

2014 NRC
Regular Category
Upper Secondary School
Game description, rules, & scoring
SPACE STATION
(FINAL COMPETITION)

1. Prelude

Yuri Gagarin is the world's first cosmonaut. He was the first man who visited outer space on the spacecraft Vostok 1 on April 12, 1961. The flight took just 108 minutes: the craft had limited amount of resources to sustain life. After that scientist and engineers from the entire world began thinking of ways to allow space stations to stay longer in orbit around the Earth. The most important thing that every spacecraft needs is energy. Energy is used to power all electronic hardware on the board, to illuminate the spacecraft and to regenerate air and water for the space crew. There are several possible ways to get energy on a space station. One is big fields of solar panels around the station, another is to include a special module containing a nuclear power plant. In both cases it is important to maintain this equipment otherwise the absence of energy is a threat to the life and safety of the crew manning the space station.

2.3. Challenge Objects

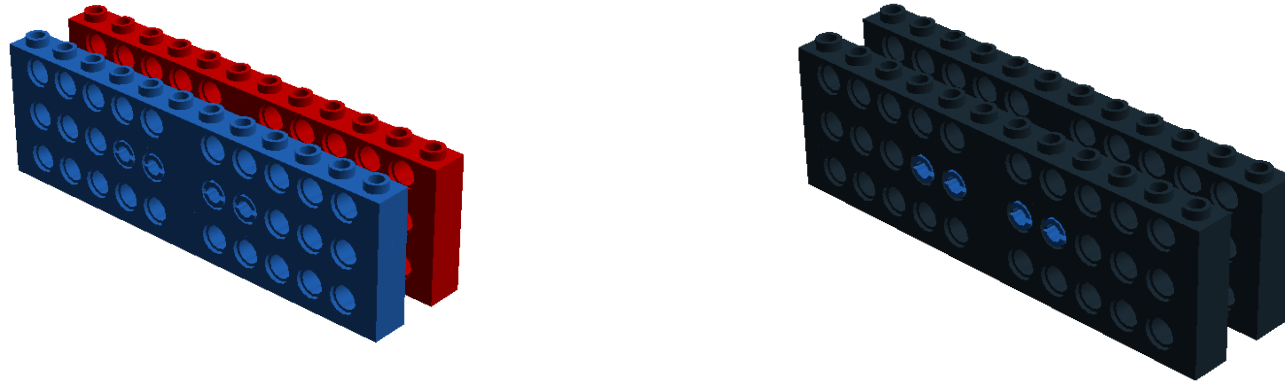


Figure 1. Solar Panel (Three LEGO bricks in height, 12 x 3 studs in size)
Colour brick represents Solar Panel in good condition while Black brick represents Bad Solar Panel

2.4. Challenge Overview

The robot begins in the Base area. The robot will have to pass through the Gate into Outer Space, check for Bad Solar Panels and replace them with good ones from Warehouse in the Space Station. The robot also needs to discover and activate inactive Coloured Solar Panels.

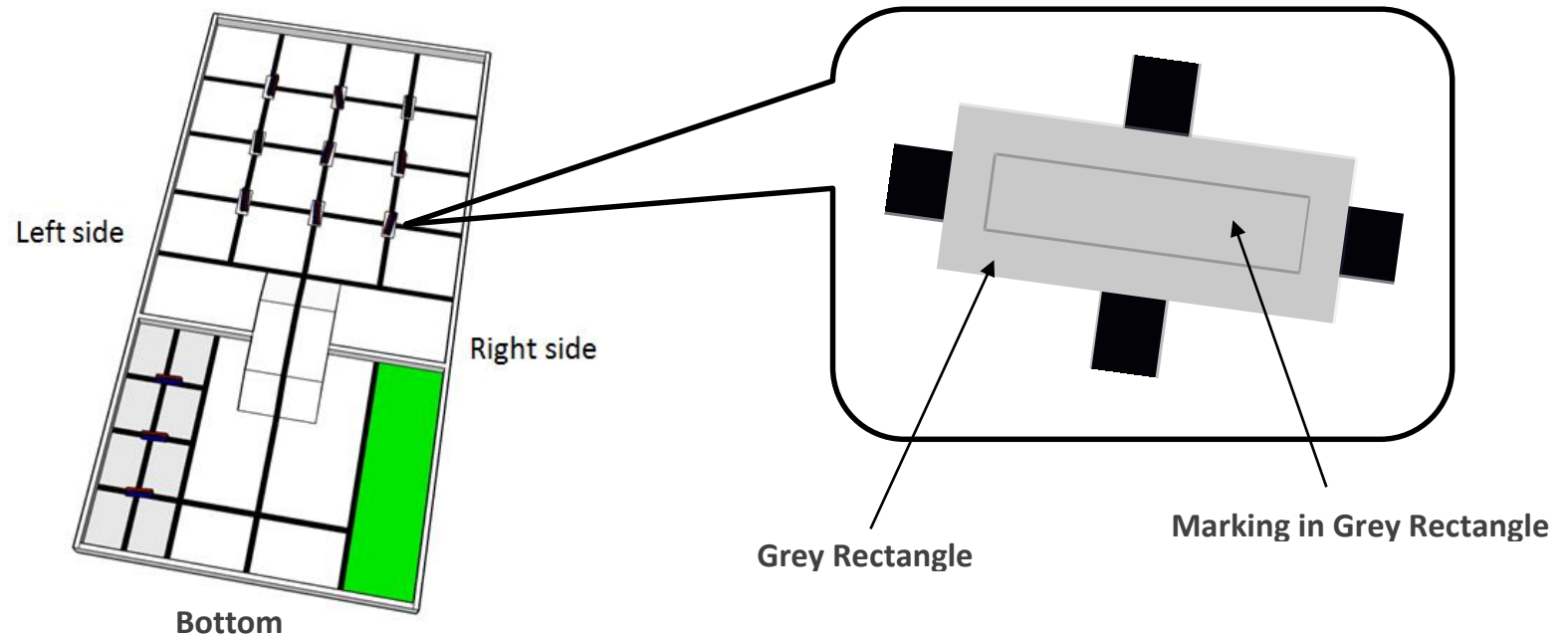
3. Match Definition

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 judges' 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 judges' 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. The judge 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 pick up good Solar Panels from the Warehouse, pass through the Gate, discover and replace Bad Solar Panels, switch on inactive Solar Panels and bring Bad Solar Panels into the Warehouse or Space station area.
6. The number of Active Solar Panels, Inactive Solar Panels and Bad Solar Panels, will be randomly decided in the competition day before assembly time. The total number of Active Solar Panels will not exceed 5, Inactive and Bad Solar Panels will not exceed 3. The total number of Solar Panels in the Outer Space at the beginning must be 9.
7. At the start of each round (post-quarantine) the location of Solar Panels on the playing field is determined and will be fixed for all teams for that specific round.

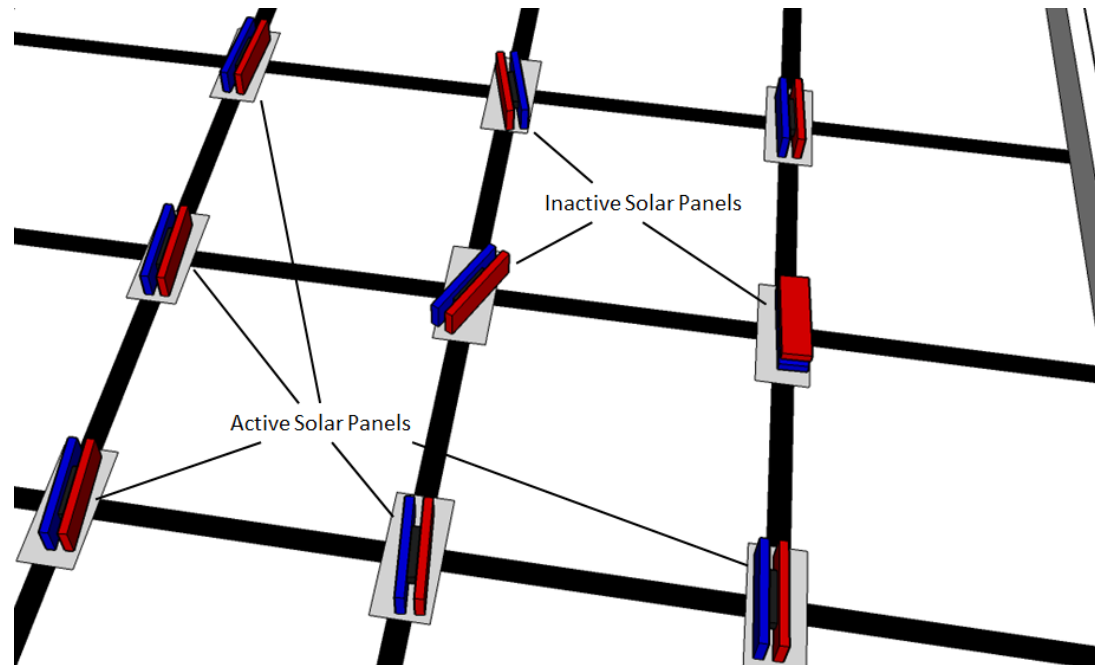
8. The robot is allowed to move to the Outer Space area (or return to Space Station area) via Gate only. None of the robot part is allowed to touch the barrier while passing through the Gate.
9. At the beginning of the match, All Solar Panels must be placed vertically within the Grey Rectangles. Active Solar Panels must be placed so that its red surfaces are facing the right side of the playing field, while the Inactive Solar Panels are vice versa. There will be 3 Solar Panels in the Warehouse at the beginning of the match. The Solar Panels must be placed vertically with its red surfaces facing the bottom of the playing field (see Figure 2.)

Figure 2.



10. At the end of the match, a Solar Panel is considered Active only if it is placed vertically in the Grey Rectangle completely, with its red surface facing the right side of the playing field. **The robot must switch on inactive Solar Panels - perform a 180-degree turn. A Panel must be completely in the Grey Square area after this operation.** Only one Solar Panel is allowed to be in every Grey Square area. (See Figure 3)

Figure 3.



11. A Bad Solar Panel is considered as 'brought to Warehouse or Space Station area' if every part of the Solar Panel is completely in the Warehouse or Space Station area.
12. Replacement of Bad Solar Panel is considered successful if a Bad Solar Panel is replaced by a good one from Warehouse, and has been activated, i.e. facing the right direction.
13. The robot is considered to have 'entered to Base area completely' if all parts of the robot are in the Base area completely.
14. Your attempt and time will end if:
 - a. robot or any other object on playing field is touched by any team member after it starts
 - b. challenge time (2 minutes) has ended
 - c. robot has entered the base area completely
 - d. the rules and regulations herein are violated

14. 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.
2. A Solar Panel is activated = 10 points each (the robot must at least activate one of the inactive Solar Panel in the Outer Space area.
3. Bad Solar Panel brought to Warehouse = 30 points each
4. Bad Solar Panels brought to Space Station area(but not in the Warehouse) = 10 points each
5. Only 9 activated Solar Panels are in the Outer Space area = 20 points
6. Replacement of a Bad Solar Panel with a good one picked up from Warehouse area = 20 points each
7. Robot enters the Base area completely = 10 points (after activating at least one inactive Solar Panel or replacing at least one Bad Solar Panel.)
8. Maximum points = 270 points

Activated Solar Panels (90 pts max)	Replacement of Bad Solar Panels (60 pts max) (depends on the draw)	Bad Solar Panels brought to Space Station area but not in Warehouse area (30 pts max) (depends on the draw)	Bad Solar Panels brought to Warehouse area (90 points max) (depends on the draw)	9 Activated Solar Panels are in the Outer Space area	Robot Enters to Base area completely
10 points each	20 points each	10 points each	30 points each	20 points	10 points

Table 1. Score allocation.

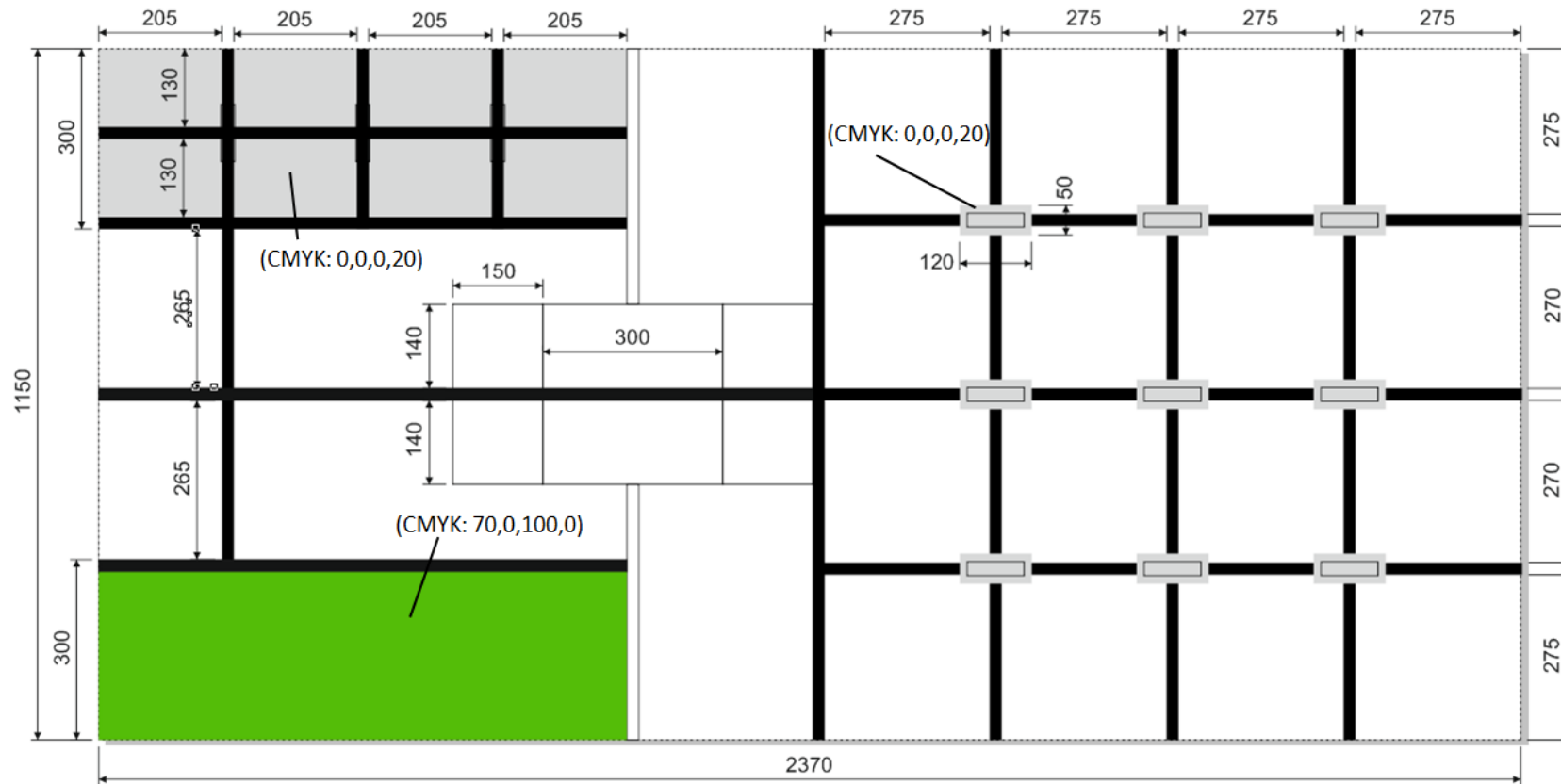
3.3. Scoring Example

	Round 1 (2 Bad Solar Panels, 3 Inactive Solar Panels)		Round 2 (3 Bad Solar Panels, 1 Inactive Solar Panel)	
	Team A	Team B	Team A	Team B
Activated Solar Panels	8 Activated Solar Panels (8 x 10 pts = 80 pts)	8 Activated Solar Panels (8 x 10 pts = 80 pts)	7 Activated Solar Panels (7 x 10 pts = 70 pts)	9 Activated Solar Panel (9 x 10 pts = 90 pts)
Bad Solar Panel brought to Warehouse	2 Bad Solar Panels (2 x 30pts = 60pts)	1 Bad Solar Panels (1 x 30pts = 30pts)	2 Bad Solar Panels (2 x 30pts = 60pts)	3 Bad Solar Panels (3 x 30pts = 90pts)
Bad Solar Panels brought to Space Station area	0	1 Bad Solar Panel (1 x 10pts = 10 pts)	0	0
Replacement of Bad Solar Panels	1 replacement (1 x 20pts = 20 pts)	1 replacement (1 x 20pts = 20 pts)	2 replacement (2 x 20pts = 40 pts)	3 replacement (3 x 20pts = 60 pts)
9 Activated Solar Panels are in Outer Space	No (0 pts)	No (0 pts)	No (0 pts)	Yes (20 pts)
Robot enters the Base area completely	Yes (10 pts)	Yes (10 pts)	Yes (10 pts)	Yes (10 pts)
Mission Time	01:10.48	00:59.10	01:20.22	01:05.71
Final Score	170 pts	150 pts	180 pts	270 pts

Table 2. Scoring example.

4. Table Specifications

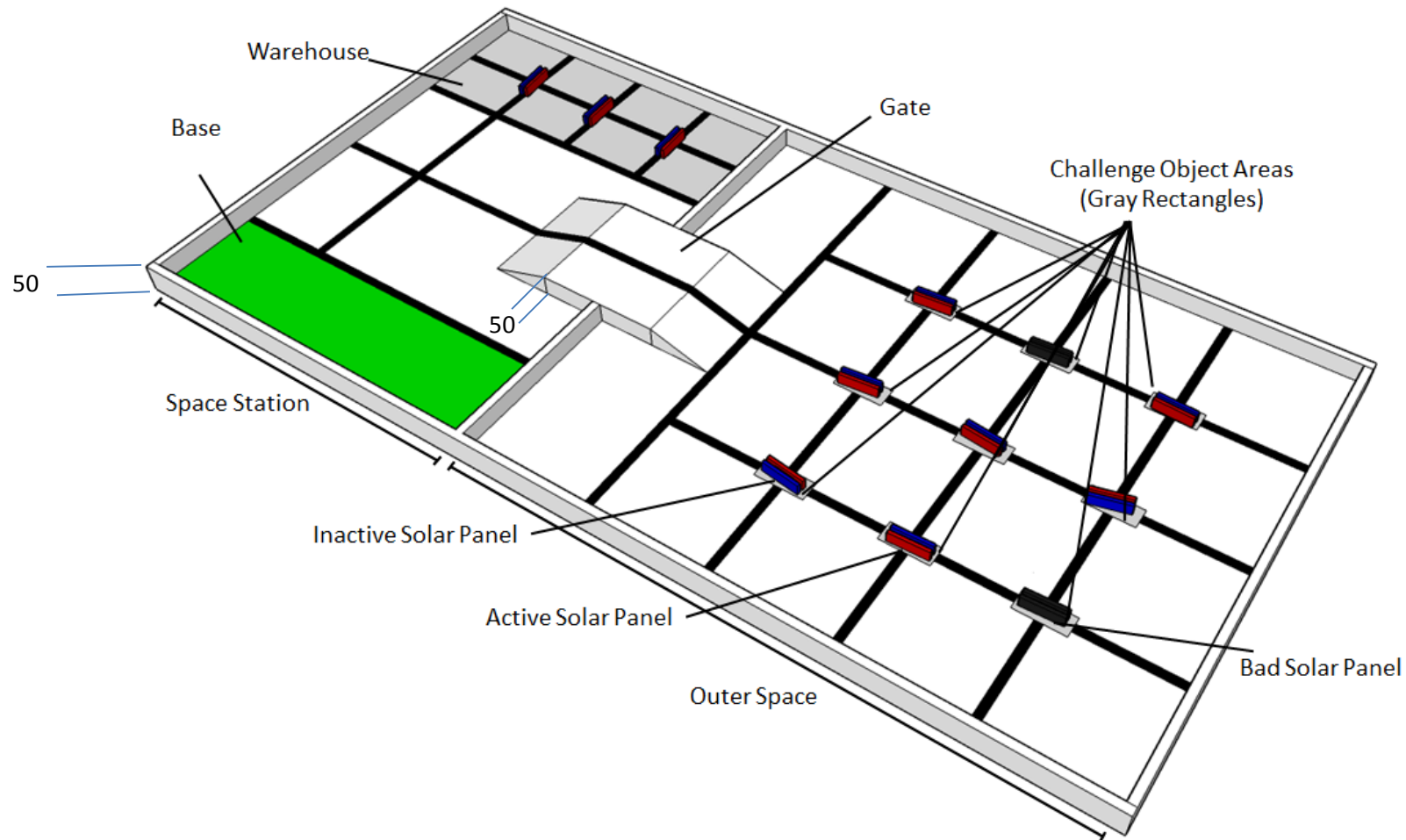
4.1. Horizontal Dimensions



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

All size is in mm.

4.2. Vertical Dimensions



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

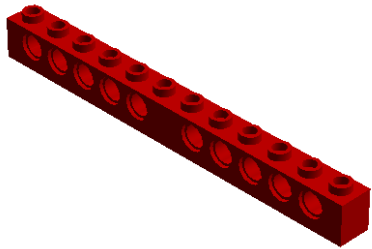
All size is in mm.

4.3. General Information

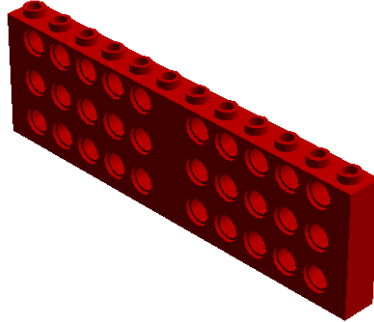
1. The internal dimension of the playing field is 2370 mm x 1150 mm.
2. The playing field is surrounded by boundary walls 50 mm in height and 16 mm thick.
3. The width of the black line on the field is ± 20 mm.
4. The primary colour of the table is white.
5. The height of the Barrier between the Space Station and Outer Space area is 50mm.
6. There are 9 rectangles in the Outer Space area that are 120mm x 50mm.
7. The error tolerance of the field is ± 50 mm.

Building instruction for Solar Panels

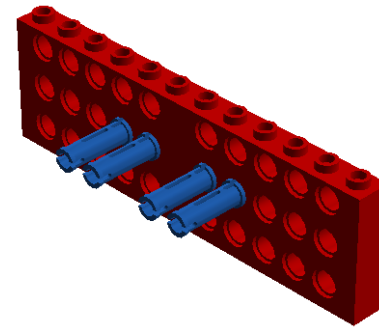
1



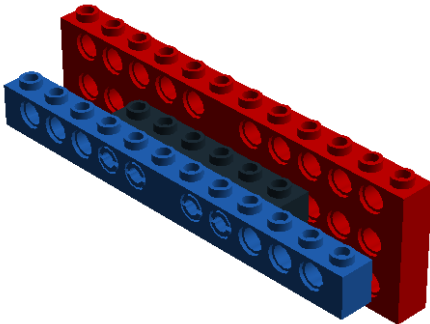
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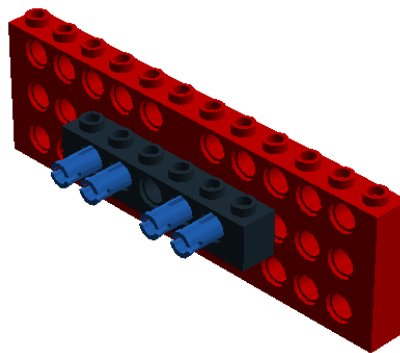
3



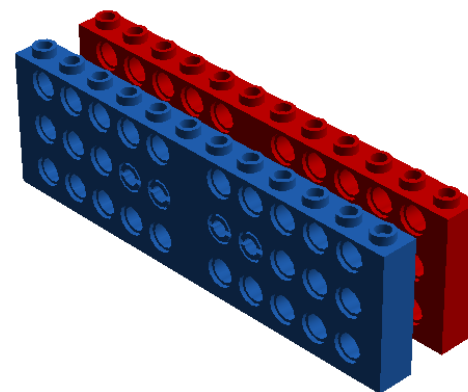
4



5



6



Frequently Asked Questions

Q. How do you define "completely" in scoring point number 7?

A. All parts of the robot including wires and/or extensions 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 except for black line on the Gate.

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 Solar Panel still contribute points if it is in scoring condition?

A. A broken Bad Solar Panel can still contribute points if there is no question that the breakage was intentional, and every part of the Bad Solar Panel (including the broken parts) must be completely in the Warehouse or Space Station area. A broken Active Solar Panel will not be considered as Active Solar Panel even if it has lost only one LEGO element.

Q. Do I have to place the Solar Panel right side up, that is with their studs facing upwards, into the Grey Rectangle in order to score point for "A Solar Panel is activated"?

A. No, you do not. As long as the Solar Panel is placed into the Grey Rectangle completely with its red surface facing the right side of the playing field, you will score points regardless of the direction of the studs.

Q. Can you give an example to illustrate what “the worst outcome available” means in Rules & Regulations point number 14?

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 cable is overhanging and slightly exceed 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 I throw the Bad Solar Panel from Outer Space area to Warehouse or Space Station area to obtain points for Scoring No. 3 and 4?

A. No. The robot must move the Bad Solar Panel from Outer Space area to Warehouse or Space Station area by carrying it and passing through the Gate to said areas.