



RoboCup Junior Australia

# Virtual Rescue Line Rules 2021

Last Modified: 31 August 2021





## RoboCup Junior Australia National Committee

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## Code of Conduct

### Spirit

It is expected that all participants, students and mentors, will respect the aims and ideals of RoboCup Junior as set out in our mission statement. In turn, the volunteers, referees and officials will act within the spirit of the event to ensure the competition is competitive, fair and most importantly fun. "It is not whether you win or lose, but how much you learn that counts."

### Sharing

It is the overall desire of RoboCup Junior competitions, that any technological and curricular developments will be shared with other participants after the competition. Any developments including new technology and software examples may be published on the RoboCup Junior website after the event, furthering the mission of RoboCup Junior as an educational initiative. Participants are strongly encouraged to ask questions of their fellow competitors to foster a culture of curiosity and exploration in the fields of science and technology.

### Local Variations

These rules will be in use for the 2021 Australian Virtual Competition only.



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## 1 The Challenge

### 1.1 The Scenario

1.1.1 A terrible earthquake has hit the city and caused a large chemical storage unit to rupture spilling thousands of litres of toxic chemicals in the centre of the city. There is a person trapped in a sinking rescue capsule (the Victim) in the chemical spill. Rescue crews are having trouble entering the city with the amount of rubble around, and rescue from the air has also been ruled out due to the noxious gases rising from the toxic chemicals directly above the spill. It has been decided that the best form of rescue is the deployment of an autonomous robot that can navigate to the scene, rescue the Victim and exit the chemical spill.

The robot is to be deployed at the start tile (City Limits). For those that have done RoboCup Junior in the past please note that there is no drop zone. In fact, many of the rules have been adapted. The idea is to rescue the victim in the shortest time possible whilst following the line accurately and avoiding the obstacles.

1.1.2 Primary, Secondary and Open Rescue Line: The robot must navigate to the scene, find and rescue the Victim by pushing or dragging (control) the Victim out of the chemical spill.

1.1.3 Teams will compete in a competition over a number of rounds and the points will culminate where the top three teams will be awarded first, second and third place as a result of them demonstrating the best solutions to the challenges according to the competition rules.

### 1.2 Changes for the Virtual Competition (2021 only)

1.2.1 As in previous years Primary, Secondary and Open Rescue Line divisions will be available with modified course layouts.

1.2.2 Two additional divisions will also be available, Primary Standard Design and Secondary Standard Design. In this division.

1.2.3 Teams can have from 1 to 5 members.

1.2.4 The Standard Design divisions for both Primary and Secondary teams will be based on programs submitted to the competition organisers developed for a robot of a standard design (see [3.1.2](#)). The program will be loaded onto a robot of identical build and run remotely.

1.2.5 Courses will not include ramps or elevation. Tiles will be printable on A3 paper. Files to print can be downloaded from the Blog Post at <https://www.robocupjunior.org.au/2021-rcja-national-championships-virtual-event-rescue-information/>

1.2.6 Teams will participate in an interview via video conference on the event weekend. This is a private meeting with the teams, their mentor(s) and the interviewers.

1.2.7 Teams will participate in six rounds.

1.2.7.1 For teams competing in **Primary, Secondary or Open divisions**, three rounds must be submitted as pre-recorded videos by 9pm Tuesday 5th October. Three rounds will be required to be completed live via Video Conference during the event weekend. In the event a team is not able to participate in the live rounds, the team's mentor should contact the Challenge Coordinator.

1.2.7.2 Primary and Secondary teams competing in the **Standard Design divisions** will be required to submit their programs by 9 pm Tuesday 5th October.



## 2 Playing Field

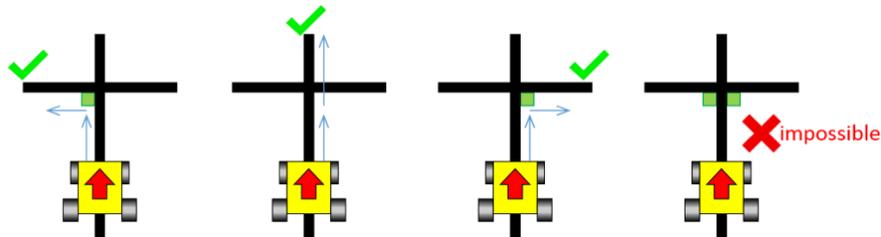
**Note: All measurements in the rules have a tolerance of 5%.**

### 2.1 Tiles

- 2.1.1 The field will consist of tiles with differing patterns. Competition tiles will be drawn from the designs shown below.
- 2.1.2 Tile files can be downloaded from the Blog Post at <https://www.robocupjunior.org.au/2021-rcja-national-championships-virtual-event-rescue-information/> and printed onto A3 paper to create a tile size of 300 mm x 300 mm. This can then be mounted onto cardboard or flute board to give it strength or fixed directly to a hard floor surface. This should provide adequate traction for the robot. These are smaller tiles and not the 600 mm x 600 mm tiles that have been used in the past. We are using the smaller tiles so that schools or groups that do not own a set of small tiles can create their own.
- 2.1.3 The tiles will need to have a uniform background colour allowing the line to be distinguishable from it by common light, colour and vision sensors.
- 2.1.4 The competition fields are set and the order of the tiles cannot be altered. The competition courses that need to be pre-recorded (video submissions) will be announced by Monday, 6 September.

### 2.2 Markers

- 2.2.1 Intersection markers can be placed anywhere except in the chemical spill.
- 2.2.2 Intersection markers are green and, on average, 40 mm x 40 mm in dimension and indicate the suggested path to follow. If no green marks are placed at an intersection, it means it is recommended to continue straight.
- 2.2.3 The intersection marker is always placed just before the intersection. See image below for possible cases.



### 2.3 Debris and Obstacles

- 2.3.1 Debris have a maximum height of 3 mm and are not fixed on the floor. Use long wooden skewers that can be purchased in any supermarket.
- 2.3.2 Debris may be spread across the tile.
- 2.3.3 The water tower obstacle should be made from a 1.25 L soft drink bottle filled with water. Remove any labels so that they do not interfere with the robot.
- 2.3.4 The water tower obstacle may not cover more than one line and should be placed in the centre of the tile.
- 2.3.5 A robot is expected to navigate around obstacles and reacquire the line before it leaves the tile. Obstacles that are moved in any way will remain where they are moved to, even if it ends up prohibiting your robot from proceeding.



## 2.4 Chemical Spills

- 2.4.1 A chemical spill will be green in colour and be distinguishable from the background colour of the tile by common light and vision sensors. It may be any shape or size but will be bounded by a white border.
- 2.4.2 At the point where the black line meets a chemical spill, fix a piece of smooth reflective tape or aluminium foil (**Spill Access Point**) to indicate to the robot that it is entering the chemical spill. The spill access point will have a minimum size of 70 mm x 20 mm.

## 2.5 Start Tiles

- 2.5.1 The 'City Limits' tile consists of a lead-in black line and does not count for any points. Any tile can serve this purpose. Robots are to start behind the join between the start tile and the first course tile.
- 2.5.4 Any tile may be used for the start of a round or when starting after a lack of progress (see rule 6.3) is called, but must be at least two tiles from the end tile (i.e. the robot must traverse at least two tiles in full before entering the chemical spill tile by crossing the Spill Access Point).

## 2.6 Rescue Capsule

- 2.6.1 A Rescue Capsule **WITH** a victim inside will be represented by a standard 375 ml aluminium can, standing upright, wrapped in aluminium foil or aluminium foil tape.
- 2.6.2 The Rescue Capsule will be located in a new position in the chemical spill for each round. The victim is to be placed on the chemical spill where indicated for each round according to the template.
- 2.6.3 The Victim will not be moved or reset to the initial position or orientation after a restart. The rescue capsule must stay in the position and orientation the robot left it in.
- 2.6.4 Rescue capsules, with or without a victim, will contain material such as rice bringing the weight of the rescuecapsule to a maximum of 100 grams. A liquid must not be used to add weight to the can.

## 2.7 Game Zone

- 2.7.1 This is the area where the Robot Handler places the robot to complete the course and the course itself. Please make sure that when you video the robot completing the course no spectators or Robot Handlers are obstructing the view of those who will be viewing the video to judge and award the points for the round.



# 2021 Virtual Competition

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## 3 Robot

### 3.1 Robot Configuration and Programming

#### 3.1.1 Team designed robots (Primary, Secondary and Open)

- 3.1.1.1 Rescue Line robots must NOT increase in size, extend or use a device intended to sweep the victim. Robots must demonstrate a search algorithm to 'find' the Victim as specified in **Section 1.1 – The Scenario**
- 3.1.1.2 Any robot kit or building materials may be used, as long as the robot fits the specifications documented in these rules and as long as the design and construction are primarily and substantially the original work of the student(s). Commercial robot kits may be used but must be substantially modified by the students.
- 3.1.1.3 Robots should be well engineered and constructed. The robot should not fall apart during the round. If the robot has substantially failed mechanically, fallen apart or is unable to complete the challenge, the robot will be deemed "damaged". The Robot Handler will need to remove the robot from the field and the round will finish.
- 3.1.1.4 The team may choose what language they use to program the robot.
- 3.1.1.5 A team will not be able to compete with a robot substantially the same as another team's robot.
- 3.1.1.6 A team will not be able to compete with a robot that is identical to another team's robot from previous years.
- 3.1.1.7 Robots that cause interference with other robots or damage to the field or the Victim will be disqualified.

#### 3.1.2 Standard Design robots (Primary and Secondary)

- 3.1.2.1 Standard Design primary and secondary robot construction guides can be found from the Blog Post at <https://www.robocupjunior.org.au/2021-rcja-national-championships-virtual-event-rescue-information/>. All submitted programs will be run on robots constructed according to these designs.
- 3.1.2.2 Programming languages that can be used to program EV3 Standard Design robots include EV3 Lab (the original graphical coding language), EV3 Classroom (new Scratch-based graphical coding language) or EV3 Dev (for text-based programming languages).
- 3.1.2.3 Spike Prime Standard Design robots must be programmed with LEGO Education Spike Prime which includes both a block-based language and Python as a text-based alternative.

### 3.2 Robot Control

- 3.2.1 Robots must be started/restarted manually by the Robot Handler.
- 3.2.2 Robots must be autonomous in operation. If the robot has the capability for remote or other forms of wireless control either by Bluetooth, Wi-Fi or some other form of wireless communication, the team must prove that they have disabled the capability for third party operation in some way. This could be by software, hardware or degree of human interaction. Robots that do not comply may face immediate disqualification from the tournament. Distributed control is allowed but must operate without human interaction after the robot has started the round.
- 3.2.3 Pre-mapping and types of dead reckoning (i.e., configuring the robot's program based on predefined locations, tiles, obstacles, location of victim, number of victims etc. before game play) are prohibited.
- 3.2.4 The use of remote control of any kind is forbidden.

### 3.3 Violations

- 3.3.1 A copy of the source code must be submitted with the video of the robots completing the rounds.
- 3.3.2 The source code needs to show that a search algorithm is being used to find the victim. Dead reckoning is not



permitted. This means that the robot cannot be programmed to go straight to the can without searching for it.

- 3.3.3 If a robot fails to meet all specifications (including modifications) the robot will be disqualified from that round (but not the tournament).
- 3.3.4 If it is determined that the work on the robot is not substantially the original work of the team members or the construction or programming of the robot be deemed not that of the team, the team may be disqualified from the competition.

## 4 Inspection

### 4.1 Electronic Submission

- 4.1.1 Before registration closes each team must electronically submit their videos, journal and program or source code to the competition organisers via the competition Website. A link will be sent to the mentor.

### 4.2 Journal/Logbook

- 4.2.1 All teams must maintain a journal/logbook or design diary detailing the design, development and construction of the robot and its programs as part of the learning experience. The journal can be in the form of a written document, slide show presentation, website or blog, etc. Journals/logbooks or design diaries are not scored and do not contribute to the team’s overall score but will be used to determine ownership of designs.
- 4.2.2 Construction of components (not freely or commercially available to all competitors) must be accompanied by full documentary proof that the developments were wholly the work of the students. This should be in the form of technical documentation showing all stages of design, development, testing and construction.
- 4.2.3 Failure to produce documentary proof of students’ work may result in the video submissions not being accepted.

### 4.3 Journal/Logbook Criteria

- 4.3.1 The following headings are a guide in the development of student journals. Note: these criteria are mapped to the Australian National Technologies Curriculum

<b>Team Name</b>	
<b>Team Members</b>	List each member’s role
<b>School or Organisation</b>	
<b>Problem Definition</b>	Define and decompose the problem
<b>Planning</b>	Identify a number of possible solutions to meet the requirements and constraints
	Identify the roles of the team and the order of tasks
<b>Solution Design</b>	Design the user experience of a digital system
	Design Algorithms and validate them.
<b>Implementation</b>	Implement modular programs, applying selected algorithms and data structures
<b>Evaluation</b>	Critically evaluate the developed solution.
<b>Student Collaboration</b>	Create innovative solutions for sharing your ideas and information.
	Plan and manage projects using an interactive and collaborative approach
<b>Robot</b>	Construction Photos
	Code



## 5 Teams

### 5.1 Definition

- 5.1.1 Teams may have a maximum of five members. There is no minimum team size for 2021.
- 5.1.2 Students will participate in ONLY ONE (1) Rescue Line divisions: Primary Rescue Line, Primary Standard Design Rescue Line, Secondary Rescue Line, Secondary Standard Design Rescue Line or Open Rescue Line.
- 5.1.3 **Primary:** Open to students studying at a recognised primary study provider. Note: Team members can compete any number of times whilst they are enrolled at a recognised primary study provider.
- 5.1.4 **Secondary:** Open to all students studying at a recognised secondary study provider. Note: Team members are only eligible to compete for a total of two (2) years in this division after which they must participate in the RoboCup Junior Australia Open Rescue Line division.
- 5.1.5 **Open Rescue Line:** Open to all students studying at a recognised secondary or primary study provider.

## 6 Game Play

### 6.1 Length of a Game

- 6.1.1 For pre-recorded rounds teams may make as many attempts at each course as needed but only one video may be submitted for each course. This will allow the judges to accurately time your robot completing the course.
- 6.1.2 For Primary divisions the length of a round is 120 seconds. For Secondary divisions the length of a round is 150 seconds. For Open the length of a round is 240 seconds.

### 6.2 Game Play

- 6.2.1 Calibration of the robot can be completed before the round timing/videoing begins for all divisions.
- 6.2.2 Once the round and videoing has begun, the robot is not permitted to leave the game zone for any reason i.e., the video is to be shot in one take.
- 6.2.3 Videos must clearly show the robot for the duration of the round.
- 6.2.4 The video that is submitted must show a clear line of sight of the robot with no other interference. The videos of each round should be completed in one take. These videos will then be uploaded to an online folder. The link for each team will be sent after registrations close. Each school will have their own unique link. Editing of the robot completing each round is not permitted and will result in disqualification for that round but not the whole competition.
- 6.2.5 Modifying a robot, once a round has begun, is prohibited until the run is over. This includes adding, removing or remounting parts. You can redo the round and video.
- 6.2.6 Any parts that have fallen off during a round, intentionally or otherwise, are to be left in the game zone and cannot be moved or removed by the Robot Handler until the run is over.

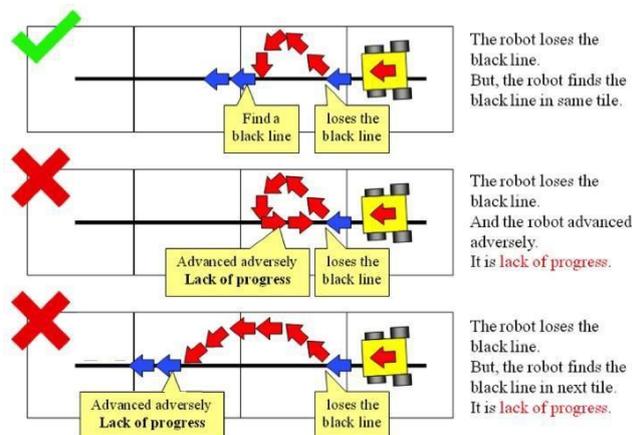


- 6.2.7 Once the robot has entered the chemical spill tile it is no longer required to “follow the line”. It may enter the chemical spill in any orientation in its efforts to rescue the Victim.
- 6.2.8 To rescue the victim:
  - 6.2.8.1 **Primary:** The Victim is considered rescued when it is moved by the robot completely outside the chemical spill.
  - 6.2.8.2 **Secondary:** The Victim is considered rescued when it has been brought under control by the robot and released in an upright position outside the chemical spill.
  - 6.2.8.3 **Open:** The Victim is considered rescued when it has been placed in an upright position on the Rescue Platform. The Rescue Platform is 70 mm high, 200 mm wide and 70 mm deep. If a wooden block of those dimension is not available, it can be made of any material strong enough to hold the weight of the Victim.
- 6.2.9 The round is considered complete when the maximum possible points for the round are achieved and the robot has rescued the victim or the Robot Handler declares the end of the round.

### 6.3 Lack of Progress

- 6.3.1 A lack of progress occurs when:
  - 6.3.1.1 the robot is touched by a human
  - 6.3.1.2 the Robot Handler calls a Lack of Progress (for example if the robot is about to fall and be damaged or the robot is malfunctioning)
  - 6.3.1.3 the robot is stuck in the same place or loses the black line without regaining it by the next tile in the sequence (see figures below in 6.3.1.6)
  - 6.3.1.4 the robot moves completely out of the field
  - 6.3.1.5 the robot exits the chemical spill in a direction other than via the ‘Spill Access Point’ or exits without attempting to rescue the Victim
  - 6.3.1.6 the robot ceases to follow the line on that tile unless there is an obstacle on that tile that must be avoided. (see rule 6.4)

**Note:** Robots are not allowed to take shortcuts within a tile, the line shape must be substantially followed.



- 6.3.1.7 the robot fails to reacquire the line before exiting the current tile after moving around an obstacle



- 6.3.2 If a Lack of Progress occurs, the robot must be repositioned at one of the Start Tiles (see rule 2.5.1) and restarted.
- 6.3.3 Only the Robot Handler is allowed to start the robot.
- 6.3.4 There is no limit to the number of starts due to lack of progress within a round.
- 6.3.5 The game clock will continue running during all starts and restarts. Otherwise, you will need to restart the video and begin again.
- 6.3.6 A team may video their scoring run as many times as they need and submit their best run for each round. This allows the team to change programs, change code or modify the robot if needed.



Reset



Power OFF & ON

**Note:** Only one video per round will be judged for scoring purposes. Submit your best video as not all robots may be able to successfully complete each round. Some points are better than none.

## 6.4 Following the Line

- 6.4.1 Where there are multiple paths, the robot may take any path.
- 6.4.2 Where the line is discontinuous, and there is no continuous path through the tile, the robot may search for the recommencement of the line but must not completely leave the tile before re-finding the line.
- 6.4.3 A robot is considered to be following the line as long as some part of the robot is over the line while being viewed from directly above the robot.
- 6.4.4 Where a line exists, some portion of the line segment must be under the robot (see rules 6.3.1.7 and rule 6.3.1.8 for regaining the line).

## 6.5 Scoring

- 6.5.1 Teams will be awarded 10 points for each line-follow tile that their robot successfully negotiates, e.g. robots reaching the 4th tile would have successfully negotiated 3 tiles and be awarded 30 points.
- 6.5.2 Teams will gain an extra 4 points for each intersection marker they correctly follow, e.g. if a robot correctly follows both shortcut markers on the roundabout, it will be awarded 10 points for completing the line follow of the tile and 8 points (4 + 4) for correctly following the two shortcut markers.
- 6.5.3 Rescue teams will be awarded an additional 20 points for fully exiting the Chemical Spill via the 'Spill Access Point'. The robot must reacquire the line and begin to follow the line **after** successfully rescuing the Victim OR attempting to rescue the Victim before the points are awarded.



## 6.5.4 Scoring summary:

Action Completed	Score
Tile	10
Follow an intersection marker	4
Debris	5
Obstacle	10
Rescue Victim - Primary	50 for Rescue
Rescue Victim - Secondary	50 Control 50 Rescue
Rescue Victim - Open	50 Control 50 Rescue
Exit the chemical spill via the spill access point and reacquire the line (this applies to all Rescue Line Divisions)	20

6.5.5 Points will be awarded only once for successful completion of an element of the course.

6.5.6 5 points are deducted from the score for each lack of progress, up to a maximum of 20 points deducted.

6.5.7 No team can end a round with a negative score. A score of zero (0) will be awarded in this case.

## 6.6 Rounds

6.6.1 A scoring run will be based on the sum of all scores (see rule 6.5.4 scoring summary).

6.6.2 There are 6 rounds per division.

6.6.3 After the judges view and score the videos of the rounds the teams will be ranked according to their cumulative score. This will be calculated by the addition of the scores of each round. If teams are ranked on the same score, then the time taken for each round (in aggregate) will come into play. The quickest time will be rewarded.



## 7 Conflict Resolution

### 7.1 Rule Clarification

If any rule clarification is needed, contact David Ebert ([david.ebert@robocupjunior.org.au](mailto:david.ebert@robocupjunior.org.au))

## 8 Code of Conduct

### 8.1 Spirit

8.1.1 It is expected that all participants (students and mentors alike) will respect the aims and ideals of RoboCup Junior as set out in our mission statement.

8.1.2 The volunteers and judges will act within the spirit of the event to ensure the competition is competitive, fair and most importantly fun.

8.1.3 It is not whether you win or lose, but how much you learn that counts!

### 8.2 Fair Play

8.2.1 It is expected that all teams participate fairly.