SkillsUSA®

RoboRescue Challenge: Explosive Ordnance Disposal (EOD)

2013 Technology Demonstration Event

Team Guide

(Version: January 25, 2013)

Note: *Event rules/regulations are subject to revision prior to competition.*

SCIENCE NEWS

Earlier today, police received a tip about a threat that needed to be investigated in a nearby neighborhood, which was quickly evacuated as a bomb squad mobilized. These highly skilled individuals who make up the SWAT team have designed a robot that will locate, neutralize, move, and dispose of the explosive materials. This scenario happens nearly every day; be on the leading edge of designing, manufacturing, and operating a life-saving robot. JOIN ROBORESCUE!

Welcome to RoboRescue, a robotics competition developed with real-world applications for career-minded students. To ensure each state competition is a success, we assembled and delivered to you these RoboRescue Competition Guidelines. These binders contain all of the rules and regulations, course diagrams, scoring rubrics, written and oral exam questions, answer keys, and team packet stickers to keep documentation organized. This comprehensive package is everything you need to successfully run the RoboRescue Competition at the State Level for 2012-2013.

Please deliver this sensitive material to the officials overseeing the Robotics Competitions at the SkillsUSA State Convention this year. These guidelines will give the robotics officials the ability to select the proper-size venue with the appropriate facilities to host a great real-life scenario experience for the teams participating. In addition to this binder, the officials will also need a folder for each participating team.

It is crucial that the RoboRescue Competition Guidelines do not make it into the hands of any students participating in the challenge.

We are looking forward to this year's exciting competition that incorporates how robotics are used by emergency services on a daily basis. If you have any questions, please contact me!

Thank you for supporting RoboRescue; we look forward to a successful 2013!

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http://tetrixrobotics.com/Competitions/RoboRescue/

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Corporate sponsors include:

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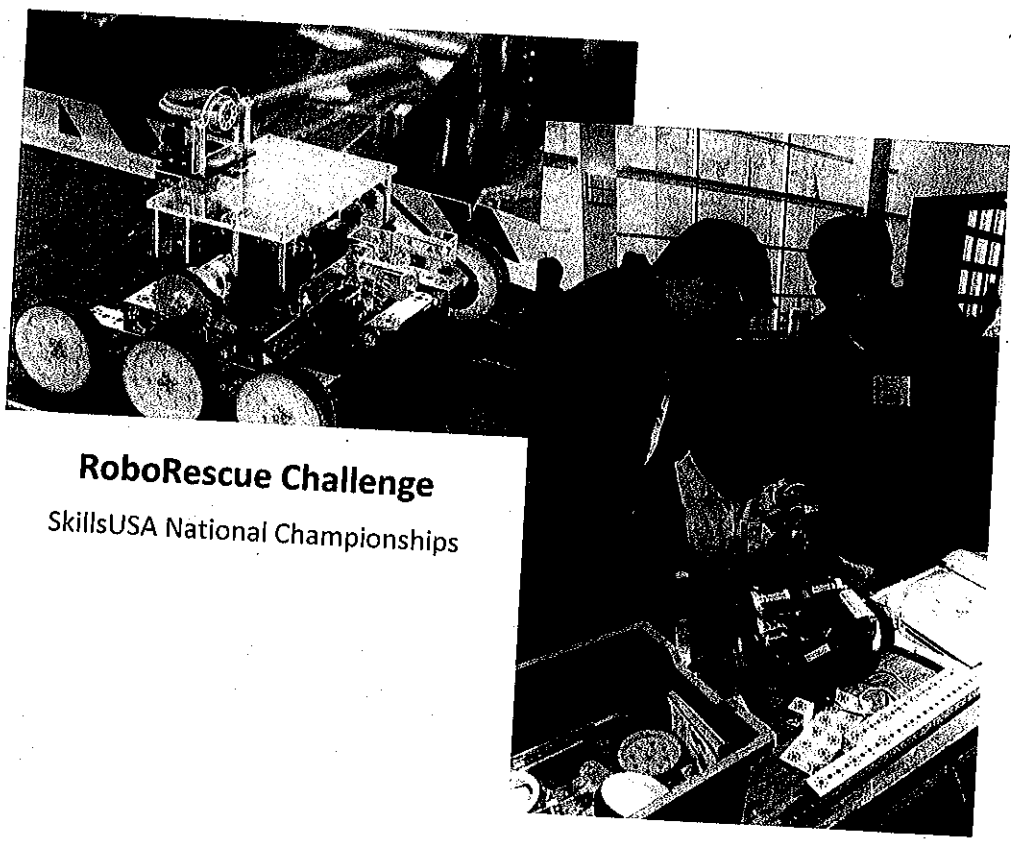


RoboRescue Challenge

SkillsUSA National Championships

Explosive Ordnance Disposal Robot, Springfield (MO) Fire Department

Event

The 2013 RoboRescue Challenge: Explosive Ordnance Disposal (EOD) challenges students to create a mobile robot like those employed by emergency service personnel (fire, police, military). The robot is designed to secure an area by locating, neutralizing, moving, and disposing of explosive materials. The demand for designers, skilled technicians, and manufacturing workers who are fluent in mechanical design and electrical systems and highly skilled in troubleshooting and maintenance of robotic systems is projected to continue to grow. The current generation of students is expected to take artificial intelligence and robotics into the evolving world of emergency services, finding new ways to help trained personnel react more quickly and effectively. Therefore, it is imperative that our future labor force be on the leading edge of current and emerging technologies and possess the technical and team skills necessary to maintain industry leadership in design, manufacture, maintenance, and operation of life-saving robotic equipment.

Purpose

- To evaluate team members' skills and preparation for employment in fields related to and including robotics, engineering, automation, manufacturing, electronics, and emergency services.
- To recognize outstanding performance by participants in scenarios that require problem solving and teamwork in a real-world situation.

Clothing Requirement

Official SkillsUSA attire is required. For complete details, visit www.skillsusastore.org. If you have questions about clothing or logo attire, call 800-401-1560 or 703-956-3723.

Eligibility

The RoboRescue Challenge is open to active SkillsUSA members.

Equipment and Materials

Supplied by Technical Committee

- Challenge field: 12' x 12' simulated neighborhood
- Field elements: components of a residential area and obstacles to traverse, open, and manipulate in order to locate and dispose of simulated explosive ordnances
- A command center cubicle equipped with a table, two chairs, and a video monitor (see "Command Center" specifications in Appendix)
- General workspace for each team designated as a "pit" area, including one table, two chairs, and access to a 120-volt electrical supply
- Time display
- Safety glasses for observers who need them

Supplied by Competing Team

- Safety equipment – eye protection is required at all times
- Laptop computer (optional)
- SkillsUSA RoboRescue Challenge Kit and additional allowed parts and raw materials necessary to create the robot and arm mechanism (see "RoboRescue Challenge Kit Bill of Materials" in Appendix)
- Team name affixed to robot
- Presentation software for oral presentation to judges (optional)
- Technical drawing/blueprint of robot drive chassis
- CAD/CAM software for blueprint design (optional)
- Engineering Notebook
- Pens, pencils, and paper
- Tools (suggested):
    - Allen wrench set (English)
    - Clamping vise
    - Metal tin snips
    - Power strip
    - Calculator
    - Tape measure
    - Hammer
    - Metal file
    - Flat-head and Phillips-head screwdrivers
    - Wire strippers (one set)
    - Wire cutters/snips (one set)
    - Roll of electrical tape
    - 4" nylon wire ties (25 pack)

- Multimeter
- Multinut pliers
- Metal-cutting hacksaw (manual)
- Cordless drill with charger
- Set of standard drill bits
- Pliers (needle nose or regular)
- Set of box wrenches

Challenge Overview

A two-member team builds its robot and arm mechanism prior to the competition and then, during the competition, remotely operates the robot, which should be capable of locating, grabbing, and moving simulated ordnances on the challenge course. This remotely operated vehicle (ROV) must traverse the course, locate the ordnances, secure them, and properly dispose of them. Each team will perform one round of competition consisting of **a time-limited mission to locate and dispose of the two ordnances**.

- During the mission, each team must complete several procedures specified in the rules provided at the event.
- The mission will be limited to **six minutes**.

Each two-member team will work from a command center to remotely operate its robot to carry out the mission. The command center will be equipped with a monitor displaying the video feed from an onboard wireless camera system attached to the robot. The robot will begin the challenge course from a starting point. The timed mission starts when the robot begins to move and ends when the robot returns to the starting point. The robot must have completed the mission within the allotted **six-minute time limit** for the team to receive full credit.

Contest Field

- 12' x 12' simulated residential area (See photos in Appendix D.)
- Features of neighborhood:
  - Starting point from which robot deploys
  - Containment boundaries marking the 12' x 12' challenge area
  - Objects often found in a neighborhood setting: home, street, grass, mailboxes

Note: Ordnances are strategically positioned on the challenge course in locations that require a robot to open doors and reach for and grab items to deliver them to a safe disposal site. Some ordnances may be located outside a direct line of sight from the command center, in which case tele-op capabilities will be put to use.

Command Center

The command center will be located within view of the contest field and equipped with a table, two chairs, and a video monitor. (See "Command Center" specifications in Appendix.)

Pit Area

A pit area where teams modify their robots and arm mechanisms will be provided. Each team will have a conference table, two chairs, and access to a 120-volt electrical outlet.

RoboRescue Challenge Kit

The RoboRescue EOD robot may be built using only components that comprise the RoboRescue Challenge Kit and other approved parts listed in the Appendix. Each kit contains everything necessary to construct a basic robot for the RoboRescue Challenge competition.

Upon registering for the event, teams may purchase a RoboRescue Challenge Kit. Each TETRIX®-based RoboRescue Challenge Kit contains:

- Bill of materials along with a *R/C Builder's Guide*
- Metal construction elements for fabricating a robot chassis
- Metal construction elements for fabricating an arm mechanism
- Tools for construction
- Control system and power electronics including 4-channel 2.4 GHz R/C transmitter (up to 6 channels are allowed), receiver, DC motor controller, rechargeable battery pack, and charger
- 900 MHz wireless video camera system
- Hookup diagrams and troubleshooting tips

Note: Additional approved parts and raw materials may also be used. A bill of materials for the RoboRescue Challenge Kit and a list of approved optional parts and raw materials can be found in the Appendix.

Challenge Checklist

- ☐ 1. Purchase RoboRescue Challenge Kit.
- ☐ 2. Thoroughly review Team Guide, scoring rubrics, and *R/C Builder's Guide*.
- ☐ 3. Design and build robot and arm mechanism within specifications that is capable of grabbing, holding, and moving objects. Document process and blueprints in Engineering Notebook.
- ☐ 4. Practice driving robot on various types of terrain while looking at a video monitor displaying the feed from an onboard camera.

☐ 5. Review basic mechanical, robotics, and electrical knowledge in preparation for written test.

☐ 6. Plan, prepare, and practice presentation.

☐ 7. Attend local, regional, state, and national RoboRescue Challenge competitions.

Sample Event Agenda

Following is a sample agenda for an eight-team RoboRescue Challenge event.

- 7:30-8 a.m. – **Check in** (submit prebuilt robot and Engineering Notebook to judges for inspection)
- 8-9 a.m. – Robot and Engineering Notebook **inspection** by judges (items then returned to teams)
- 9-Noon –
    - Teams complete **technical presentation** (oral and physical) over robot, Engineering Notebook, and arm mechanism (following presentation, items will remain in judges' possession until challenge field competition).
    - Final robot and arm mechanism **inspection** by judges
    - **Written test** administered
- Noon-1 p.m. – **Lunch**
- 1-2:30 p.m. – Challenge field **competition** conducted

Contest Guidelines/Rules

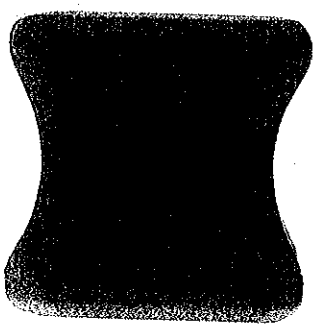
Note: Guidelines and rules are subject to change.

- Each **team** must be composed of two members.
- Each robot must have an **identification label** with the team's name listed.
- Each **technical presentation** should last from 10 to 15 minutes and should be primarily oral, with supporting materials of printed or electronic media and physical models. Students should be prepared to discuss the roles they played, their robot design, and the functions of their robot. (**Note:** The Technical Committee will **not** provide projector, screen, or other presentation equipment.)
- **Before attending** the competition, team members should design, build, and experiment with robots constructed from the SkillsUSA RoboRescue Challenge Kit. Additional TETRIX or other

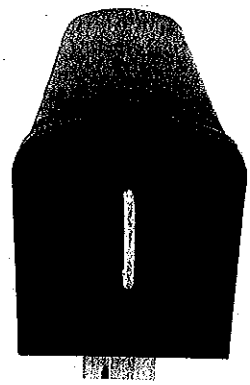
approved parts and raw materials (see Appendix) may also be used. The prebuilt robot and arm mechanism will be required to grab, hold, and move objects during the mission.

- The robot's arm mechanism must be capable of opening a standard-size mailbox and reaching **into the box up to five (5) inches**, grabbing the simulated ordnance, and pulling it out of the mailbox. The arm mechanism must be capable of reaching items positioned **at least nine (9) inches off the floor**.

- The simulated ordnances (below, left) are not included in the competition kit and are **approximately 2.7 inches cubed**. The handles on doors and mailboxes (below, right) are **3.3 inches long and .41 of an inch wide**.



Ordnance (wooden block)



Mailbox handle

- **Part Restrictions:**
  - Limit of **four** continuous rotation DC motors or servo motors per competing robot
  - Limit of **four** standard-scale proportional servo motors or equivalent
  - Maximum of **one** R/C transmitter (non-programmable, **up to six channels**) and **one** DC motor controller (**Note:** To avoid radio interference issues, it is strongly recommended that RoboRescue teams use the 4-channel Futaba 2.4 GHz R/C control system included in the RoboRescue Challenge Kit, though up to 6 channels are allowed.)
  - **One** rechargeable battery pack, maximum 12 volt (**Note:** In the interest of keeping the competition fair, it is strongly recommended that RoboRescue teams use the 12-volt, mAh NiMH rechargeable battery pack and charger included in the RoboRescue Challenge Kit.)
  - Robot must fit into an **18" x 18" x 18"** space when starting **but may be expanded to a larger size during the challenge**.

- Each team must provide in its Engineering Notebook a **technical drawing or blueprint** detailing the construction of its robot drive chassis and additional drawings/blueprints for its associated arm mechanism.

- The robot and arm mechanism must be **assembled by the team prior to the competition**.

- All robots will be required to **pass inspection** by judges to determine if all of the parts used are from the list of allowed parts. Any team whose robot fails inspection will be given 10 minutes to correct the infraction, after which the robot will be disqualified if proper modifications have not been made.

- Robots will not be allowed to compete with an arm mechanism that poses **danger** to competitors or could potentially cause damage to the challenge field.

- Accuracy of the robot's **construction matching the blueprint** will be considered during scoring. All necessary parts and tools for construction must be brought to the competition site.

- Team members will be required to follow proper safety procedures and use eye protection.

- Teams may bring a **laptop computer and blueprint drawings** of their robot and arm mechanism designs to the contest building area for use only as reference tools. A description of the assembly process is required with the Engineering Notebook. The designs also may be printed or hand-drawn copies.

- Teams **may view the simulated neighborhood** prior to the beginning of competition and may watch other competing teams during the challenge event.

- **Final team results** will be posted at the conclusion of the event, and each team will receive a copy of the **judges' rubrics** with scores and comments about the team's performance.

Engineering Notebook

The Engineering Notebook will be submitted for judging at check-in. Required elements:

- Overall neat and professional appearance

- A complete bill of materials for the robot drive chassis and arm mechanism designed and used in competition at the event

- A description of the assembly process for the robot drive chassis and arm mechanism

- Illustrations, sketches, photos, and written log entries accurately documenting the design and prototyping iterations detailing the evolution and logical progression of the robot's design

Challenge Course Rules

Note: Team members must wear safety glasses at all times while they are in the competition area! All teams will be expected to adhere to the official rules for the RoboRescue Challenge competition and compete in a positive and professional manner.

- At the competition site, the **simulated residential area** will be provided and maintained by the technical committee. During competition, the course will be reset to its original state before each team competes.

- The RoboRescue Challenge: Explosive Ordnance Disposal event will consist of **a single timed mission** for each team. During the mission, the robot has up to six minutes to navigate the course, complete the challenge, and return to home base.

- Each team will **operate its mobile robot via R/C** and navigate by line of sight and by the video feed from an onboard wireless camera. The command center will be within view of the playing field, and team members must remain at the command center while competing.

- An official will be in charge of placing the team's robot at the starting point on the challenge course. (**Reminder:** The robot must fit within an 18" x 18" x 18" space at the start but **may expand to any size after it enters the neighborhood.**)

- After a "clear" signal is issued by a challenge course official, **time will begin** as soon as the robot moves. Following completion of a mission, **time will stop** upon successful return to home base following disposal of two simulated explosive ordnances.

- Robots should remain on roads and paths within the neighborhood in order to avoid property damage. Shortcuts are not allowed and will result in penalties.

- The mission will last a **maximum of six minutes**.

- Penalties:

    - A five-point deduction will be assessed each time an ordnance is dropped. If necessary, and at the request of a team member, a course official will set the ordnance upright so that the team can continue its mission.

    - All **parts** except nuts and bolts must remain attached to the robot for the duration of the mission.

    - Each time the **robot stalls or becomes hung up** and has to be freed by officials, a five-point deduction will be assessed. An official will free a robot at the request of a team member.

    - A deduction will be assessed whenever a robot goes off the designated path within the neighborhood or **outside of the course boundaries. Shortcuts are not allowed.**

- Team members are **not allowed to touch** their robot at any time while a mission is in progress, unless instructed to do so by a judge.

- An official will award points for the team's mission based on the official **"Challenge Field Skills" rubric**. The team ranking for the total time to complete the mission will be used to determine bonus points within the rubric.

Standards & Competencies

RR 1.0 Demonstrate knowledge in safety rules and practices

1.1 Maintain a safe work area.
1.2 Demonstrate safe and correct use of hand tools.
1.3 Follow safety rules during robotic assembly.
1.4 Demonstrate safe operation of robotic equipment in tele-op mode.

RR 2.0 Produce Technical Documentation

2.1 Keep an engineering notebook detailing design discussions, design details, design changes, and troubleshooting notes.
2.2 Develop a technical drawing of the final competitive robot design.
2.3 Produce a bill of materials for the final competitive robot design.
2.4 Explain design choices and changes made within the engineering design process.

RR 3.0 Demonstrate knowledge of robot parts

3.1 Identify mechanical and electrical parts of the final robot design.
3.2 Demonstrate understanding of the mechanical and electrical functions of the parts of the final robot design.

RR 4.0 Demonstrate understanding of robot mechanical systems

4.1 Identify mechanical systems within the final robot design.
4.2 Demonstrate the function of control systems of the final robot design.
4.3 Demonstrate and explain the functioning of the drivetrain of the robot.
4.4 Demonstrate and explain the functioning of the package delivery system of the robot.

RR 5.0 Demonstrate understanding of robot electrical systems

5.1 Identify electrical/electronic systems within the final robot design.
5.2 Demonstrate and explain the function of electrical control systems of the final robot design.

RR 6.0 Demonstrate tele-op skills and real-time problem solving

6.1 Demonstrate ability to safely and quickly maneuver the robot through rough and unknown terrain via tele-op.
6.2 Demonstrate ability to overcome challenging areas of course terrain via tele-op.
6.3 Demonstrate ability to locate objects through remote robotic manipulation via tele-op.
6.4 Demonstrate ability to transport objects via tele-op.

RR 7.0 Demonstrate ability to present and explain technical information

7.1 Demonstrate correct and effective use of oral, written, and technological tools to present technical information regarding engineering design process, robot construction, and robotic tele-op control.

7.2 Demonstrate knowledge of design choices and implementations during the engineering design process.

7.3 Demonstrate knowledge of team processes and individual team member contributions.

Committee-Identified Academic Skills

Math Skills

- Students use fractions in contextual applications to solve problems.
- Students use percentages in contextual applications to solve problems.
- Students solve problems through the contextual application of proportions.
- Students measure time, distance, and angles within contextual problem-solving applications.
- Students simplify numeric expressions.
- Students use comparisons, predictions, and inferences in analyzing data to solve a problem.
- Students utilize modeling techniques to solve problems.
- Students write and solve algebraic expressions in one or more variables.
- Students use derived measurements to solve problems.

Science Skills

- Students apply the scientific method to plan and conduct experiments.
- Students apply knowledge of heat, sound, mechanical, chemical, electrical, and light energy within contextual problem-solving applications.
- Students apply knowledge of kinetic and potential energy in contextual applications to solve problems.
- Students apply knowledge of Newton's laws of motion to solve problems.
- Students apply knowledge of simple and compound machines to solve problems.
- Students apply knowledge of gears, motors, and linkages to solve problems within contextual applications.
- Students use formulas to solve problems.
- Students apply scientific knowledge within the engineering design process.
- Students apply knowledge of force and motion concepts in contextual problem solving.

Engineering Skills

- Students apply the engineering design process to solve a contextual problem.
- Students apply the principles of circuit analysis.
- Students apply the elements of circuit design and construction.
- Students understand and apply energy and power types, sources, and conversions.

- Students apply methods of maintaining, servicing, troubleshooting, and repairing systems.
- Students apply skills and techniques related to building, repairing, and maintaining robotic mechanisms.
- Students apply techniques and technologies related to the production of technical drawings.
- Students apply basic mechanical skills related to robotic design, construction, and troubleshooting.
- Students understand and apply knowledge of safety during construction and use of equipment.
- Students apply problem-solving and engineering-design processes to solve unforeseen challenges.

Language Arts Skills

- Students make effective use of spoken, written, and visual communications with team members within the problem-solving and engineering-design processes.
- Students make effective use of spoken, written, and visual communications with a variety of audiences.
- Students use appropriate information resources within the research-and-design process.
- Students organize and synthesize information for use in research-and-design processes and in formal presentations.
- Students demonstrate the ability to correctly read and interpret rules, instructions, and specifications within the robotic challenge.
- Students demonstrate the proper use of language, both written and verbal.

RoboRescue Challenge – Possible Points: 200

Team: _____

Robot Drive Chassis & Technical Drawing

Objective	Points Performance Level					Poin
	5	10	20	30	40	
Design, construction, and durability of power drive-system assembly (gears, chain, sprocket, wheels, treads, and so forth)	Drive-system assembly is poorly designed or constructed and lacks durability.	Drive-system assembly demonstrates adequate design, construction, and durability.	Drive-system assembly demonstrates average design, construction, and durability.	Drive-system assembly demonstrates above-average design, construction, and durability.	Drive-system assembly demonstrates excellent design, construction, and durability.	
Electrical components installation and wire management	Poor effort given to wire routing and safety management.	Minimal effort given to wire routing and safety management.	Average effort given to wire routing and safety management.	Above-average effort given to wire routing and safety management.	Excellent effort given to wire routing and safety management.	
Basic driving performance test (FWD, REV, turn right, turn left)	Robot chassis does not function in any capacity when demonstrated.	Robot chassis powers up but performs only one basic control function.	Robot chassis powers up but performs only two basic control functions.	Robot chassis powers up but performs only three basic control functions.	Robot chassis powers up and performs all four basic control functions.	
Technical drawing quality	Drawing detail and quality are inferior.	Drawing detail and quality are adequate.	Drawing detail and quality are average.	Drawing detail and quality are above average.	Drawing detail and quality are excellent.	
Accuracy of technical drawing to assembled drive train	Technical drawing does not match assembled drive train.	Technical drawing matches few components of the assembled drive train.	Technical drawing matches major components of the assembled drive train.	Technical drawing matches all major and most minor components of the assembled drive train.	Technical drawing matches all major and all minor components of the assembled drive train.	
					Total:	

Judge's comments:

RoboRescue Challenge – Possible Points: 150

Team: _____

Arm Mechanism

Objective	Points Performance Level					Points
	10	20	30	40	50	
Performance test of arm mechanism	Arm mechanism does not function in any capacity.	Arm mechanism functions unreliably and is poorly engineered.	Arm mechanism functions satisfactorily but lacks engineering efficiency.	Arm mechanism functions well and is moderately engineered.	Arm mechanism functions reliably and is well constructed and engineered.	
Arm stability and clearance to robot drive chassis	Arm is not stable and does not clear the robot drive chassis at all points.	Arm is not stable but clears the robot drive chassis at all points.	Arm is stable but does not clear the robot drive chassis at all points.	Arm is stable and clears the robot drive chassis at all points.	Arm is very secure and clears the robot drive chassis at all points.	
Appropriateness of arm end effector to size and weight of ordnance	Ordnance does not fit into arm end effector with sufficient freedom to allow transport and disposal.	Ordnance fits into arm end effector with sufficient freedom to allow transport, but device lacks the ability/strength to effectively dispose of the ordnance.	Ordnance fits into arm end effector with sufficient freedom to allow transport and has minimal ability/strength to effectively dispose of the ordnance.	Ordnance fits into arm end effector with sufficient freedom to allow transport and has adequate ability/strength to effectively dispose of the ordnance.	Ordnance fits into arm end effector with sufficient freedom to allow transport and exceeds the amount of ability/strength to effectively dispose of the ordnance.	
					Total:	

Judge's comments:

RoboRescue Challenge – Possible Points: 150

Team: _____

Engineering Technician Notebook

Objective	Points Performance Level					Points
	10	20	30	40	50	
Overall content format and appearance	Notebook did not follow mission format/guidelines or demonstrate understanding of task.	Notebook adequately follows some, but not all, of the mission format/guidelines and demonstrates understanding of task.	Notebook adequately follows mission format/guidelines and demonstrates understanding of task.	Notebook meets the mission format/guidelines and demonstrates understanding of task.	Notebook is outstanding and goes above and beyond format/guidelines and demonstrates understanding of task.	
Logical structure and documentation	Team did not document the project in a satisfactory manner.	Team adequately documents project but lacks logical flow and structure of project from start to finish.	Team completed documentation, flow, and structure in an average manner, but more could have been done.	Team documented the project "journey" with good flow and structure from beginning to end.	Team's documentation of project demonstrates an effort that goes above and beyond.	
Technical accuracy and bill of materials	Technical content (descriptions, sketches, drawings, tables, and figures) does not match robot project build.	Technical content (descriptions, sketches, drawings, tables, and figures) matches robot project build in a satisfactory manner.	Technical content (descriptions, sketches, drawings, tables, and figures) adequately matches robot project build.	Technical content (descriptions, sketches, drawings, tables, and figures) matches robot project build.	Technical content (descriptions, sketches, drawings, tables, and figures) matches robot project build with outstanding detail and clarity.	
					Total:	

Judge's comments:

RoboRescue Challenge – Possible Points: 150

Team: _____

Technical Presentation

Objective	Points Performance Level					Points
	10	20	30	40	50	
Explanation of mechanical systems within the robot	Demonstrates little knowledge of mechanical parts and their functions.	Demonstrates minimal knowledge of mechanical parts and their functions.	Demonstrates adequate knowledge of mechanical parts and their functions.	Demonstrates a working knowledge of mechanical parts and their functions within the mechanical system.	Demonstrates a thorough knowledge of mechanical parts and their functions within the mechanical system.	
Explanation of electrical systems within the robot	Demonstrates little knowledge of electrical parts and their functions.	Demonstrates minimal knowledge of electrical parts and their functions.	Demonstrates adequate knowledge of electrical parts and their functions.	Demonstrates a working knowledge of electrical parts and their functions within the electrical system.	Demonstrates a thorough knowledge of electrical parts and their functions within the electrical system.	
Description of design challenges and solutions implemented for the robot	Demonstrates little knowledge of design challenges faced or solutions implemented.	Demonstrates minimal knowledge of design challenges faced and solutions implemented.	Demonstrates adequate knowledge of design challenges faced and solutions implemented.	Demonstrates a working knowledge of design challenges faced and solutions implemented.	Demonstrates a thorough knowledge of design challenges faced and solutions implemented.	
					Total:	

Judge's comments:

RoboRescue Challenge – Possible Points: 250

Team: _____

Challenge Field Skills

Objective	Points Performance Level						Points
	50	100	150	170	200	Time	
Challenge Course Mission: Ordnance retrieval and containment	Robot became disabled on the course and could not continue.	Robot found at least one of the ordnances but was unable to retrieve and dispose of it.	Robot was able to retrieve and dispose of one of the ordnances.	Robot was able to retrieve and dispose of both of the ordnances, but not within the allotted time.	Robot was able to retrieve and dispose of both of the ordnances within the allotted time.		

Point Deduction Worksheet

Infraction	Number of Incidents	Points to Deduct
Loss of ordnance (5 points per incident)		
Vehicle stalled (5 points per incident)		
Robot intentionally outside of boundaries (25 points per incident)		
Deduction Total (insert into main scoring rubric)		

Total Time		
1st Place Time . . . . . 50 points Top 25% of times . . . . . 30 points 26% to 50% of times . . . 10 points **Time Bonus**		
Challenge Field Points (subtotal)		
Deduction Total (from Point Deduction Worksheet)		
Challenge Field Point Total		

Judge's comments:

RoboRescue Challenge – Possible Points: 100

Team: _____

Written Test

Topical Area	Number of Questions	Points Possible per Question	Points Possible	Points Scored
Terminology	7	5	35	
Mechanisms	8	5	40	
General Robotics (including Asimov's Laws of Robotics)	5	5	25	
			Total:	

Judge's comments:

Team: _____

Total Possible Points: 1,000

Category	Possible Points	Points Scored	Judge's Comments
Robot Drive Chassis & Technical Drawing	200		
Arm Mechanism	150		
Engineering Technician Notebook	150		
Technical Presentation	150		
Challenge Field Skills	250		
Written Test	100		
Team Total:	**1,000**		

(A) RoboRescue Challenge Kit

RoboRescue Challenge Kit Bill of Materials	
Item	**Quantity**
4" Wheel	6
16T Sprocket	4
24T Sprocket	6
32T Sprocket	2
Chain w/Link	1
Chain Breaker	1
Gear Hub Spacer	10
100 mm Axle	12
DC Drive Motor	2
Motor Mount	2
Axle Set Collar	12
288 mm Channel	6
160 mm Channel	4
96 mm Channel	4
32 mm Channel	6
L Bracket	6
Flat Building Plate	2
Flat Bracket	6
Standoff Post	12
1" Standoff Post	12
180 Servo	2
Single Servo Bracket	2
Bronze Bushing	24
Axle Hub	12
Motor Hub	2
1/8" Axle Spacer	24
3/8" Axle Spacer	6
Motor Power Cable	2
On/Off Switch	1
12-volt TETRIX Battery	1
Motor Speed Controller	1
1/2 SHCS	200
Hex Keys	1
Zip Tie Pack	20
Kep Nut	200
3/8" SHCS	50
NiMH Battery Charger	1
4ch R/C Controller	1
288 mm Flat Bar	4
Servo Pivot w/Bearing	1
80T Gear	2
900 MHz Camera	1
9-volt Adaptor	1
Camera Mount	1
40T Gear	2
Electronics Deck	1
Green Bin	1
Lid	1
Top Card	1
Side Label Sticker	1
User Guide	1

Camera Pack	
Item	**Quantity**
900 MHz Camera	1
9-volt Adaptor	1
Camera Mount	1

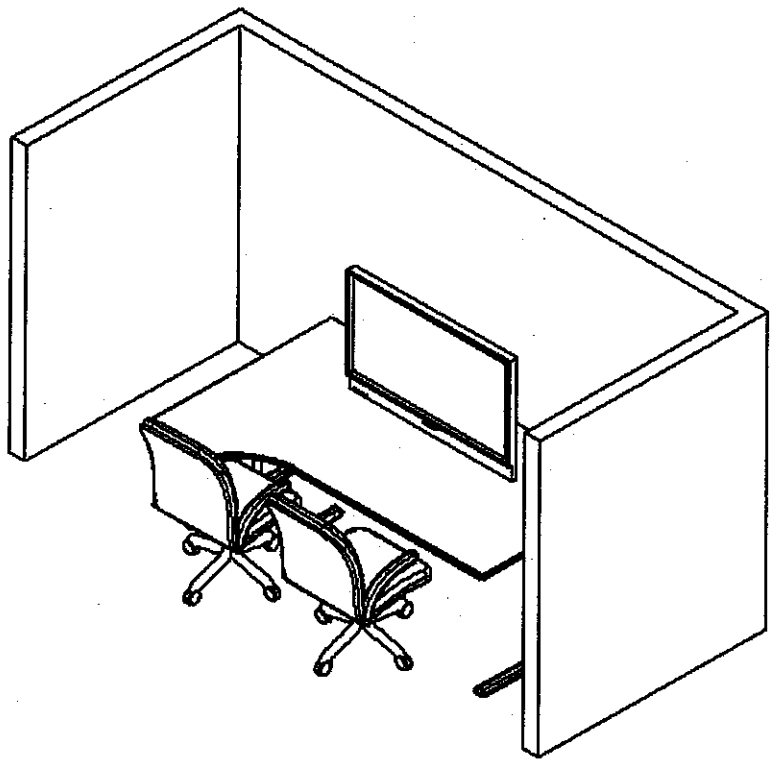
Control System	
Item	**Quantity**
2.4 GHz 4ch R/C Controller	1

Additional parts and raw materials legal for use:

- TETRIX Building System parts (http://shop.pitsco.com/roborescue, 800-835-0686, or roborescue@pitsco.com)
- Other robot parts similar in size and design to RoboRescue Challenge Kit materials
- (1) 12" x 24" sheet of acrylic plastic, maximum thickness of 0.250"
- (1) 12" x 24" sheet of aluminum, maximum thickness of .080"
- Raw material used for fabricating custom robot parts

(B) Command Center

- (1) Six-foot table or equivalent
- (2) Chairs
- (1) Video monitor connected to 900 MHz camera receiver (camera and receiver included in RoboRescue Challenge Kit)
- Access to a 120-volt electrical outlet



RoboRescue Command Center

Engineering Journal Worksheet

Objectives	Achievements	Issues and Concerns

Create a rough sketch of your robot. Create a legend with symbols for specific components of your robot, such as sensors and motors.

	Legend

Engineering Journal Worksheet

Explain the testing that was done with the robot you created to make sure it could perform your objectives.

If the robot could not perform all of your objectives, what steps did you take to redesign the robot so that it could complete the exercise?

Describe what technical skills you learned in this activity? (For example: building, wiring, designing)

Describe the nontechnical skills you have learned in this activity? (For example: teamwork, communication)

From your experiences in building this robot, list some ideas for other robots, or for modifications to this robot. Please include what objectives would be met with the new designs, and what steps would need to be taken to meet those objectives.

(D) 2013 Challenge Field