

2014 NRC Regular Category Lower Secondary School

Game description, rules, & scoring

SPUTNIK

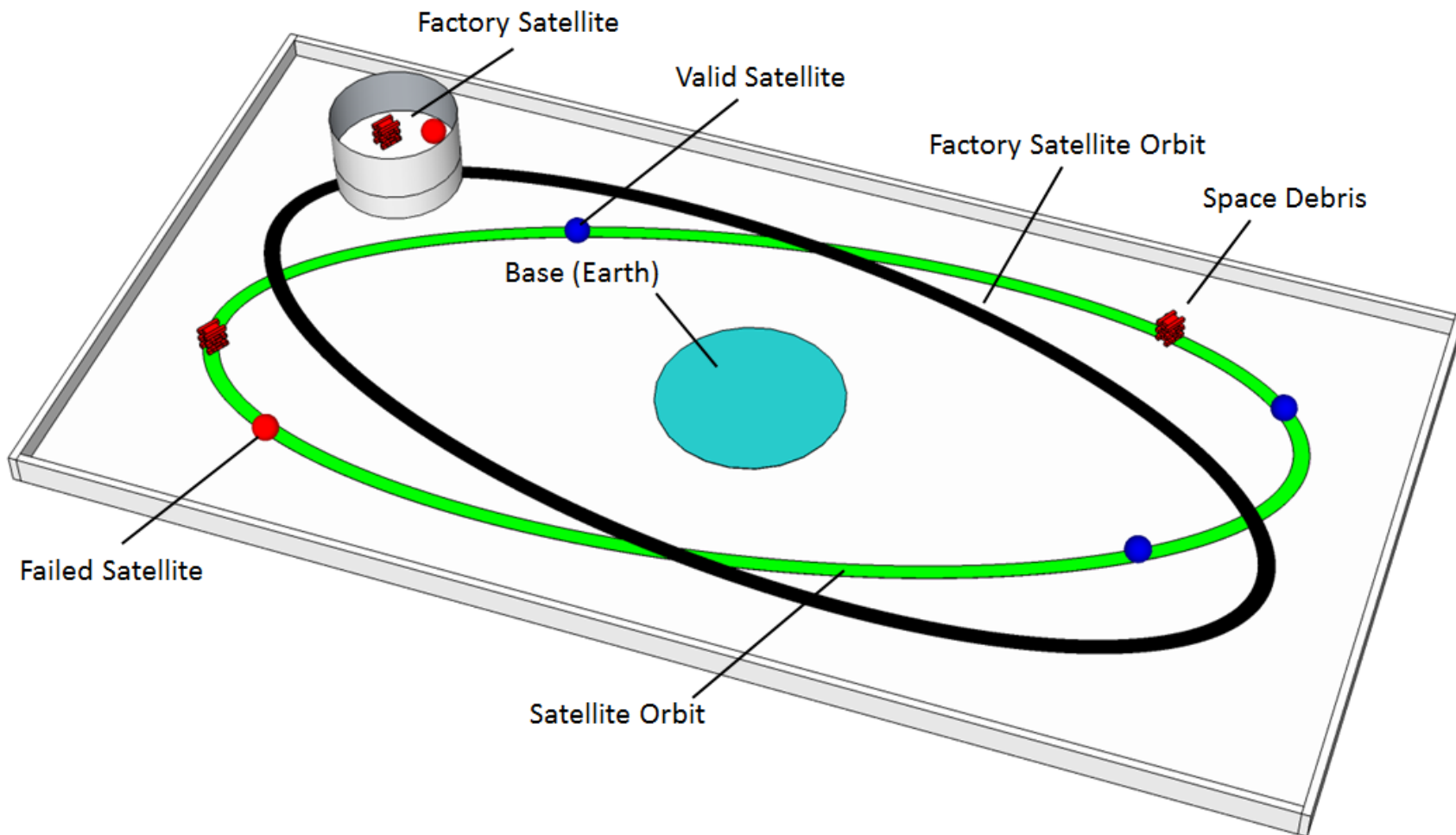
(FINAL COMPETITION)

1. Prelude

In 1957 Soviet Union made the first launch in the Sputnik program - the very first satellite designed and created by humankind. It was a 58 cm diameter polished metal sphere, with four external radio antennae to broadcast radio pulses. The era of space exploration had begun. Since that time hundreds of satellites continue to fill the space surrounding our planet and help people in solving every day routine. One satellite usually serves the needs of people for several years and then it goes down into the ocean or goes up to outer orbits and cannot return to the Earth. However a lot of crashes happen as a result of satellite colliding with other objects in space. Such crashes lead to a large amount of debris polluting the near-Earth space. According to scientists there is more than 100 thousand debris 1x1 cm in size weighing more than 5000 tons 2000 km above the Earth. Considering all the tiny objects the amount of debris reaches 300 million. Meanwhile even a collision with a 1 mm size element speeding up to 10-15 km/s is able to destroy a whole space station. In order to resolve the space debris problem the area around the Earth should contain factories-satellites for collecting and recycling any kind of space debris. The factories could be completely automated and special robots will explore Outer Space to discover artificial objects and distinguish satellites in service from real debris.

2. Challenge

2.1. Table Definitions



2.2. Challenge Objects

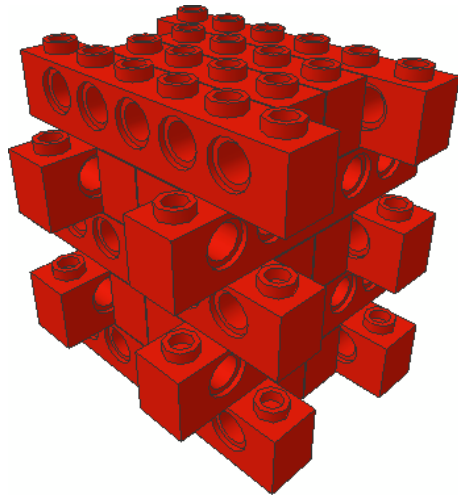


Figure 1. Space Debris (Five LEGO Bricks in height, 6 x 6 studs in size)

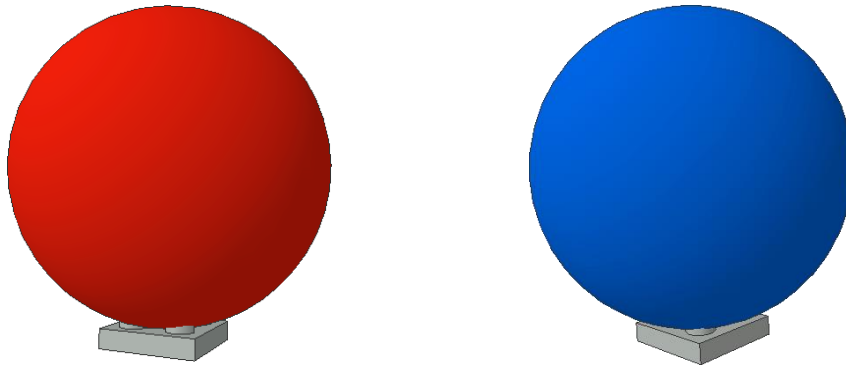


Figure 2. Satellites (Red represents Failed Satellites and Blue represents Valid Satellites. Balls are placed on 2 x 2 LEGO Plates.)

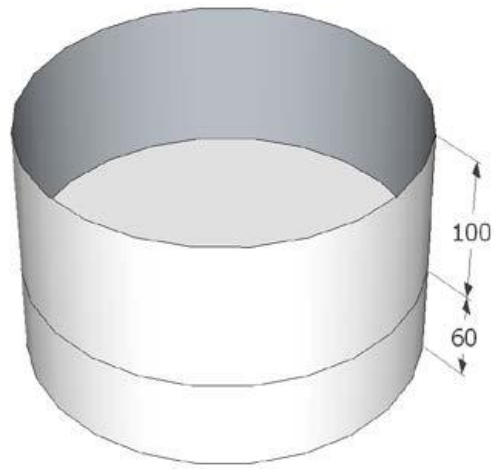


Figure 2. Factory Satellite (Cylinder $\pm 250\text{mm}$ in diameter and $\pm 160\text{mm}$ in height)

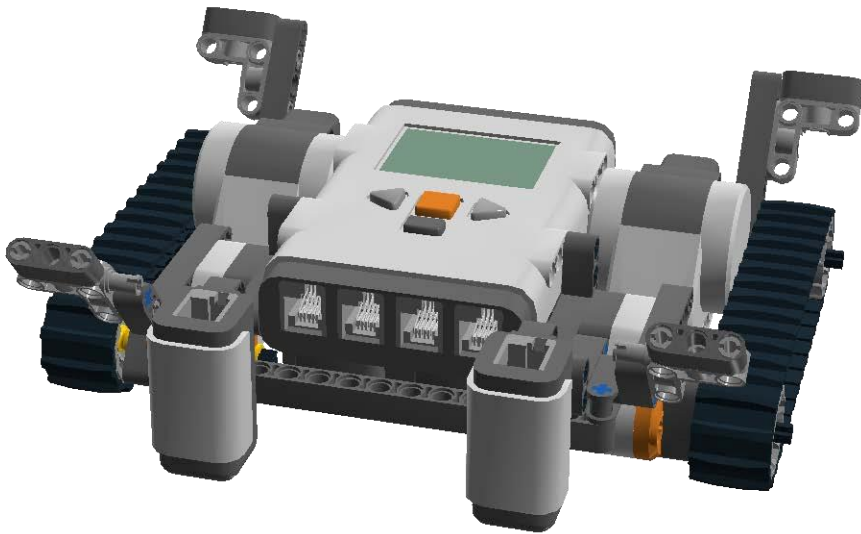


Figure 3. Factory Satellite is moved by a LEGO Mindstorms robot (see building instruction at nrc.sasbadi.com)

2.4. Challenge Overview

The mission of the robot is to collect all the Space Debris and Failed Satellites and to load them into Factory Satellite. Valid Satellite must remain in orbit.

3. Match Definition

3.1. Rules & Regulation

1. The robot must be placed in the start area with the RCX/NXT/EV3 switched off. Once physical adjustments have been made to the satisfaction of the participants, the judge will give the signal for RCX/NXT/EV3 brick to be switched on and a program to be selected (but not run). In the event where running a program immediately sets the robot in motion, wait for judge's signal to start before running a program.
2. In the event where running a program does not immediately set the robot in motion, participants are allowed to run their program before judge's signal to start, but no further human inputs are allowed after that. The only exception to this rule is when sensors are used to set the robot in motion, but even so participants are limited to just one interaction only. Judges must witness all of this, and upon his/her satisfaction, the signal to start will then be given.
3. The maximum dimensions of the robot before it starts are 250 mm × 250 mm × 250 mm. After it starts, the dimensions of the robot are not restricted.
4. The robot must start within the Base area. No part of the robot is allowed to exceed the Base area before it starts.
5. The robot's mission is to collect all the Space Debris and Failed Satellites and to load them into the Factory Satellite. Valid Satellites must not be moved from their initial position. Penalty will be given for every Valid Satellite moved from their initial position.

6. An object is considered 'loaded into the Factory Satellite' only when the object is completely placed into the container of the Factory Satellite.
7. A Valid Satellite is considered as 'moved' if it is shifted from its plate or both the Satellite and plate are completely out of the markers on the Satellite Orbit.
8. Space Debris is considered 'out of Satellite Orbit' if it is not touching Satellite Orbit.
9. Failed Satellite is considered 'out of Satellite Orbit' if it is shifted from its plate or both Satellite and plate are completely out of the markers on the Satellite Orbit.
10. The number of the challenge objects is determined in the competition day before assembly time. In order to do this 10 cards with possible combination (Figure 4) of the challenge objects are put in a non-transparent box (draw out cards). The number of the objects on the cards is from 6 to 8 and 2 or more objects of the same type can be used. One of the card is taken for the box and it will determine the combination of the challenge objects which will be used in all rounds during this competition day.

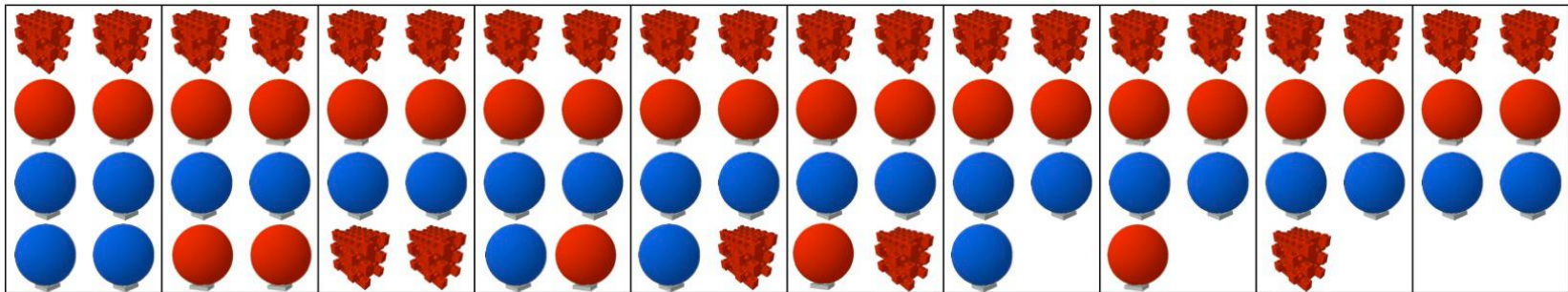


Figure 4

11. At the start of each round (post-quarantine), the location of every challenge object is determined. The objects placed in every arc between intersections will be from 0 to 2, none of which will be identical. There will be 4 or 5 markers on each arc. No object will be placed adjacent to one another (not side by side). This method to determine the location of the challenge objects will be made for every round during the competition day.

12. The Factory Satellite moves counter clockwise along the Satellite Orbit on the playing field with a speed from 5cm/s to 10cm/s.
13. The robot is considered to have 'entered Base area completely' if every part of the robot that is in contact with the table (for example, a wheel or any other part that is in contact with the table) enters Base area completely.
14. Your attempt and time will end if:
 - a. the robot or any other objects on the playing field is touched by any team member after it starts
 - b. the Factory Satellite got off its orbit as a result of the robot's action
 - c. challenge time (2 minutes) has ended
 - d. the robot has entered the Base area completely and stopped moving
 - e. the rules and regulations herein are violated
15. In the event of any ambiguity, note that the judge will pass the final verdict and will decide in the negative (i.e. the worst outcome available) according to the context of the situation.

3.2. Scoring

1. Score will only be calculated at the end of the challenge or when time stops.
2. Space Debris or Failed Satellite is out of Satellite Orbit = 5 pts each.
3. Loading a Space Debris into the container of the Factory Satellite = 40 pts each.
4. Loading a Failed Satellite into the container of the Factory Satellite = 50 pts each.
5. Robot enters Base area completely = 20 pts (**with condition at least one Space Debris or Failed Satellite is out of Satellite Orbit**) If teams acquire the same score, ranking is decided by the fastest time recorded.
6. Maximum score = 330

Space Debris or Failed Satellite is out of the Satellite Orbit	Loading of Space Debris	Loading of Failed Satellite	Returns to Base completely
5 points each	40 points	50 points	20 points
15 points penalties will be subtracted for every Valid Satellites moved from its initial position on the Satellite Orbit.			

Table 1. Scoring allocation.

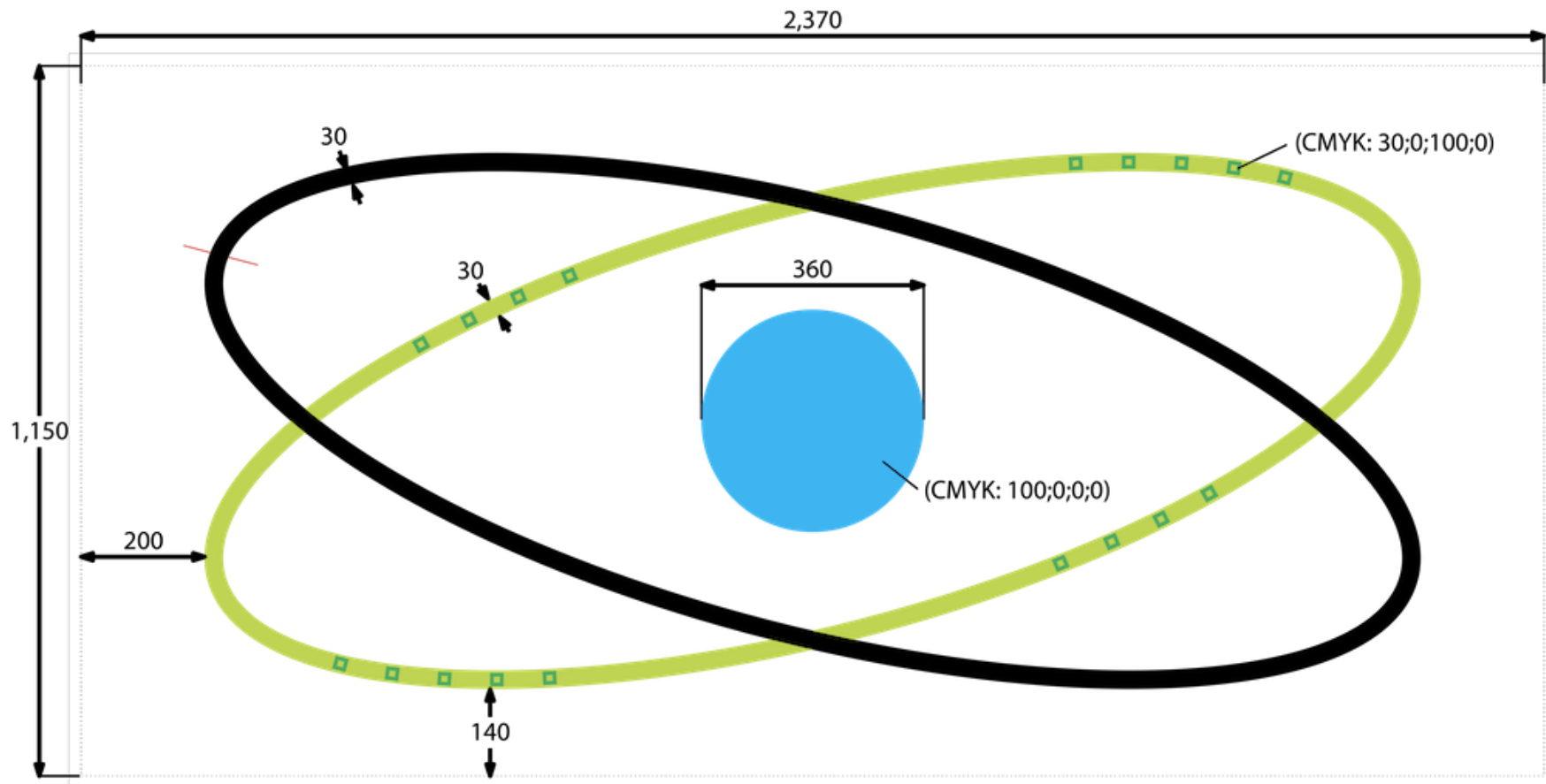
3.3. Scoring Example

	(4 Space Debris, 2 Failed Satellites, 4 Valid Satellites)	
	Team A	Team B
Space Debris or Failed Satellite is out of the Satellite Orbit	4 Space Debris + 2 Failed Satellites (6 x 5 pts = 30pts)	4 Space Debris + 2 Failed Satellites (6 x 5pts = 30 pts)
Loading of Space Debris	4 Space Debris loaded (4 x 40pts = 160 pts)	4 Space Debris loaded (4 x 40 = 160 pts)
Loading of Failed Satellite	2 Failed Satellite loaded (2 x 50 pts = 100 pts)	2 Failed Satellite loaded (2 x 100 pts = 100 pts)
Robot enters the Base area completely	No (0 pts)	Yes (20 pts)
Penalty (Valid Satellite moved from initial position)	2 balls (2 x 15pts = 30 pts)	0 ball (0 x 20pts = 0 pts)
Final Score	260 pts	310 pts

Table 2. Scoring example.

4. Table Specifications

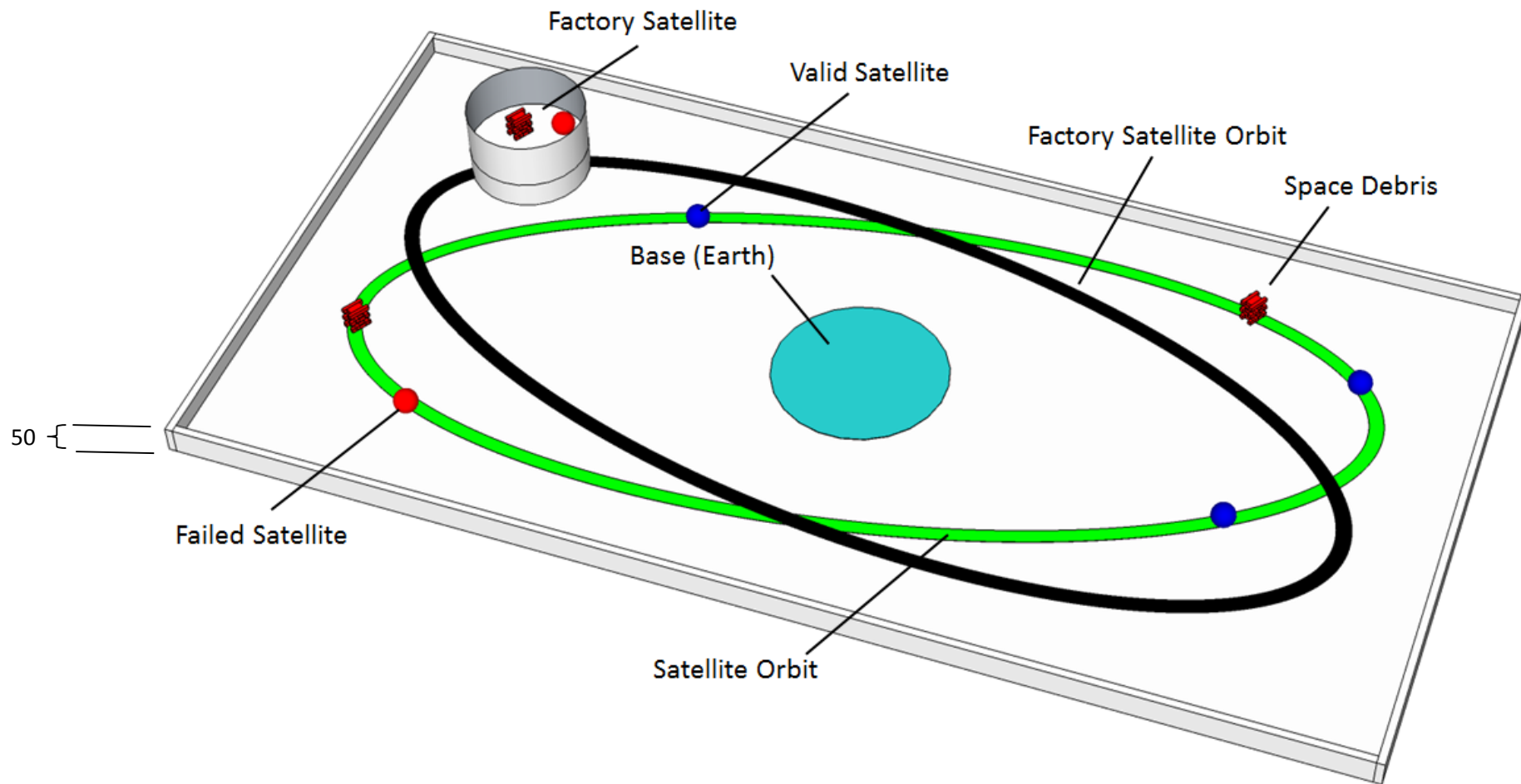
4.1. Horizontal Dimensions



<Error tolerance of court: $\pm 50\text{mm}$ >

All size is in mm.

4.2. Vertical Dimensions



<Error tolerance of court: $\pm 50\text{mm}$ >

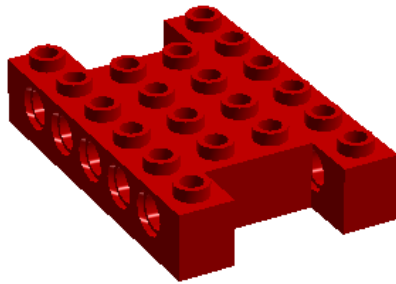
All size is in mm.

4.5. General Information

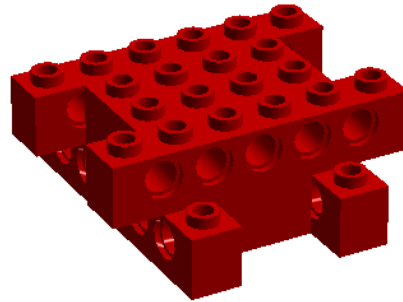
1. The internal dimension of the playing field is 2370 mm × 1150 mm.
2. The playing field is surrounded by boundary walls 50 mm in height and 16 mm thick.
3. The width of the black and green line on field is ± 30 mm.
4. The primary colour of the table is white.
5. Factory Satellite is a cylindrical container 250mm in diameter and 160mm in height.
6. The robot in the Factory Satellite is made of LEGO Mindstorms set. Please download the building instruction and program at nrc.sasbadi.com
7. The error tolerance of the field is ± 50 mm.

Building instruction for Space Debris

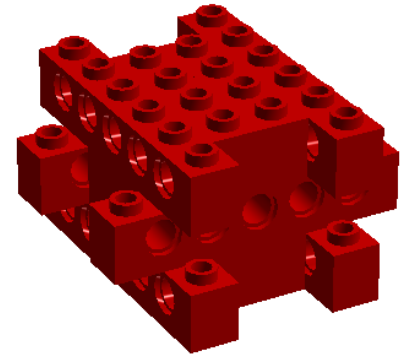
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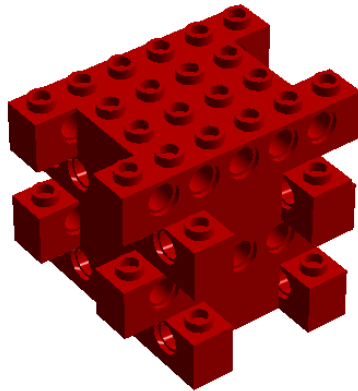
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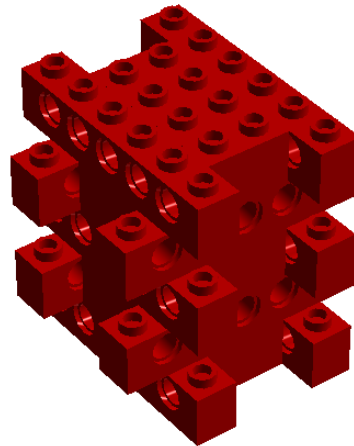
3



4



5



Frequently Asked Questions

Q. How do you define "completely" in scoring point number 5?

A. Every part of the robot that is in contact with the table must be well within the Base area in order to be considered "completely" entering the Base area. In the event where ambiguity arises, note that the judge will decide in the negative (i.e. the worst outcome available) according to the context of the situation.

Q. Are the black lines printed or taped on?

A. All black lines are printed.

Q. How do you treat parts that are detached from the robot?

A. Parts that are detached from the robot will no longer be considered to be part of the robot.

Q. Will a broken Space Debris still contribute points if it is in scoring condition?

A. Broken Space Debris can score if there is no question that the breakage was intentional, and every part of the Space Debris (including the broken parts) must be completely in the container of Factory Satellite.

Q. Can you give an example to illustrate what "the worst outcome available" means in Rules & Regulations point number 15?

A. An example would be whether the robot has entered the Base area "completely". If after a fair assessment of the situation, participants and judges still cannot agree whether a robot has entered the Base area "completely" (perhaps a some part is slightly exceeds the Base area), the judge will rule that the robot has not entered the Base area "completely" and the team will not get any point for "enter Base area completely".

Q. Can a robot pass through the Base area?

A. Yes, a robot is allowed to pass through the Base Area. But if the robot is completely in the Base Area and stops moving, even for a split second, the judge will consider that the robot “has entered the Base Area completely and stopped moving”. Attempt and time will end.