Robots for Urban Search and Rescue

Performance Metrics and Standards

ASTM
E54.08.01

January 30, 2008

Homeland Security

ASTM INTERNATIONAL

NIST
National Institute of Standards and Technology
Technology Administration, U.S. Department of Commerce

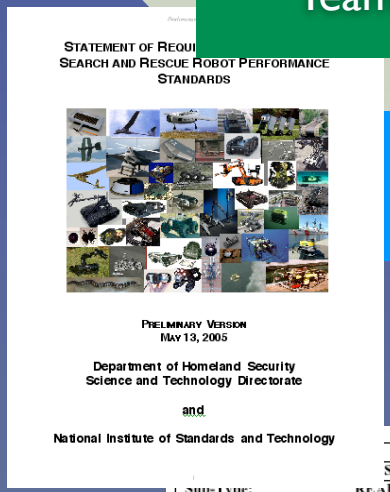
Scope Statement

- The scope of the task group is to specify a set of performance requirements, test methods, and associated standards for robot systems used in urban search and rescue applications. Emergency responders, pertinent technology developers, and interested government officials have defined these standards to provide an objective measure of robot performance for representative urban search and rescue applications. Results from such performance tests can be considered against specific purchaser/user performance objectives for envisioned applications.
  - These standards specify a variety of performance criteria and associated test methods for urban search and rescue robots. Several representative applications of robots used in urban search and rescue have been considered in defining these test methods. These representative applications, although comprehensive, are certainly not complete.
  - The standards developed by this task group will provide a means to ensure that a robot meets the performance requirements stated. Successful completion of the tests should not be construed as an ability to successfully operate in environments other than those specifically identified in the test methods.
  - These standards do not address special applications outside the stated requirements, such as certain extreme weather conditions for example. To ensure performance for such applications, additional requirements need to be established along with associated standards.

US&R Robot Standards: The Big Picture

Requirements from FEMA Teams → Standard Test Methods → "Consumer's Guide"

Responders Meet Robots Exercises

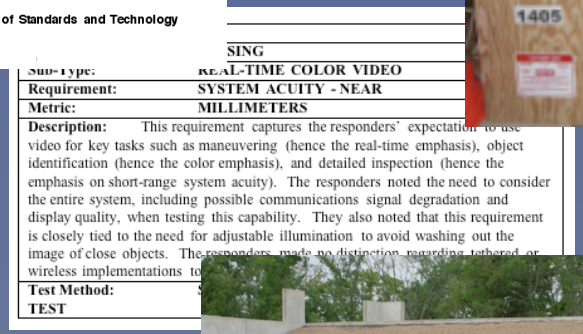

STATEMENT OF REQUI
SEARCH AND RESCUE ROBOT PERFORMANCE STANDARDS

PRELIMINARY VERSION
MAY 13, 2005

Department of Homeland Security
Science and Technology Directorate

and

National Institute of Standards and Technology


	SING
Sub-Type:	REAL-TIME COLOR VIDEO
Requirement:	SYSTEM ACUITY - NEAR
Metric:	MILLIMETERS
Description:	This requirement captures the responders' expectation to use video for key tasks such as maneuvering (hence the real-time emphasis), object identification (hence the color emphasis), and detailed inspection (hence the emphasis on short-range system acuity). The responders noted the need to consider the entire system, including possible communications signal degradation and display quality, when testing this capability. They also noted that this requirement is closely tied to the need for adjustable illumination to avoid washing out the image of close objects. The responders made no distinction regarding tethered or wireless implementations to
Test Method:	
TEST	

Working Groups within E54.08.01

- Logistics - Bob McKee, FEMA Texas TF-1, Elena Messina, NIST
- Communications - Kate Remley, Galen Koepke, NIST
- Human-System Interaction - Sal Schipani, NIST
- Sensing - John Evans, John Evans LLC
- Mobility - Bill McBride, SwRI; Adam Jacoff, NIST
- Safety and Operating Environment - Mark Micire, UML and American Standard Robotics
- Power - Jim Rogan, Jim Kozlowski, Penn State Applied Research Laboratory
- Terminology - Hui-Min Huang, NIST

Standards Process Status

- 6 Work Items introduced; 3 balloted
  - ✓Visual Acuity and Field of View
  - ✓Terminology
  - ✓Logistics, Cache Packaging
  - – Human-System Interaction: Usability
  - – Communications: Line of sight and Non-line of sight wireless
  - – Mobility
- Additional ones in queue
  - – Safety; Power

Terminology

- E2521-07a Standard Terminology for Urban Search and Rescue Robotic Operations
- WK14885 Revision of E2521-07 Standard Terminology for Urban Search and Rescue Robotic Operations
  - Balloted, but negative votes related to whether terms are not specific to US&R robots and ought to be at the E54 level
  - However E54.92 has not been active
  - Next steps?

Logistics

- E2592-07 Standard Practice for Evaluating Cache Packaged Weight and Volume of Robots for Urban Search and Rescue

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Sample Data Collection Form

Standard Practice For Response Robots

Logistics - Cache Packaging

Robot: _____ ☐ TETHER ☐ RF

Operator: _____ Org:: _____

Training: ☐ 0-24 HRS ☐ 24-100 HRS ☐ > 100 HRS

INSTRUCTIONS: 1) Note the number and weight of each loaded container necessary for robot to deploy for 10 days, without re-supply for the first 72 hours. 2) Time the setup process until robot is operational. 3) Weigh the deployable robot and operator control unit. 4) Note the tools needed to perform setup and repair.

Planning for a 10 day deployment, without resupply for the first 72 hours

Number of packages plus total weight for each type of package

_____ Pelicans _____ kg or _____ lb

_____ Hardiggs _____ kg or _____ lb

_____ Ropaks _____ kg or _____ lb

_____ Pallets _____ kg or _____ lb

Pallet dimension: _____ x _____ mm (_____ x _____ in)

Total Weight: _____ kg or _____ lb

NOTE: Brand name packaging is listed on this form. See text of standard practice for equivalent dimensions if another brand can be used.

Measure the length of time to unpackage the robot system and fully prepare it for deployment.

Setup Time:

Start Time: _____

End Time: _____

Elapsed: _____ minutes

Down-Range Weight:

Robot: _____ kg Operator Control Unit: _____ kg Total: _____ kg

Robot: _____ lbs Operator Control Unit: _____ lbs Total: _____ lbs

Setup and Repairs can be performed at the base of operation

Tools Needed:

☐ None

☐ Typical Toolbox: Metric or English (circle one)

☐ Any Specialized Tools: Describe: _____

Describe: _____

Describe: _____

TEST LEADER DATE NOTES ☐

Sensors

- WK10336 Standard Test Method for Evaluating Visual Acuity of Video Sensing for Robots for Urban Search and Rescue

Upcoming Ballots

- WK11331 Standard Test Method for Evaluating the Usability of the Human-robot Interface for Robots for Urban Search and Rescue
- WK12399 Practice for Evaluating the Cache Packaging Weight and Volume of Robots for Urban Search and Rescue
- WK14437 Evaluating the Performance of Radio (Wireless) Communication Links used for the Control and Telemetry Systems on Urban Search and Rescue Robots
- WK15347 Practice for Evaluating Ground Mobility of Robots for Urban Search and Rescue Applications

Today's Agenda

- 8:15-10:30 Work Group Updates
  - Sensors WG: John Evans
  - Communications WG: Galen Koepke
  - Mobility WG: Adam Jacoff
  - Power WG: Adam Jacoff
  - Safety & Operating Environment WG: Mark Micire
- 10:30 - 11:00 General Discussion, Future Directions

Requirements Addressed in Wave 1

Requirement #‡	Requirement
38	Logistics-Cache Packaging-Volume
34	Logistics-Cache Packaging-Weight
36	Logistics-Cache Packaging-Setup Time
96	Sensing-Vision System-Acuity, Near
99	Sensing-Vision System-Acuity, Far
101	Sensing-Vision System-Field of View
14	Human-System Interaction - Acceptable Usability
3	Chassis - Adjustable Illumination
6	Communications-Range NLOS
8	Communications-Range LOS

‡ References original requirements in Preliminary Report. See http://www.isd.mel.nist.gov/US&R_Robot_Standards

Requirements Addressed in Wave 1

Requirement # ‡	Requirement
59	Payload-Manipulation
65	Payload-Retrieval
60	Payload-Manipulation-Sensor Manipulation
45-47	Mobility-Locomotion-sustained speed
44	Mobility-Aerial-Stationkeeping
new	*Mobility-Vertical Climbing*
new	*Mobility-Locomotion-Random Step Fields*
new	*Mobility-Stair Climbing*
new	*Mobility-Ramps*
new	*Mobility-Confined Space Access*
new	*Sensing-Vision System-Acuity, Aerial*

‡ References original requirements in Preliminary Report. See http://www.isd.mel.nist.gov/US&R_Robot_Standards