RoboCup Rescue Rulebook

(as of 2017-07-21)
Version 1.5 (with FAQ section)

Overview of Changes from 2016

- Changed the Best in Class certificates to have four classes: Best in Class Autonomy; Best in Class Dexterity; Best in Class Mobility; Best in Class Small Robot
- Readiness test can start as soon as the team is ready
- The TC might decide to perform the readiness test after the runs (e.g. on the second day)
- Shortened teleop time from 15 to 10 minutes
- Increased autonomy time from 5 to 10 minutes
- Added the option to perform semi-autonomous tasks during the autonomy
- Small robots optionally can also enter through a 50cm diameter pipe (as alternative to 60cm square vertical insertion)

Organizational:

- We will ask each team to nominate one team judge (very small teams are excused). The team judge should have a decent level of English. The team judges will be trained during the last setup day and perform task adjudication. Team judges are not allowed to judge their own team, nor teams from the same country as their own team nor the country that they are citizen of.
- Wifi for RoboCup Japan 2017:

  Wireless LAN is limited to 5 GHz band.
  See the RoboCup2017 Wireless LAN Guideline
  https://www.robocup2017.org/file/RoboCup2017_WirelessGuideline_0712.pdf

Concept for RoboCup Rescue

The main objective of our league is to conduct challenging and fair competitions that inform teams about the tasks necessary to be effective for responders. We also need to measure progress in our robotic systems to highlight breakthrough capabilities that responders can understand and appreciate. Ten or more successful repetitions begin to indicate a reliable capability. A series of trials across a suite of complementary tests begin to evaluate the system.

The RoboCup Rescue competition is organized in a format that resembles Response Robot Exercises. These have been effective in communicating capabilities between robot manufacturers and responders. Each robot will be evaluated in standard and draft standard test methods during Preliminaries to demonstrate functionality, reliability, operator proficiency, and autonomous/assistive capabilities. The resulting scores will qualify them for a "deployment" into a more complicated scenario in the Finals. This will enable concurrent testing opportunities for more robots to capture statistically significant performance. It will also encourage testing in more complex or difficult settings, challenging robots beyond their comfort level to compile more points.

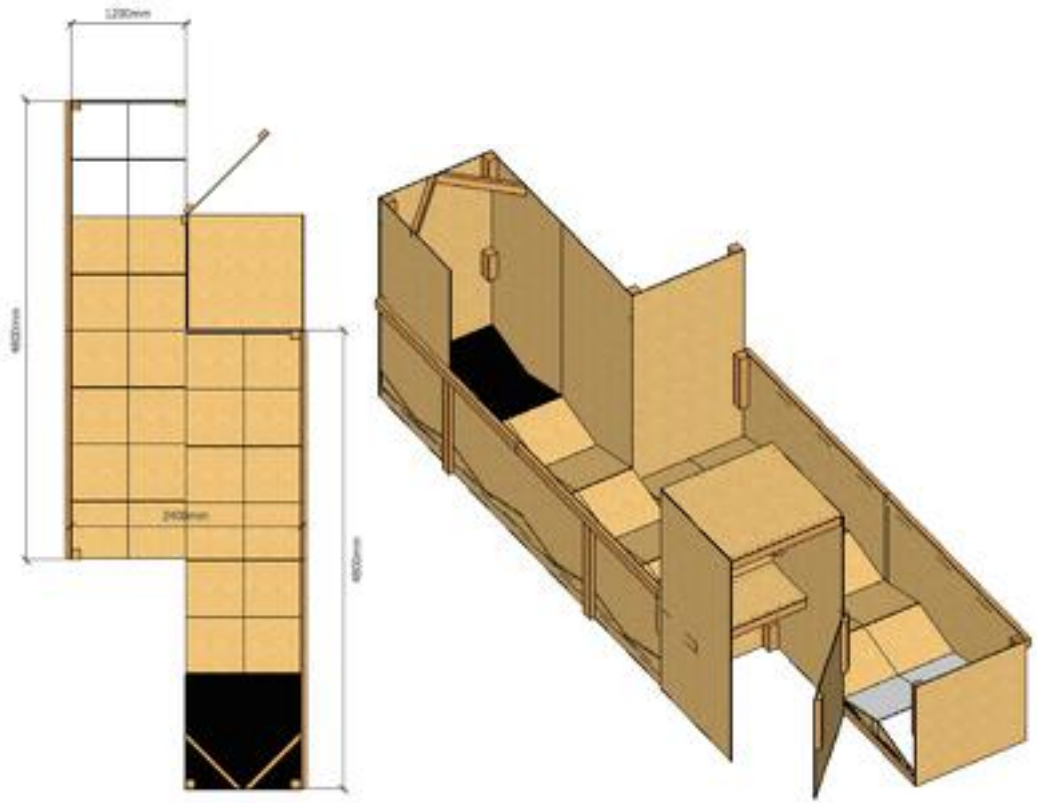
The Finals will remain a comprehensive search and identification of simulated victims in the overall maze for the best performing robots. Each qualified team is allowed one robot. The maze will consist of all the same test apparatuses and tasks. As always, the search scenario will be conducted from random start zone and performed in any order of tasks the team chooses.

Again we will instantiate a rigorous, standardized process for practicing and measuring league capabilities throughout the year, with competitions being the public demonstration of those capabilities and sharing of results. So we encourage you to build and practice these tests during your development. Then demonstrate your capabilities at competition time for scores.

This new structure will help our league communicate emerging capabilities to responders and allow them to guide such capabilities toward deployment. Local responders may come watch the competition and potentially demonstrate their own robots. This will familiarize them with the test methods and our emerging capabilities, making RoboCup Rescue a leading incubator for robots and test methods worldwide.

1 Test Suites

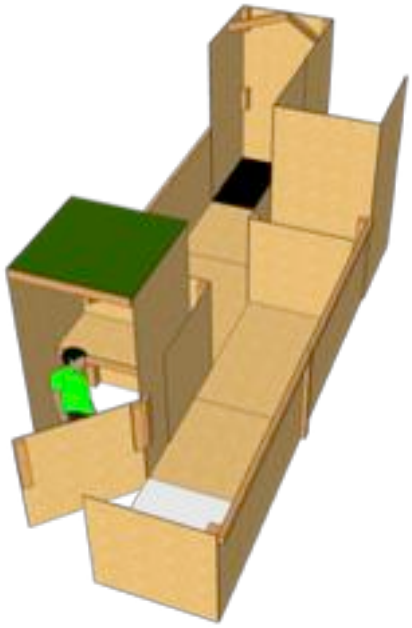
The RoboCup Rescue League competition is designed around standard robot test methods that evaluate each robot's capabilities individually in a systematic way. The new competition consists of 20 ground robot tests which are structured into four suites: Maneuvering, Mobility, Dexterity and Exploration. **All bays are 7.2m (24ft) in length and minimum of 1.2 m (4ft) in width.**

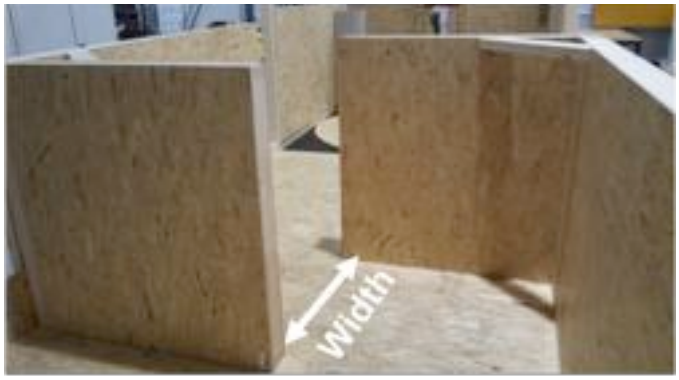


1.1 Maneuvering

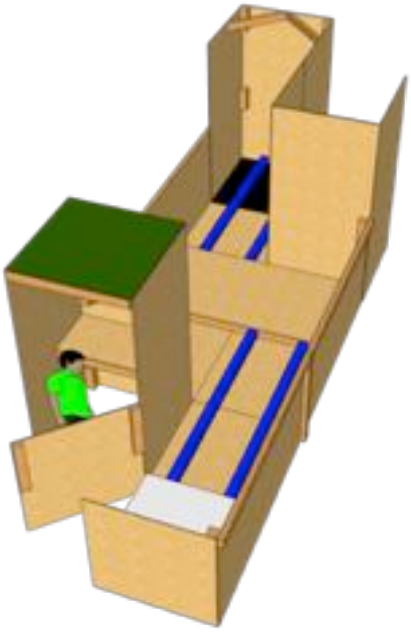
5 tests for basic driving over quite easy terrain completed in forward and (for non autonomous robots) reverse driving orientations (all tests are mandatory for each robot):

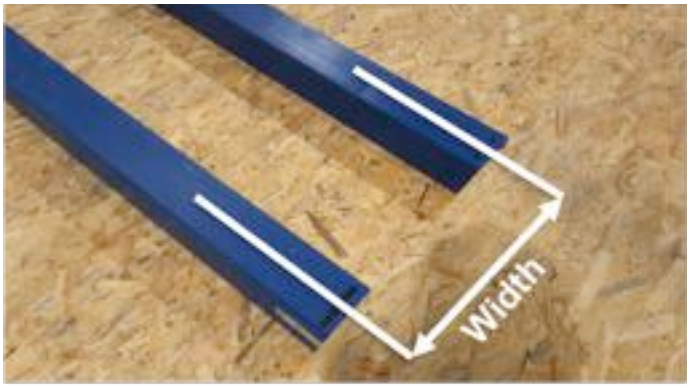
- (MAN 1) **Center**: A slalom with turn width set to the robot's diagonal ground contact dimension, challenging a robot's awareness of interactions across it's width.



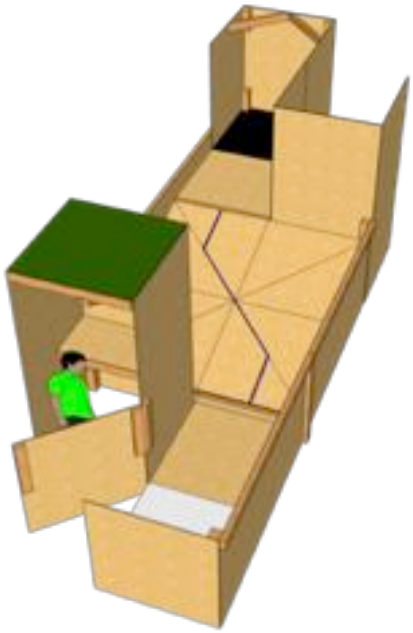


- (MAN 2) **Align**: Two bars (100 mm width) to cross which are set to the robot's outer ground contact dimension. The robot's tracks outer edges will be centered on each rail to limit left/right error similarly for various locomotion designs.

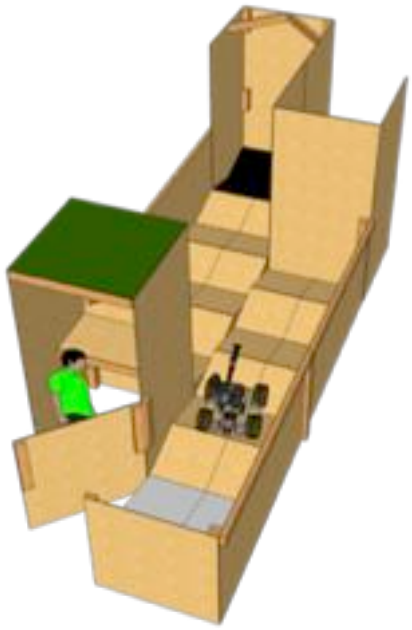




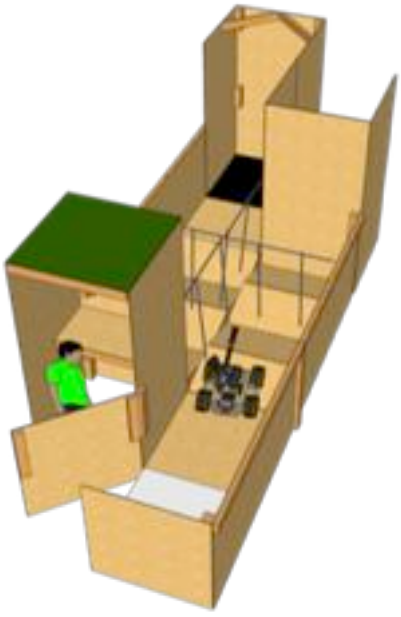
- (MAN 3) **Traverse**: A 30 degree inclined OSB surface to follow line in a zig-zag pattern both forward and reverse.



- (MAN 4) **Crossover**: A field of 15 degree ramps with a discontinuity to crossover.



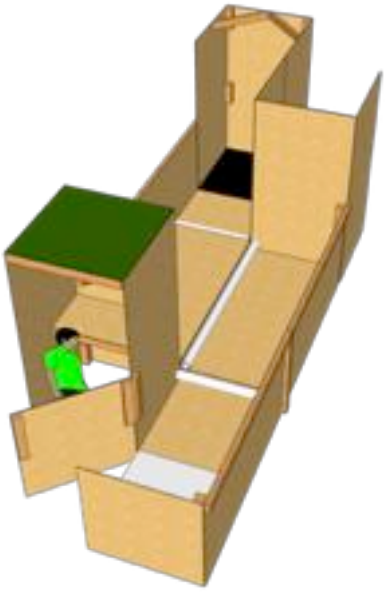
- (MAN 5) **Negotiate**: A set of movable vertical and diagonal sticks to push through (without breaking the sticks) or avoid.



1.2 Mobility

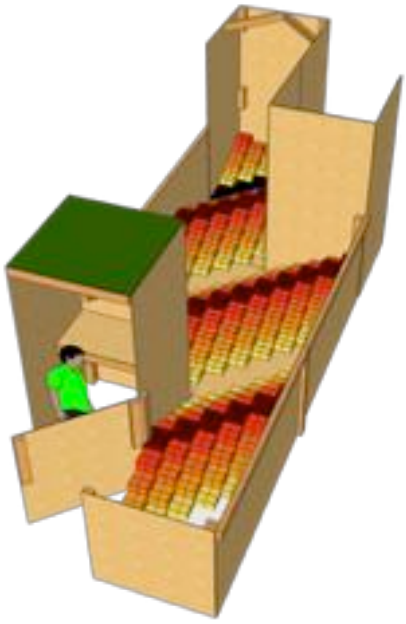
5 tests for driving over terrain with medium to hard difficulty (all tests are considered for a robot to win Best in Class Mobility). Robots are able to turn around.

- (MOB 1) **Hurdles**: A 20 cm tall rolling pipe obstacle to climb and descend.

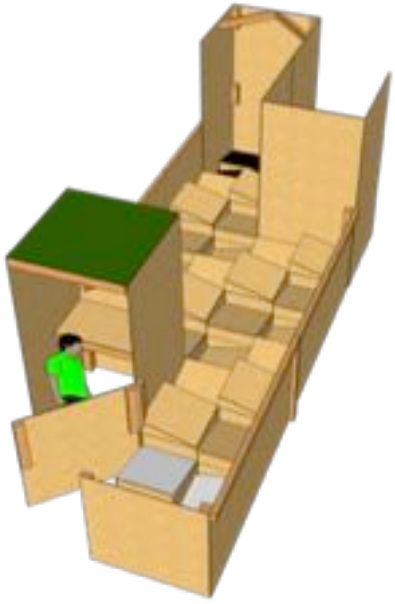


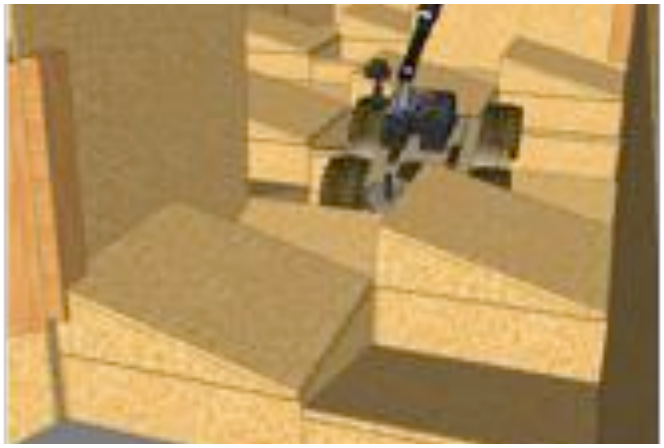
- (MOB 2) **Sand/Gravel Hills**: An alternating hill terrain with 15 degree slope.

- (MOB 3) **Stepfields**: A diagonal hill terrain consisting of 20 cm square steps made from posts with flat tops.



- (MOB 4) **Elevated Ramps**: A diagonal hill terrain consisting of 60 cm ramps with sloped tops (similar to the DARPA Robotics Challenge).



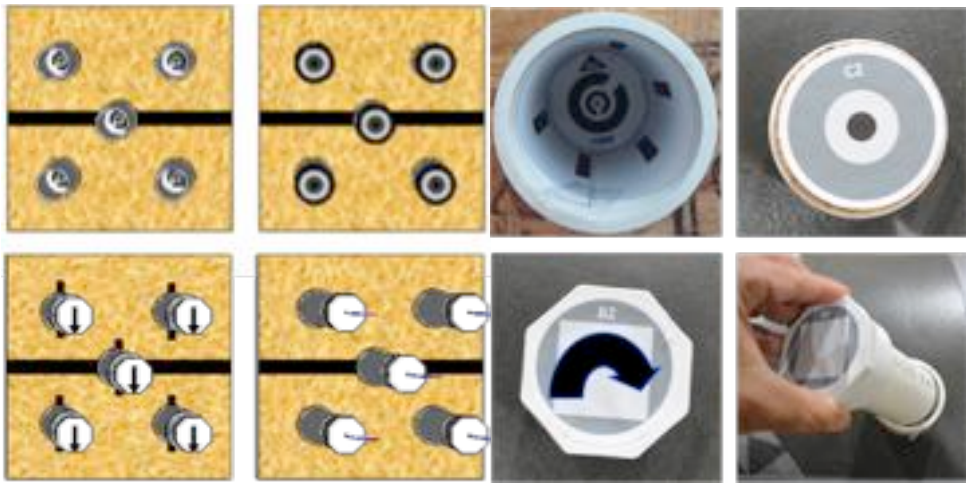


- (MOB 5) **Stair Debris**: 35 and 45 degree stair obstacle partly blocked with debris, e.g. angled bars in defined locations.

1.3 Dexterity

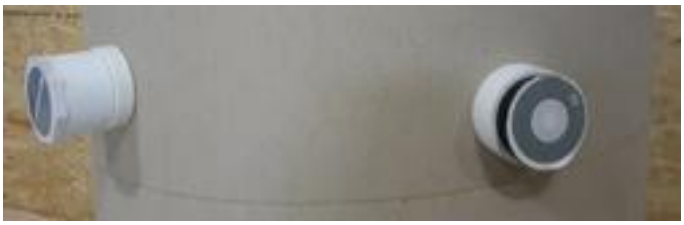
5 tests for manipulation and inspection (all tests are considered for a robot to win Best in Class Dexterity). **Pipes are 10 cm (4 in) in length and 5 cm (2 in) in diameter. Extract and rotate caps have 8 facets which are approximately 2 cm (1 in) wide.**

- (DEX 1) **Parallel Pipes**: Inspect, Touch, Rotate and/or Extract in total 20 parallel mounted pipes (mounted on 4 boards with 5 pipes on each board). This test is conducted within a terrain with ramps that requires mobility.



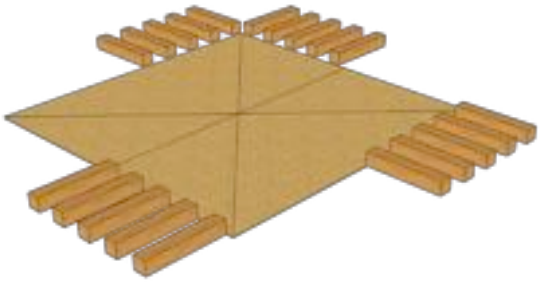
- (DEX 2) **Omni-Directional Pipes**: This is the Pipe Star variant of Parallel Pipes, but mounted in an omnidirectional orientation (tasks include Inspect, Touch, Rotate, Extract). This test is conducted on an inclined surface.

- (DEX 3) **Cylindrical Pipes**: Same as Parallel Pipes, but pipes are mounted within a 60 cm diameter cylinder placed horizontally on the ground (tasks include inspect victims inside the cylinder through holes). This test methods is conducted on a flat surface.



- (DEX 4) **Door Opening**: Open and drive through push and pull doors with lever handles. Doors **<u>will not</u>** have spring closures during the preliminaries. One door will have springs during the finals. The doors may be accessible from open 240 cm square areas or more confined 120 cm x 240 cm hallways.

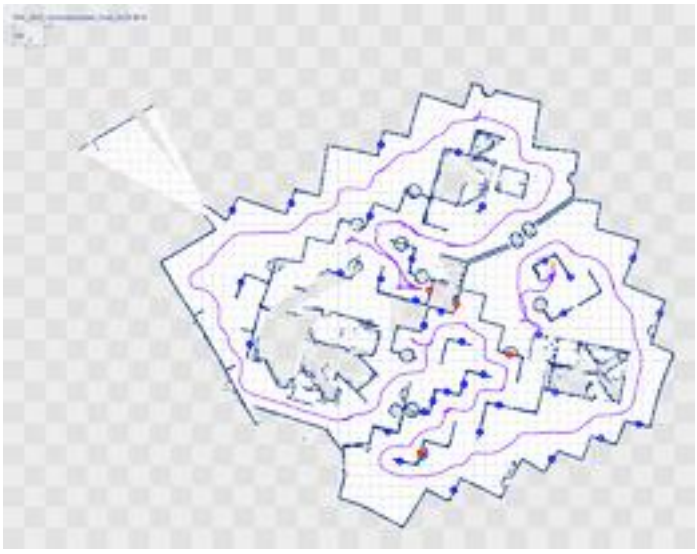
- (DEX 5) **Shoring**: Build a shoring structure composed of two wooden blocks in each layer of a vertical tower. The blocks are 600 mm (24 in) in length and approximately 1.8 kg (4lbs) in weight. This test is conducted on on a flat surface 2.4 m x 2.4 m area.



1.4 Exploration

5 tests for mapping, object/terrain recognition and detection (all tests are considered for a robot to win Best in Class Autonomy only if those tests are performed autonomously).

- (EXP 1) **Map on Continuous Ramps**: Create a 2D and/or 3D map of a dark Labyrinth while traversing modest ground complexity. This capability has to be an autonomous background service for teleop or autonomous robots.



- (EXP 2) **Map on Crossing Ramps**: Create a 2D and/or 3D map of a dark labyrinth while traversing increased ground complexity. This capability has to be an autonomous background service for teleop or autonomous robots.
- (EXP 3) **Recognize Objects:** Including QR codes, fire extinguishers, doors, simulated victims, and other items. This capability has to be an autonomous background service for teleop or autonomous robots.
- (EXP 4) **Avoid Holes**: Drive and map while avoiding amorphous negative obstacles along a robot's path - augmenting capabilities demonstrated in Align test method. This is for autonomous robots only.
- (EXP 5) **Avoid Terrains**: Drive and map while avoiding amorphous terrain obstacles without enclosing walls (e.g. stepfields, small obstacles). This is a test for autonomous robots only.

Additionally there will be a number of tests just for aerial robots and outdoor robots.

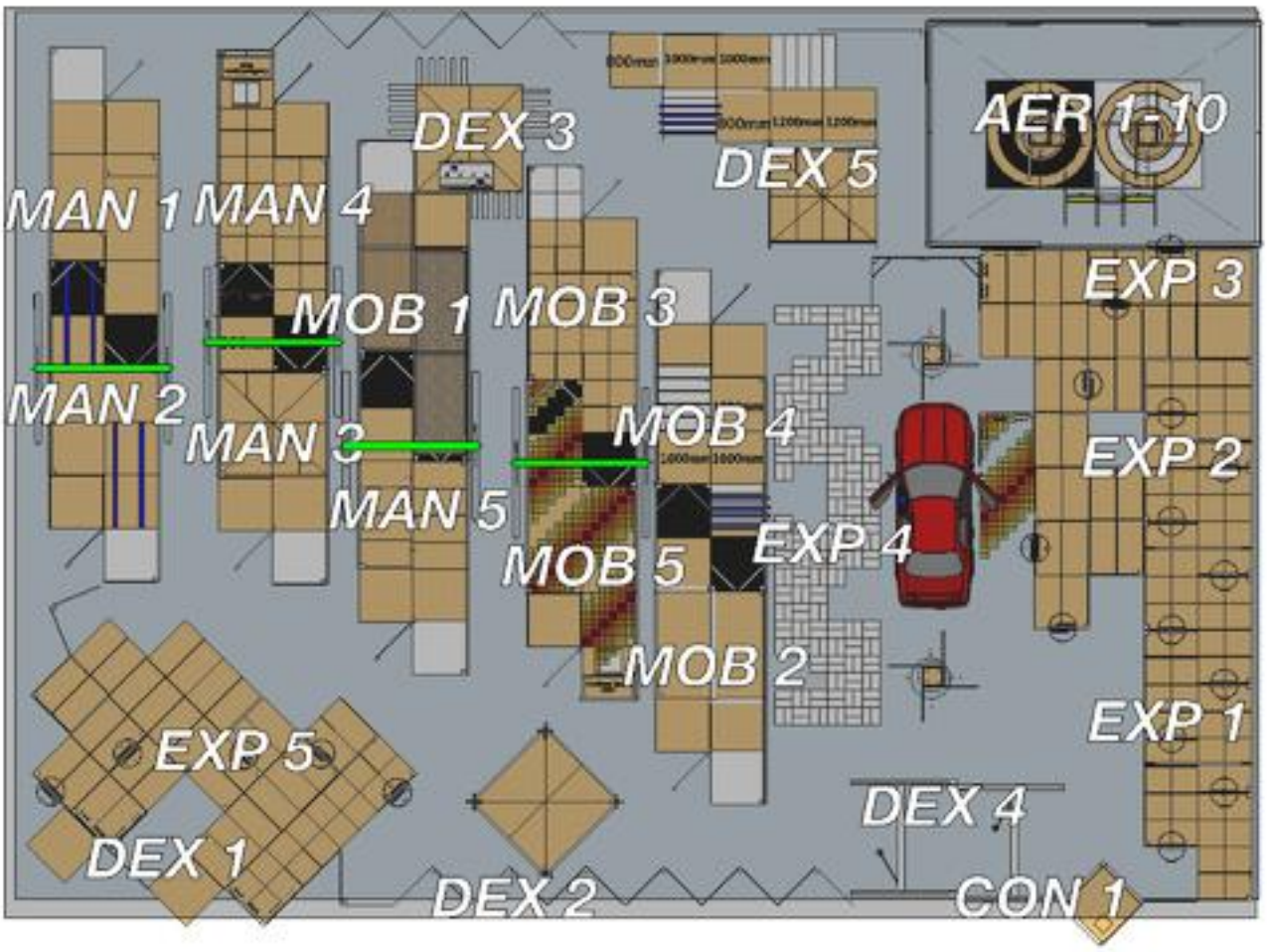


Figure 1: Sample arena layout showing locations of all the test lanes set up for concurrent operation, limited only by the number of available test administrators and radio channels.

2 Robot Configurations

Readiness check of system sensors and dexterity

The preliminary test trials have no victims. In order to reflect expected performance in the finals where robots are expected to locate victims, at the start of each trial, the robot will perform a set of 6 inspection and 4 dexterity tasks. The number of successfully completed tasks will form a multiplier on the test trial score. This encourages more capable systems toward the finals and expects less capable systems to be much more efficient in performing each task. Teams may trade off between spending longer on this task to yield an increased multiplier, or spending more time performing repetitions in the trial.

The 6 identification tasks, worth 1 point each:

- **Video Image Resolution:** Use any ca*mera to either teleoperatively identify the middle concentric C gap relative to the center of the of the 4 square panel (answer shown = 0°), or autonomously identify the middle size QR code and display correctly on the OCU display*
- **Motion Detection**: Use any camera and integrated video processing to correctly identify the number of moving targets (1-4) automatically, not by operator. Highlight (e.g. draw a rectangle around the area) and track the identified motions in the OCU display and textually or audibly warn the operator about such motions. Teleoperatively initiating this capability for a stationary robot is permitted.
- **Thermal Image Resolution**: The operator identifies the concentric Landolt C with a 2 cm gap to evaluate thermal resolution (regardless of the robot being teleoperated or autonomous).
- **Audio Acuity**: Use system microphones and speakers to correctly identify 2 lines which consists of 5 random numbers for each line. Random number strings (5 single digits each) will be articulated by a computer voice in .
- **Color/Pattern Recognition:** Use any camera and integrated video processing to correctly identify 3 of 4 hazmat labels from a known set of 12 possible. Highlight and track the identified labels in the OCU display and textually or audibly warn the operator about such hazards. The labels can be found at http://wiki.robocup.org/images/2/27/Hazmatlabels.pdf
- **Gas**: Operator demonstrates active display of increase in CO_2 concentration when a team-mate breaths into the robot's sensor or a CO_2 cartridge is opened near the sensor.

Figure 2: Identification Tasks.

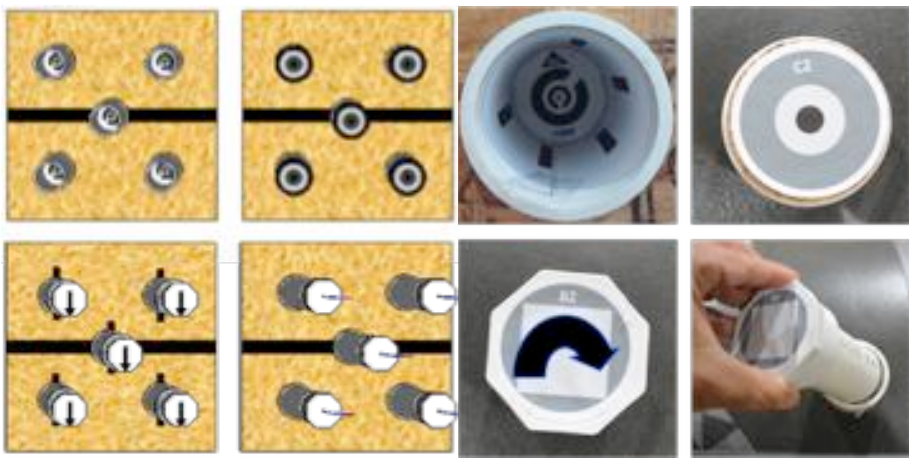


Figure 3: Dexterity tasks

The 4 dexterity tasks, worth 1 point each:

- **Inspect**: Identify the number of bars placed on the internal walls of a 5 cm pipe.
- **Touch**: Touch a 1 cm diameter circular target on the end of a pipe.
- **Rotate**: Grab a 5 cm octagonal pipe cap and rotate 180 degrees.
- **Extract**: Grab a 5 cm octagonal pipe cap and pull out of the pipe.

3 Robot Classes

Autonomous, Telepoerated and Small Robots are compared together as they compete the exact same terrain, obstacle, or task repetitions. Outdoor CarryBot and MicroAerial will be compared separately on a subset of terrains/obstacles. A repetition consists of successful completion of a terrain or obstacle from start zone to end zone, or a dexterity task.
A robot may be in more than one class. The classes are:

- **Autonomous Robot**: A robot that completes a repetition without intervention by a single operator in a remote operator station. Any repetition (which is a subtask such as driving from the start zone to the end zone or the other way) that requires operator intervention is considered a teleoperation repetition. This could be a robot that entered the test lane either through the 120 cm door or 60 cm vertical entry. Only the team's Primary robot can qualify for the Best in Class "Autonomous Robot" award.
- **Teleoperated Robot**: A robot that completes a repetition with any intervention by a single operator in a remote operator station. This could be a robot that entered the test lane either through the 120 cm square door or the 60 cm square vertical entry hole. Only the team's Primary robot can qualify for the Best in Class "All Robots" awards.
- **Small Robot (60 cm Vertical Entry or 50 cm Pipe Entry)**: A small robot that enters the test lane through confined space. Either vertically through a 60 cm square hole 2.4 m above the starting zone. The robot then may be lowered on a tether or removable rope

by a handler on the floor. Alternatively the robot may enter through a 50cm pipe. Only the team's Primary robot can qualify for the Best in Class "Small robot" awards.

- **Outdoor CarryBot**: A suite of test methods for autonomous robots with reasonable payload or trailer towing capacity, a GPS receiver for waypoint following, and/or line following capabilities as the simplest level of autonomy. This does not need to be the Primary robot.
- **MicroAerial Robot**: For aerial robots. This does not need to be the Primary robot.

4 Primary robot / CarryBot / MicroAerial

One major objective of the new competition is to encourage teams to combine capabilities onto a single robot. The new competition structure measures the overall capability per robot. **Teams will declare a single primary robot to compete for awards.** A sticker will be affixed to it at the configuration identification station (photo booth) to identify it. The sticker has to stay on this robot during the whole competition for test administrators to reference.
Teams may bring additional robots for two of the Best in Class competitions: Outdoor CarryBot and MicroAerial. Furthermore, teams may bring as many additional robots as they like and self-evaluate them (without being eligible for a certificate or trophy) in unused lanes if they are tethered (no Wi-Fi communications).

5 Trophies and Certificates

5.1 RoboCup Rescue Championship

The following trophies result from multiple Final trials:

- First Place
- Second Place
- Third Place

5.2 Best in class certificates

The team/ robot with the highest score in a specific robot class wins the according Best in Class certificate.

- Only the runs in the preliminary round count for Best in Class.
- To win any Best in Class certificate, you need a positive, non zero score in 4 of 5 maneuvering tests.
- It is possible that a team could win more than one Best in Class certificate.

- A certificate is only given if at least three teams compete in the same test bracket / robot class.
- Best in Class Mobility: best scores of 5 different tests from Mobility.
- Best in Class Dexterity: best scores of 5 different tests from Dexterity.
- Best in Class Autonomy: best scores of 5 different tests from **autonomous** Exploration (only exploration tasks performed fully autonomously can be used). An additional requirement is that 2 out of 5 maneuvering tests must have a non zero autonomous score.
- Best in Class Small Robot: best scores of 5 different tests from Mobility, Dexterity or autonomous Exploration. Only for Small Vertical Entry robots class (Entry through a 60 cm square (vertical) or 50cm diameter pipe).
- Best in Class Aerials: Pass all Aerial safety tests; then the best 5 aerial tests count. (The aerial competition is run in its own area, separately from the ground robot competition.)
- Best in Class Outdoor CarryBot: Best score in the outdoor transport competition.

6 Competition Schedule

The competition is structured as follows:

- Preliminaries: At least 12 missions (time slots) per primary robot are assigned to the teams; up to 15 min each plus an additional 5 min for pure autonomy. The goal here is to score as many points as possible in the test methods. In general, you get one point for getting from the start zone to the end zone and another point for the way back from the end zone to the start zone (and so on). The result of the 5 maneuvering tests plus 5 other best test results are added up for the qualification. See Sec. 6.1 for details.
- Finals: Each mission lasts 30 min. The goal here is to score victims with the Primary robot. See Sec. 6.2 for details.

6.1 Preliminaries

Your team will select a certain subset (at least 10) of the 20 test methods and perform in up to 20 minute test runs. You will get at least 12 time slots to perform the selected tests, such that you have the chance to improve your score of two (or more) tests.

Scheduling for the preliminaries

This is an example of the dispatch board for day 1:

	Number of admins / max. teams per line: c		Maneuvering (mandatory)					Mobility					Dexterity					Exploration				
			1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
			Center	Align	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
MORNING	P1	9:00	Team 1							…					…							
	P2	9.30						…						…								
	P3	10:00								…												
	P4	10:30													…							
	P5	11:00	Team 2	Team 1															…			
	P6	11:30																				
	P7	12:00		Team 2																	…	
	P8	12:30	Team 3																			
	P9	13:00																				
AFTERNOON	P10	13:30	Team 3						…													
	P11	14:00		Team 1										…					…			
	P12	14:30																			…	
	P13	15:00		Team 3						…						…						
	P14	15:30																				
	P15	16:00	Team 2						…										…			
	P16	16:30	Team 1												…							
	P17	17:00		Team 2																…		
	P18	17:30																				

Procedure for the scheduling

- Each team gets 4 (magnetic) tokens with their team name on it.
- The evening before each preliminary test day the following procedure will define the schedule for the following day:
    - A random order of the teams is drawn.
    - According to that order, the teams pick one free test method/time slot of the above table to reserve a free test method/time slot in the morning and place one of the tokens.
    - Not more than c tokens can be placed in one row, where c is the number of test administrators.
    - After each team has placed their first token, in a second round (same order) the teams pick another free test method/time slot and place a second token.
    - Then the order of teams is reversed and according to this new order teams place a third token for the afternoon session.
    - After each team has placed the third token, in a fourth round the team picks another free test method/time slot and places a fourth token.
    - At this point, each team has selected four test runs for the next day.
- After a team has finished a run, they are free to place the token representing the completed run to a later free test method/time slot for the same half day, if test administrators are available for this time slot.
- A team may elect to move a token from a timeslot that has not yet occurred to another free test method/time slot, if test administrators are available for this time slot., freeing the original slot.
- A team should not place more than one token in the same row, since only the primary robot is allowed in the main competition and cannot be in two test methods at the same time.

Test execution

- Each time slot is 30 minutes.
- Before your mission, move your robot to one of the provided waiting tables.
- **5 minutes Setup Phase and Readiness Test**: place your robot at the start zone and establish the connection to the operator station. Your robot should point towards the open victim box, which is placed near the start zone. The readiness test can start as soon as the robot is ready. The readiness test can continue in the next phase.
- **10 minutes Readiness Test and Run Phase**.
- During the readiness test teams may obtain up to 10 points:
    - 6 for sensor tests:
        - Video Resolution (either manual Landolt C or automatic hazmat sign or automatic QR code detection)
        - Motion detection,
        - Thermal Image Resolution,
        - Audio Acuity,

        - Color/Pattern Recongition
        - Gas (CO_2).
    - 4 dexterity tests:
        - Inspect,
        - Touch,
        - Rotate,
        - Extract,

  These points serve as a multiplier for the results.
- At the discretion of the TC we might perform readiness tests in the 5 minutes after the run (e.g. during one whole morning session) instead.
- A team can perform each repetition (i.e. move from the start zone to the end zone or move from the end zone to the start zone) either tele-operated or autonomously.
- Each successful complete repetition is counted as one point.
- Only if a repetition is done completely autonomously, it counts as an autonomous repetition (for the Best in Class Autonomy award).
- If the operator switches back within a repetition from autonomous mode to teleop mode, the repetition is still valid, but is considered as done teleoperated.

- Extra 10 minutes: 2 options:
    - **Extra 10 minutes Autonomous Operation only**. Teams can use extra 10 minutes to perform the same task autonomously to gain autonomously scored points. In that phase no switch to tele-operation is allowed; switching back to teleoperation mode would end the run automatically. At the start of this 5 minute time slot, if the robot is not autonomous since it left the start zone, the robot has to be driven back to the start zone and continue autonomous for the rest of the run.
    - **Semi-Autonomous** functions during the 10 minutes Autonomous Operation: Teams can also continue to run during the 10 minutes Autonomy if their system features semi-autonomous functions that are useful in the particular test. Teams that want to use this have to announce this to the administrators at least the day before the run. The team should then demonstrate and describe the semi-autonomous function to the RoboCup Rescue Technical Committee (TC) for evaluation. Upon the discretion of the TC the function might be declared eligible for semi-autonomous scoring during the autonomy operation time. Border cases or disputes can be decided by a team leader meeting.
      Those semi-autonomous functions have to be actively used/ in operation during the extra 10 minutes.
      Points gained during those extra 10 minutes in semi-autonomous mode do not count towards any best in class certificate. .
      Examples for semi-autonomous functions: Waypoint navigation; full-autonomous flipper motion; Cartesian arm control with collision detection.
    - During the extra 10 minutes it is not possible to switch between Semi-Autonomous functions and Fully Autonomous Operation.

- **5 minutes to clear the arena**.
- There will be a global clock, so all tests in all test lanes start and stop at the same time.
- If your robot has radio issues, you are free to use a tether / cable to communicate with the robot.

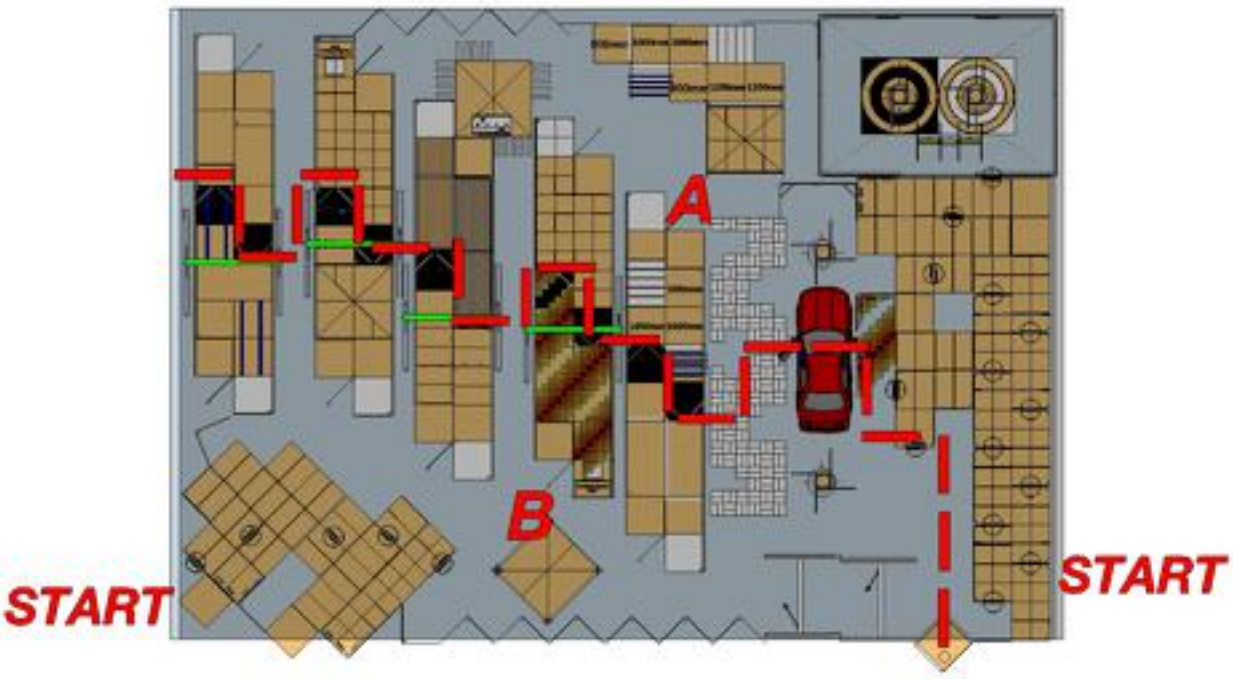
Scoring

- Every team can repeat a test, as often they want if it is available and the team has a free token to place. Only the best result will be kept for the task and team.
- All scores will be normalized per test method, so that the best team gets 100 points. This calculation is done after all teams have completed all tests in the preliminary round. The other teams get points proportionally. Example: For test method Dexterity 1: If team A scored 20 points and team B scored 10; then at the end of the preliminaries the score of team A will be set to 100 and the score of team B to 50. This way, for each test method the best team gets 100 points.
- There is no multiplier for autonomous operation, but autonomous robots get extra time (10 minutes) in each test method in which only autonomous operations are allowed. Also robots that worked teleop during the mission get this extra time if they switch to autonomy.

6.2 Finals

- The best teams qualify for the finals.
- Only a single robot (the qualified Primary robot) is allowed in the finals.
- Score is reset to 0 before the finals (i.e. points from the preliminaries do not count for the finals).
- Goal of the finals is to score as many victims as possible, and to gain as much information about each victim as possible (e.g. vision, heat, audio, mapping).
- There will be an even number of final missions; each robot will see arena A and arena B (each half of the total arena) the same number of times.
- If the robot is able to find all victim locations during the final run, it can start over the search to gain more points.

This is a sample configuration for the arena:



7 Remarks

- Resets: 2 min time penalty for each touching and/or moving of robot. After a reset, the robot has to start from the last start zone again. The robot keeps the points achieved so far.
- For some test methods, the robots have to drive in reverse mode. So make sure you are able to do that by either having backwards looking cameras or other sensors on the backside of the robot.
- The competing robots can be tethered.
- Radio regulations of the host country have to be respected.
- Rules and arena layouts are subject to change.
- The pictures of the test method in this document do not guarantee the actual implementation of this test method.

8 FAQ

Q (2016-06-10): Are the specific wheels part of the "fixed configuration"? Our robot would remain the same (all sensors, robot arm, computers, actuators, etc), but we planned on using different wheels if required for different tasks. They are passive wheels, just climbing stairs require different wheels than the other tasks. Is this ok?

A: No. Fixed configuration means fixed configuration, i.e. no modification is allowed. Think of the test lanes be combined in one big scenario. Then you also have to decide which configuration you pick to bring your robot to the end of this single scenario.

Q (2016-06-10): We've planned on using our primary robot in the outdoors test, with different wheels installed (larger diameter means more speed, which might matter when we have to travel hundreds of meters). Is this ok?

A: Yes. We do consider the outdoor arena as a completely separate test. You can even show up with a completely new robot. So using the primary robot with new wheels is OK. Remember to change the robot back to its original configuration before you use it indoors again.

Q (2016-06-10): When radio problems occur, and one must fall back to wired networking, can someone help manage the cables (to not constrain the movement of the robot)?

A: Yes, a second person for the cable management is allowed. In most lanes the cable management person can (and then must) do this from outside of the test lane. However, the cable cannot be used to steer the robot by pulling it in a specific direction (the cable handler might have a good direct view on the robot.) Communication between the operator and the cable management person is of course forbidden.

Q (2016-06-10): Our robot arm most probably won't handle the weight of the 1.8 kg wooden blocks of the shoring task, as they were designed with the balsa blocks in mind (long before the rules came out).

A: We might provide a second, lighter set of wooden blocks (e.g. made of balsa wood). However, using this second set of lighter blocks will give significantly fewer points compared to the 1.8 kg blocks.

Q (2016-05-25): Can we use two wifi networks to communicate with the robots from the operator station?

A: If you use only one radio channel, you can use multiple wifi networks.

Q (25.05.2016): Can we use multiple wireless channels (different frequencies) to communicate with the robot?

A: No. We will have several teams running at the same time, therefore each team is allowed only one channel for the communication between the operator station and the robot.

Q: Can we use multiple robots in the finals?

A: No. Only the primary robot in its fixed configuration is allowed in the finals.

Q (2016-06-02): It is denoted in the rulebook that small vertical entry robots would enter the test lane vertically through a 60 cm square hole 2.4 m above the starting zone. So is there any structure like a stair for us to elevate the robot to 2.4 m above? Or should we bring our own elevating machine?

A: This is not decided yet. If you can bring your own deployment mechanism, you are welcome to bring, use and maybe share it.

Q (2016-06-15): The readiness check section shows the readiness check both (a) mounted at a wall unobstructed and (b) inside a barrel. What is the configuration that will be used at the competition?

A: During the preliminaries (when the identification test is performed) the board is uncovered and sits next to the start point. During the finals the board is behind a fiducial and can be inspected only through some holes (it then simulates a hidden victim).

Q (2016-06-16): Regarding the "fixed configuration": If parts of the robot break, or the whole robot fails, can we repair it or replace it?

A: If you replace broken parts of the robot by identical parts (e.g. you replace a motor), you are free to do so. However, the Technical Committee has to be informed and decides if the replacement is acceptable. Since the fixed configuration rule is intended to measure the reliability of the robot, replacing the whole robot is not allowed.