



Competition Rules for Lego Challenges

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Disclaimer

It is your responsibility to read and understand this document on a regular basis because we may update it from time to time.

If there are any exceptions or additions to the restrictions, they will be listed in each challenge. If you have any questions, please email the Lego Team at orclego@gmail.com.

This year, we will allow both the EV3 Mindstorms Robots and the Spike Robots. All entries to the competition, with your choice of Robot should be informed with this in mind. The differences between the two Robot systems are explained at the end of this document. We will not accept any complaints regarding one system being superior, stronger or better than the other system. We expect all the competitors to learn the benefits and deficiencies of their robotic system and use them to their advantage. If you feel that one system is better than the other, feel free to use that to your advantage, but as previously stated, we will not tolerate it as a complaint.

**If you are unsure about something,
please ask!**

Participation Rules

As a participant of the IEEE Ottawa Robotics Competition, **respect** your teammates, your supervisors, the volunteers organizing the event, and to all other attendees of any ORC event. Our goal is to allow you to **have fun** at the ORC while **learning** and **working together as a team** as you prepare for competition day.

Have fun and help each other out—it's all about participating!

Team Requirements

Your team must have **one** team captain and **one** assistant captain who will be responsible for approaching judges for any questions and/or clarifications about the rules. Team captains are responsible for making sure their team has fully read the rules of any challenges they are register in before competition day.

Any non-team member (team supervisor, parents, mentors, etc.) must act in an advisory role only. **Your team must do the work!** Otherwise, your results may be invalidated.

For every challenge your team is registered in, there must be one robot (i.e. 2 challenges = 2 robots). Your team may register into up to two challenges. Furthermore, **your team is expected to show up when it is your team's turn for a challenge, even if you are competing in two challenges.**

We strongly urge teams to have one team member periodically checking in on the competition areas to ensure they do not miss their challenges.

The Robots

Your team must build and program a robot **before** competition day, but you will still be allowed to modify your programs on competition day. The school's lighting conditions will affect sensors, so your team should bring their laptops and programs to adjust your programs.

Your robot must be built and programmed following the below specifications:

1. **Software and Programming Language:** Your team can use any program/IDE or language to program your brick.

2. **Programming Brick:** One EV3 brick or SPIKE brick must be used per robot.
3. **Non-Lego and Lego pieces:** Unless specified by individual challenge rules, your team can use any non-electronic Lego pieces from any Lego kit for robot construction. However, these pieces must not be modified in any manner (i.e. not cut up, burned, etc.). Non-Lego pieces are not allowed with the exceptions of (1) holding the drawing utensils in the Analog Devices da Vinci Challenge or (2) decorating the robot. **Note:** plastic ramp covers are banned in all challenges.
4. **Motors and Sensors:** Each robot may use a maximum number of the following motor and sensors:
 - 3 motors (medium and/or large)
 - 2 touch sensors
 - 1 gyro sensor
 - 1 ultrasonic sensor **or** 1 infrared sensor
(in proximity mode only—the infrared beacon may not be used)
 - 2 colour sensors **or** 2 light sensors **or** 1 of each typeThe motors and sensors can be from an NXT, EV3 or SPIKE kit.
5. **Robot Dimensions and Weight:** Maximum robot dimensions are 1 ft × 1 ft (30.48 cm × 30.48 cm) and the maximum robot weight is 1 kg, unless otherwise specified in the challenge rules. Judges will check your robot to make sure it meets our requirements throughout the day. If your robot changes dimensions while competing, judges may double check to see whether your robot still meets the requirements. This check does not apply when a part of the robot falls off unintentionally while competing. For example, if parts were to fall off since two robots crashed into each other, judges will not double check dimensions. However, if parts of the robot unfold or open, judges can check the dimensions of the robot before continuing with the challenge.
6. **Remote Control:** Forms of remote control, such as Bluetooth, are not allowed, unless otherwise stated in a challenge. A robot must be autonomous and rely only on its original programming. Any actions your team may purposely do, like: clapping hands, issuing voice commands, Bluetooth, infrared remote, waving objects, etc., that causes a robot to begin behaving differently after the program has started is considered as human interference and is not allowed.
7. **Inspections:** With the addition of a new challenge requiring Bluetooth and remote control, inspections will be more frequent throughout

competition day. In all autonomous challenges, it is very important that Bluetooth and/or remote control be off while competing. In addition, teams can request for their opponent's robot to be inspected at any point during competition day. Judges must be able to verify the Bluetooth/Wi-Fi status of your robot at any time.

8. **Challenge attendance:** Teams must be ready to compete when it is their turn. Given the nature of competition day, the schedule is subject to change without notice. Thus, teams must be near their challenge area and be ready to compete at any time. Teams will have 5 minutes to show up when judges call them before the team loses automatically.
9. **Projectiles:** Projectiles in any shape or form are not allowed. Robots must not intentionally shoot out/up objects or put any objects down in the competition arena/area during a match.

Important Information for LEGO Motors

EV3 Large Servo Motor 45502:

The EV3 Large Servo Motor is a powerful motor that uses tacho feedback for precise control to within one degree of accuracy. By using the built-in rotation sensor, the intelligent motor can be made to align with other motors on the robot so that it can drive in a straight line at the same speed. It can also be used to give an accurate reading for experiments. The motor case design also makes it easy to assemble gear trains.

- Tacho feedback to one degree of accuracy
- 160-170 RPM
- Running torque of 20 N/cm (approximately 30 oz/in)
- Stall torque of 40 N/cm (approximately 60 oz/in)
- Auto-ID is built into the EV3 software
- <https://raisingrobots.com/product/large-servo-motor/>
- The rated maximum speed of the Lego EV3 large motor is 1050 degrees per second

EV3 Medium Servo Motor 45503:

The EV3 Medium Servo Motor is great for lower-load, higher speed applications and when faster response times and a smaller profile are needed in the robot's design. The motor uses tacho feedback for precise control within one degree of accuracy and has a built-in rotation sensor.

- Tacho feedback to one degree of accuracy
- 240-250 RPM
- Running torque of 8 N/cm (approximately 11 oz/in)
- Stall torque of 12 N/cm (approximately 17 oz/in)

- <https://raisingrobots.com/product/medium-servo-motor/>
- The rated maximum speed of the Lego EV3 medium motor is 1560 degrees per second.

LEGO SPIKE Prime Large Angular Motor 45602:

The motor is designed to function in models as both a motor and sensor. With the integrated advanced Rotation Sensor, the motor can report both speed and position.

The motor can also sense direct user input if the output is rotated by hand.

Key features • Speed Sensor (measures percentage of maximum design speed)

- Relative position in degrees
- Absolute position in degrees (-/+ 180 degrees)
- Cross hole output on one side, rotating disc with Cross hole and building interface on the other side
- The motor has a Technic build geometry that allows for versatile building and easy integration into models

LEGO® Power Functions 2.0 (LPF2) for connection to LEGO Smart-hubs

Wire length - 250 mm

Motor output Voltage range: • Min: 5V • Max: 9V

No load: • Torque: 0 Ncm • Speed: 175 RPM +/- 15% • Current consumption: 135 mA +/- 15%

Maximum efficiency: • Torque: 8 Ncm • Speed: 135 RPM +/- 15% • Current consumption: 430 mA +/- 15%

Stall: • Torque: 25 Ncm • Speed: 0 RPM • Current consumption: 1900 mA +/- 15%

All performance data is based on a 7.2V power supply. Accuracy: $\leq \pm 3$ degrees - Accuracy is defined as the tolerances in the sensor combined with the gearbox slack. Update rate: 100 Hz

https://education.lego.com/v3/assets/blt293eea581807678a/bltb9abb42596a7f1b3/5f8801b5f4c5ce0e93db1587/le_spike-prime_tech-fact-sheet_45602_1hy19.pdf

LEGO SPIKE Prime Medium Angular Motors 45603:

The motor is designed to function in as both a motor and sensor. With the integrated advanced Rotation Sensor, the motor can report both speed and position. The motor can also sense direct user input measures if the output is rotated by hand.

Key features • Speed sensor (measures percentage of maximum design speed)

- Relative position in degrees
- Absolute position in degrees (-/+ 180 degrees)

- Cross hole output on one side, rotating disc with cross hole and building interface on the other side
- The motor has a Technic build geometry that allows for versatile building and easy integration into models

LEGO® Power Functions 2.0 (LPF2) for connection to LEGO Smart hubs
Wire length 250 mm

Motor output Voltage range: - - • Min: 5V - - • Max: 9V

No load: • Torque: 0 Ncm - - • Speed: 185 RPM +/- 15% - - • Current consumption: 110mA +/- 15%

Maximum efficiency: • Torque: 3.5 Ncm - - • Speed: 135RPM +/- 15% - - • Current consumption: 280mA +/- 15%

Stall: • Torque: 18 Ncm - - • Speed: 0 RPM - - • Current consumption: 800mA +/- 15%

All performance data is based on a 7.2V power supply. Accuracy: $\leq \pm 3$ degrees - Accuracy is defined as the tolerances in the sensor combined with the gearbox slack. Update rate: 100 Hz

https://le-www-live-s.legocdn.com/sc/media/files/support/spike-prime/techspecs_technicmediumangularmotor-19684ffc443792280359ef217512a1d1.pdf

Device

EV3

Spike Prime

Ports	4 motors, 4 sensors	6 ports (Both motors and sensors
Batteries	rechargeable	in the hub
Touch sensor	pressed/released	same plus force sensor
Gyro	plugged in	on-board sensor
Colour	colours/light sensor	updated technology
Motors	2 large motor 1 angle motor	1 large motor 2 angle motors