

# MOBILE ROBOTICS TECHNOLOGY



## PURPOSE

To evaluate each contestant's preparation for employment in the field of robotics with emphasis on the team approach to problem solving in a work environment. To recognize outstanding students for their excellence and professionalism in the emerging field of mobile robotics.

First, download and review the General Regulations at: <http://updates.skillsusa.org>.

## ELIGIBILITY

Open to a team of two active SkillsUSA members enrolled in a career and technical education engineering program or a program that integrates robotics, engineering or pre-engineering techniques as an integral component of the instructional program.

## CLOTHING REQUIREMENTS

### Class E: Contest specific — Business Casual

- Official SkillsUSA white polo shirt
- Black dress slacks (accompanied by black dress socks or black or skin-tone seamless hose) or black dress skirt (knee-length, accompanied by black or skin-tone seamless hose)
- Black leather closed-toe dress shoes

These regulations refer to clothing items that are pictured and described at: [www.skillsusastore.org](http://www.skillsusastore.org). If you have questions about clothing or other logo items, call 800-401-1560 or 703-956-3723.

**Note:** Contestants must wear their official contest clothing to the contest orientation meeting.

## EQUIPMENT AND MATERIALS

1. Supplied by the technical committee:
  - a. All necessary information for judges and technical committee
  - b. One standard 120-volt electrical outlet
  - c. One standard 6' conference table
  - d. Two chairs
  - e. Description of robotic challenge
  - f. Junior Mobile Robotics Teams will receive VEX IQ Robotic equipment for building their robot at NLSC. Post-Secondary and Secondary Teams must bring their own robots.
2. Supplied by the contestant:
  - a. Computer with programming software installed and licensed
  - b. Programming cable or other connection devices
  - c. Engineering notebook
  - d. All competitors must create a one-page résumé and submit a hard copy to the technical committee chair at orientation. Failure to do so will result in a 10-point penalty.
  - e. Post-Secondary and Secondary Teams: Fully built mobile robot as specified in the current SkillsUSA Mobile Robotics Technology game manual. Robot must be capable of being re-programmed and minor physical design modifications
  - f. Any non-powered hand tools necessary to modify their robot as needed.

**Note:** Your contest may also require a hard copy of your résumé as part of the actual contest. Check the Contest Guidelines and/or the updates page on the SkillsUSA website at <http://updates.skillsusa.org>.

## SCOPE OF THE CONTEST

Teams are given a task they are asked to solve using a mobile robotic system. Post-Secondary and Secondary Teams will come prepared with a fully built robot capable of being re-programmed quickly to adapt to modifications of the game presented to the teams during Orientation. Middle School Mobile Robotic Teams will be given new VEX IQ kits to assemble their robot during the competition. The contest will test the ability to document, construct, program and exhibit their solution to

industry-based judges. Teams will be given two interviews, the first for their overall design process, and the second for their programming solution to the problem.

### **Knowledge Performance**

The contest will include the SkillsUSA Framework Essential Element Assessment. This will be given during Orientation.

### **Skill Performance**

The contest will include activities that simulate situations encountered by robotic programmers and support professionals.

### **Contest Guidelines**

1. Teams must be comprised of two members.
2. Teams are given a task that they will solve using a mobile robotic.
3. Each team will have 10 minutes to present its engineering design process to the judges.
4. Each team will have 10-minutes to present its programming code to the judges.
5. Teams can only use an engineering notebook during the contest as a reference tool in the construction and programming of their robot
6. The engineering notebook is a tool for students to document their designs prior to the competition. It can include pictures, printed out sections of code, detailed assembly instructions, etc. All pages must be bound and numbered.
7. Each team will be given points for CAD drawings of their robot. These drawings should be included in the engineering notebook.
8. Robot(s) can only be constructed by the materials specified in the SkillsUSA Mobile Robotics Technology game manual.
9. Teams will have six scored chances to solve the mobile robotic challenge three chances for Programming Skills and three chances for Driving Skills. The highest score in each Skill will be recorded and submitted for judging.
10. Contestants are required to adhere to industry safety standards using the hardware and software provided.
11. All team members are responsible for double-checking each other's work and quality control.

12. All engineering notebooks, and résumés must be turned in to the judges at Orientation. Notebooks will be returned no later than the start of the debriefing session
13. All team members and advisors are required to attend the debriefing session after the competition has concluded.

### **Standards and Competencies**

#### **MR 1.0 — Demonstrate knowledge in safety rules and practices**

- 1.1 Maintain a safe work area
- 1.2 Demonstrate correct use of hand tools
- 1.3 Follow safety rules during robotic assembly
- 1.4 Demonstrate proper use of safety equipment including eye protection
- 1.5 Define and document all safety issues

#### **MR 2.0 — Produce technical documentation**

- 2.1 Maintain professional engineering notebook
- 2.2 Document assembly instructions and illustrations
- 2.3 Produce Bill of Materials (BOM)
- 2.4 Document the engineering design process
- 2.5 Produce CAD drawings of the robot

#### **MR 3.0 — Apply knowledge of robotic assembly and part identification**

- 3.1 Identify various parts used on a mobile robot (wheels, motors, gears, etc.)
- 3.2 Identify the various systems in a mobile robot
- 3.3 Demonstrate the use of various components of a mobile robot
- 3.4 Demonstrate proper assembly techniques

#### **MR 4.0 — Understand mechanical systems of a robot**

- 4.1 Understand and identify the various types of gears and their application
- 4.2 Demonstrate the use of gears on a mobile robot
- 4.3 Understand and identify the various types of chain and sprocket mechanisms
- 4.4 Demonstrate proper mechanical component alignment

**MR 5.0 — Wire a mobile robot**

- 5.1 Demonstrate proper wiring techniques
- 5.2 Maintain and analyze battery voltage
- 5.3 Understand and use multiple types of mobile robotic sensors

**MR 6.0 — Produce examples of basic computer programming and flowcharting**

- 6.1 Draw a programming flow chart representing a robot program for a given scenario
- 6.2 Develop a basic computer program to control robot
- 6.3 Manipulate feedback from robotic sensors in a program
- 6.4 Demonstrate proper commenting of code in a mobile robot program

**MR 7.0 — Presenting technical information and technical problem solving**

- 7.1 Demonstrate the knowledge of various visual aids used to present technical information
- 7.2 Present technical material in a professional manner
- 7.3 Define team roles and responsibilities
- 7.4 Demonstrate ability to solve problems as a team in a given time frame
- 7.5 Demonstrate and document a comprehensive plan to solve an engineering problem
- 7.6 Use proper time management when solving a problem
- 7.7 Demonstrate efficient project management and planning

**MR 8.0 — Identify communication protocols for mobile robots**

- 8.1 Understand basic communication techniques in mobile robotics
- 8.2 Demonstrate proper communication between a transmitter and a robot

**Committee Identified Academic Skills**

The technical committee has identified that the following academic skills are embedded in this contest.

**Math Skills**

- Use fractions to solve practical problems
- Use proportions and ratios to solve practical problems

- Simplify numerical expressions
- Use scientific notation
- Solve practical problems involving fractions
- Solve single variable algebraic expressions
- Solve multiple variable algebraic expressions
- Apply transformations (rotate or turn, reflect or flip, translate or slide, and dilate or scale) to geometric figures
- Construct three-dimensional models
- Apply Pythagorean Theorem
- Make predictions using knowledge of probability
- Make predictions using knowledge of probability
- Organize and describe data using matrixes
- Find slope of a line
- Solve practical problems involving complementary, supplementary and congruent angles
- Solve problems involving symmetry and transformation
- Make comparisons, predictions and inferences using graphs and charts
- Organize and describe data using matrixes
- Solve problems using proportions, formulas and functions
- Use measures of interior and exterior angles of polygons to solve problems
- Find arc length and the area of a sector
- Demonstrate measuring skills

**Science Skills**

- Plan and conduct a scientific investigation
- Use knowledge of physical properties (shapes, density, solubility, odor, boiling point, color)
- Use knowledge of potential and kinetic energy
- Use knowledge of mechanical, chemical and electrical energy
- Use knowledge of heat, light and sound energy
- Use knowledge of temperature scales, heat and heat transfer
- Use knowledge of sound and technological applications of sound waves
- Use knowledge of the nature and technological applications of light
- Use knowledge of speed, velocity and acceleration
- Use knowledge of Newton's laws of motion

- Use knowledge of work, force, mechanical advantage, efficiency and power
- Use knowledge of simple machines, compound machines, powered vehicles, rockets and restraining devices
- Use knowledge of principles of electricity and magnetism
- Use knowledge of static electricity, current electricity and circuits
- Use knowledge of motors and generators

### Language Arts Skills

- Provide information in conversations and in group discussions
- Provide information in oral presentations
- Demonstrate use of such verbal communication skills as word choice, pitch, feeling, tone and voice
- Demonstrate use of such nonverbal communication skills as eye contact, posture and gestures using interviewing techniques to gain information
- Analyze mass media messages
- Demonstrate comprehension of a variety of informational texts
- Use text structures to aid comprehension
- Identify words and phrases that signal an author's organizational pattern to aid comprehension
- Understand source, viewpoint and purpose of texts
- Organize and synthesize information for use in written and oral presentations
- Demonstrate knowledge of appropriate reference materials
- Use print, electronic databases and online resources to access information in books and articles
- Demonstrate narrative writing
- Demonstrate informational writing
- Edit writing for correct grammar, capitalization, punctuation, spelling, sentence structure and paragraphing

### Connections to National Standards

State-level academic curriculum specialists identified the following connections to national academic standards.

#### Math Standards

- Numbers and operations
- Algebra

- Measurement
- Problem solving
- Reasoning and proof
- Communication
- Connections
- Representation

**Source:** NCTM Principles and Standards for School Mathematics. For more information, visit: <http://www.nctm.org>.

#### Science Standards

- Understands the sources and properties of energy
- Understands forces and motion
- Understands the nature of scientific inquiry

**Source:** McREL compendium of national science standards. To view and search the compendium, visit: <http://www2.mcrel.org/compendium/browse.asp>.

#### Language Arts Standards

- Students adjust their use of spoken, written and visual language (e.g., conventions, style, vocabulary) to communicate effectively with a variety of audiences and for different purposes
- Students use a variety of technological and information resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge
- Students use spoken, written and visual language to accomplish their own purposes (e.g., for learning, enjoyment, persuasion and the exchange of information)

**Source:** IRA/NCTE Standards for the English Language Arts. To view the standards, visit: [www.ncte.org/standards](http://www.ncte.org/standards).