>
 - Any material strictly used as a color filter for a Light Sensor.
 - The Permatex Super Lube provided by the TETRIX system may be used only to reduce friction with the *Robot*. Lubricants shall not be allowed to contaminate the playing field or other *Robots*.
- c. Teams may add non-functional decorations from parts not on the above list, provided that these parts are non-functional, do not affect the outcome of the match, are not hazardous to themselves or other teams, and must be in the spirit of "Gracious Professionalism".
- d. No additional components may be used.

<R6> All parts that are used must be tracked through a Bill of Materials (BOM). This list can be included in your Engineering Notebook.

<R7> During inspections if there is a question about whether something is an official TETRIX, LEGO, or Vex component, a team will be required to provide documentation to an inspector, which proves the component's source. Such types of documentation include receipts, part numbers, or other printed documentation.

<R8> No more than one NXT Controller may be used to control a single robot during the tournament

- <R9> Parts may NOT be modified as follows:
- Motors, extension cords, sensors, controllers, battery packs, and any other electrical component may NOT be altered from their original state in ANY way.
 - Welding, soldering (except teams using the NXT Prototype Board – Solderable) brazing, gluing, melting or attaching in any way that is not provided within the TETRIX System will NOT be allowed.
 - Mechanical fasteners may be secured using Loctite® or a similar thread-locking product. .
- <R10> Robots **must** display their team number (numerals only, e.g. “106”).
- The judges, referees, and announcers must be able to easily identify robots by team number.
 - Team number must be visible from two sides of the robot (180 degrees apart).
 - The numerals must each be at least three inches high, at least in 3/4-inch stroke width and in a contrasting color from their background.
- <R11> The NXT controller must be accessible by competition personnel including inspectors, referees, and field control operators.
- The NXT battery must be easily removed without disassembly of the robot.
 - The USB port on the NXT must be easily accessible to allow for rapid registration at the match.
- <R12> Robots **must** include a mounting device to securely hold one FTC Robot Identification Flag throughout an entire match.
- The flags will be provided at the event**
 - The flag tube dimensions are .250” OD x .200” ID x 8.250” length with a triangular flag 4.000” high x 6.000” wide.
 - The flag-mounting device may not be a non-reinforced antenna tube.

4.3 – Programming Guidelines

Teams will have access to www.ftctraining.com as a resource to learn how to program with NXT-G, LabVIEW, or ROBOTC. The bulletin boards at the site will be managed daily by Robotics Academy staff. Information on the most current versions of the programming softwares can be found at <http://www.usfirst.org/community/FTC/content.aspx?id=6650>.

NOTE TO TEAMS:

For NXT-G or LabVIEW:

You **MUST** download the most current version of the NXT device firmware to your NXT device in order to compete in the FIRST Tech Challenge (FTC) competition.

The field management system at the FTC competition cannot communicate with your robot unless you use the most current version of the firmware on the NXT device. The FTC software provides the correct version of this firmware.

Refer to the FIRST Tech Challenge Software Installation Instructions printed document, available as part t of the FTC kit, for information about installing the FTC software.

Refer to Chapter 4, Controlling the Robot with the FTC Controller Station, of the Getting Started with the FIRST Tech Challenge Software manual for information about downloading the firmware from either LabVIEW or LEGO®

MINDSTORMS® to the NXT device. Access the Getting Started with the FIRST Tech Challenge Software manual by navigating to the National Instruments\LabVIEW 8.5\manuals directory or the LEGO Software\LEGO MINDSTORMS Edu NXT directory and opening FTC_Getting_Started.pdf.

For ROBOTC:

The field management system at the FTC competition cannot communicate with your robot unless you use ROBOTC firmware version 7.52 or higher on the NXT device. The 1.40 version of ROBOTC provides the correct version of this firmware.

Users of ROBOTC can refer to the instruction on the CD packaging for help on installing ROBOTC, or to the built-in help documentation in ROBOTC under "Help - Getting Started - Downloading Firmware (NXT)" for a step by step guide on how to download the latest firmware.