

**2017 WER Contest**  
**—The Industrial Age Challenge—**  
**Rule Book**



In the early 1760s, mankind entered an extremely important period in the course of scientific and technological development, the First Industrial Revolution. With the emergence of steam engine, machines started to replace humans while large factories started to replace individual workshops. The rapid growth of productivity stimulated higher-than-ever demands for transportation. As a result, an unprecedented amount of canals, hard pavements and railways appeared. Meanwhile, charcoal, the main source of fuel used in metal production, was replaced with a cheaper alternative, coal, to enable larger scaled steel structures soaring the ground at an affordable cost.

This year's WER contest is calling all teams to design robots to impersonate miners, architects and workers of the Industrial Revolution to complete tasks such as mining, road building, transportation, smelting, building and even helping Watt to improve the steam engine, propelling human beings to enter the Industrial Age.

## **1. Team Makeup**

Each team should consist 2-3 students and 1 coach.

One should respect teammates, competitors, volunteers, judges and everyone who has put in tremendous effort into the competition. All team members should tackle problems encountered during the competition with a positive attitude and demonstrate good sportsmanship. We genuinely hope all participants will have a great time during the competition and take home a wonderful experience of learning from and collaborating with each other...Good luck, players!

## **2. Competition Overview**

WER Brick Robot Contest is divided into 3 tiers separating by grade levels. Your team may enter elementary school division, middle school division or high school division according your school standing.

Each team will compete for three rounds. After all rounds are completed, points from different rounds will be summed for a final score. Teams are ranked according to the final score received. Each team will have debugging time prior to each round. However, the debugging time for a single round may not exceed 2 hours. Each team has 3 minutes to complete each round.

Modifications to the rules may be made by the contest organizing committee base on the actual number of registrations and venue situation. However, all rule changes will be fair and will not give any particular team an advantage or disadvantage over the others.

## **2. Robot Rules**

This section specifies restrictions and requirements for the design and construction of robots. All robots must pass inspection before competition. To ensure fairness, judges may randomly examine the robots during the competition. Robots not in accordance with the rules should be adjusted to meet the requirements to avoid disqualification.

### Size

Size of the robot at the starting position for each round should not exceed 12\*12\*12 inches (Length\*Width\*Height); after leaving the base, the robot's body can stretch to larger dimensions.

### Controller

Only one controller can be used in a single round. Replacement of controller is not permitted during

that round.

#### Actuator

Each robot can use no more than 4 DC motors (digital servos are not permitted).

#### Sensor

Each robot can use unlimited types and numbers of sensors, but cannot use integrated transducer that is made of several identical or different sensor probes.

#### Structure

Each robot must use detachable assembling structures made from plastic materials without using auxiliary connection materials such as cable ties, screws, rivets, glue, or tape.

#### Power supply

Each robot must be equipped with a battery instead of external power supply. The battery voltage cannot be higher than 9V. Boost, buck, stabilization and other circuits are not permitted.

### **3. Competition Procedure**

#### Robot construction and programming

Student players may enter the preparation area only after registration. During registration, judges will inspect equipment carried by each team. Already-built robot are allowed into the preparation area, however, if the robot is not in accordance with robot rules (see section 2 for rule details), corresponding team will be asked to make adjustments based on the requirements set forth in this document; otherwise, they will be rejected of entry into the preparation area. In addition, players should not carry storage and communication devices such as USB drive, CD-ROM, wireless routers, mobile phones, cameras, etc. for receiving outside aids. After all student players are seated in the preparation area, the judge will distribute arena maps and announce instructions for the competition.

Players may only go to the competition area to test the program and if there are multiple teams waiting to test the program, each team should take turns to run program. Robot construction and programming should be carried out in the preparation area.

All teams should bring their own laptops, tools and spare parts. Players may not access the Internet and download any programs at the preparation area, nor are they allowed to use cameras and other equipment to take pictures of the arena and contact an outside help in any way.

There is a 2-hour debugging time before each round for teams to design the structure and programs

of robots based on the true environment of the competition venue and carry out simple maintenance operations.

Competition venue has built-in lighting fixtures, and players may need to calibrate sensors accordingly. However, it is not a guarantee that lighting of the venue will stay consistent throughout the day. Some of the factors to be considered including the change of natural lighting, the influence of camera or camcorder flashlight, supplemental light, or other unknown light sources. Players should be aware of these unpredictable factors in the competition environment.

Players must carry out all robot construction and programming in an orderly manner, being respectful of other participants. Coaches should not intervene in any way. Teams violating rules will be given a warning and further violations will be subject to disqualification of the team. At the end of the debugging time, teams should place their robots at the designated location of the preparation area with robots turned off.

#### Pre-Round Set up

Before each round of the match, teams should collect their robots and enter the competition area accompanied by the competition staff. Teams failing to present at the designated location within the time given will be forfeited.

When robot is placed inside the base, no parts of the robot should exceed the peripheries of the base markings.

Players can take no longer than 2 minutes to position and prepare the robot before signaling to the judge that the robot is ready to start up.

After the judge confirms that all teams are ready, he will start the countdown by saying "3, 2, 1, go". Upon hearing the "Go" order, players can press buttons or send a signal to the sensor to start the robot.

If a player starts the robot before the "Go" order, it will be considered as a "false start", and the team will be given a warning or penalized accordingly.

Upon starting, the robot can only be controlled by programs embedded in the controller. Players may not touch the robot (except for restarting).

#### During match

Robots should not intentionally drop mechanical parts on the site; it will be considered as a foul. Accidentally fallen parts will be immediately cleared out of the site by the judge. If a robot projected any part of itself out of the arena due to fast speed or program errors, the item cannot be put back



The size of the arena map is  $7' \frac{7}{32}" * 3' \frac{15}{16}"$  (220 \* 120 cm) and is made of PU cloth or inkjet cloth. The routes marked by black lines have widths of  $\frac{25}{32}"$  to  $1' \frac{3}{16}"$  (2-3 cm). The task models are located at the end of the route inside the model area indicated by thick rectangles. However, the location and orientation of the task models will be randomly placed for each round during the completion. The base area, is a square with length of  $11' \frac{13}{16}"$  (30 cm). Robots are initially placed in the base area and are expected to return to the base area autonomously.

### Environment

The arena features cold light sources, low illumination, and no magnetic interference. However, there may be uncertain factors common in a competition environment, such as random scratches on the surface or uneven surface, changes in lighting conditions, etc. Teams should take countermeasures in designing the robot.

## **5. Tasks and Scoring**

The competition comprises of 4 pre-determined tasks and 3 on-site tasks. This document will provide teams with pre-determined tasks, but task model location and orientation may be different than shown in figure 1 arena map. The arena map used for each round during the competition will only be released during the 2-hr preparation period prior to each round of match. On-site tasks will also be released during the 2-hr preparation period of each competition; participants will need to design the structure and program on site.

\*\*The following pre-determined tasks are only simulations of certain scenarios in real life, please do not mistaken them with true scenarios in real life.

### Pre-determined Task 1: Obtaining Energy Block

2 energy blocks will be placed on the task model, as shown in Figure 2.

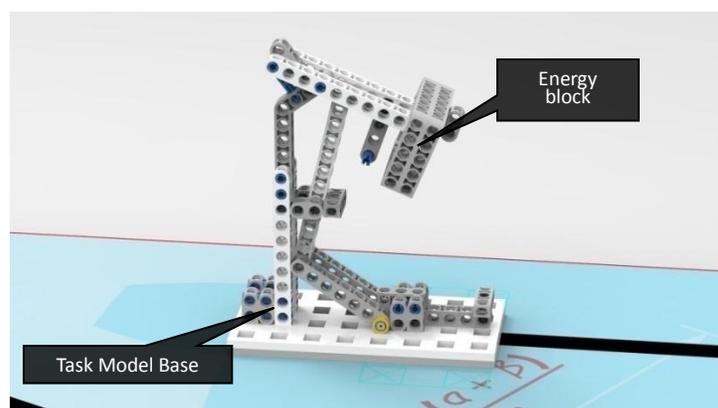


Figure 2 Energy block on the task model

The robot need to remove the energy block from the task model and par of the vertical projection of the robot must overlap the base (part of the shadow of the robot must be projected onto the base). 30 points will be awarded for each energy block successfully removed and brought back to the base. Energy blocks may be brought back to the base separately or simultaneously.

### Pre-determined task 2: Bridge construction

Test model of a bridge will be placed onto the arena, as shown in Figure 3.

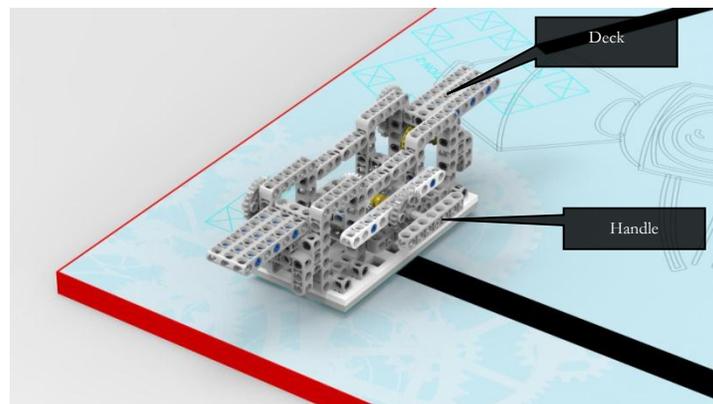


Figure 3 Initial State of the Bridge

The robot needs to turn the handle of the bridge model to connect the decks. 40 points are given if the gap between two decks is no more than  $3/16$ " (5 mm). Figure 4 shows an example of the completed task model.

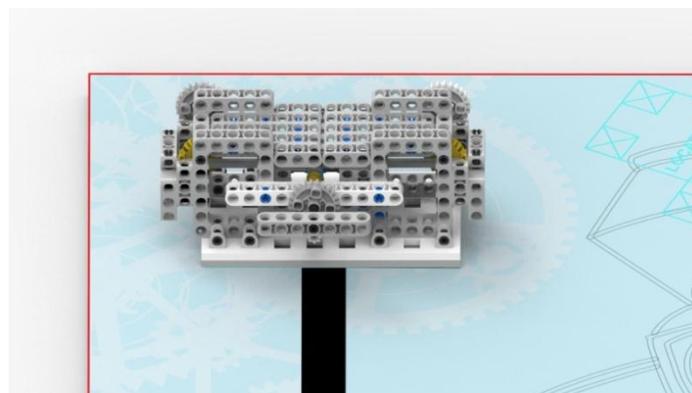


Figure 4 Competition Status of the Bridge

### Pre-determined task 3: Fan Repairing

Task model resembling a fan will be placed onto the arena with the handle parallel to the ground, as shown in Figure 5.

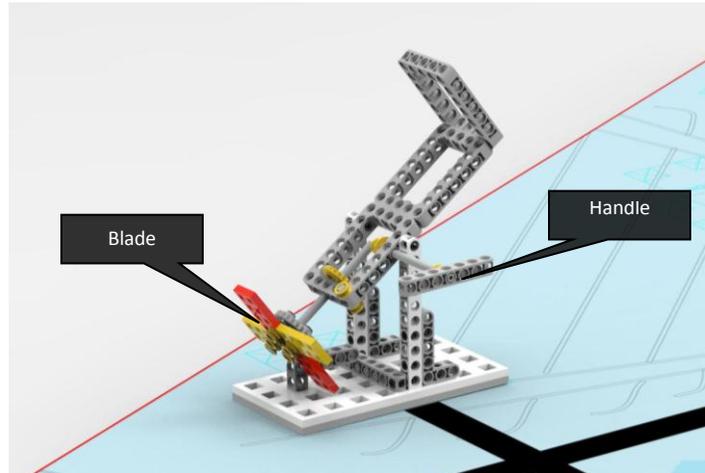


Figure 5 Fan model before repair

If the robot can tilt the body of the fan so it is restored to be perpendicular to the ground as shown in Figure 6, 40 points

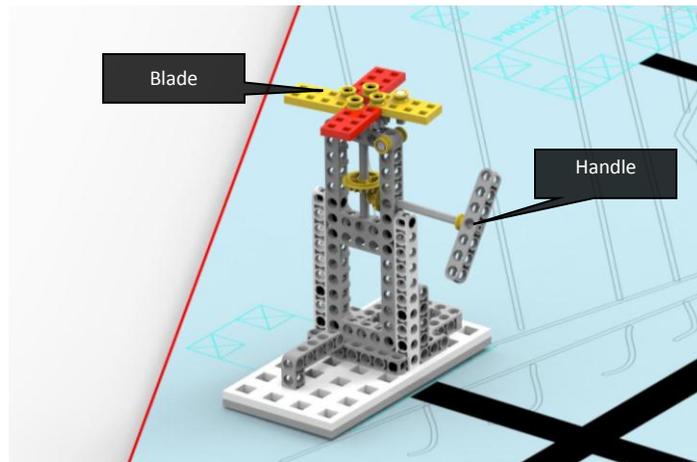


Figure 6 Fan model after repair

If the robot can restore the fan to be perpendicular to the ground and then turn handle to rotate the fan blades for more than 1 cycle, 60 points are given.

#### Pre-determined task 4: Iron ore mining

The iron ore task model is placed in the middle of the model area, as shown in Figure 7.

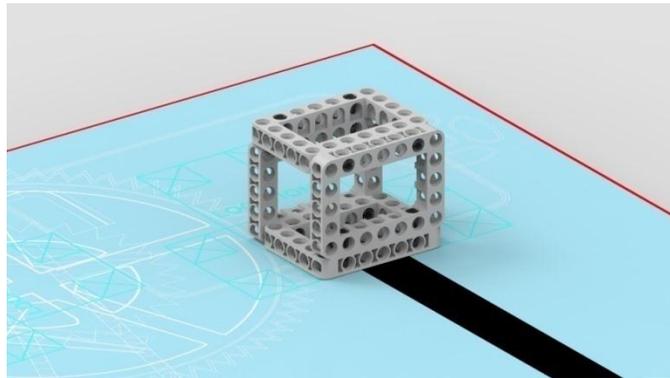


Figure 7 Iron ore model

**If the robot can move the iron ore out of the model area and the vertical projection of the iron ore is completely beyond the model area (shadow of the robot does not fall into the model area), 20 points are given.**

If the robot can move the iron ore out of the model area and back to the base, as long as the projection of the iron ore enters the base, 40 points are given.

#### Scoring

Points for one round of match are summed based on the tasks performed at the end of each round.

Robots may return to the base repeatedly at anytime. The sequence in which tasks are performed will not affect the points of individual tasks.

For tasks requiring the task model to be brought back to the base, points will be given if all of the following criteria are met:

- 1) robot returns to the base autonomously and part of its projections is in the base
- 2) projection of the robot and that of the model are overlapped in whole or in part, or the robot is in contact with the task model.

#### **7. Fouls and Disqualification**

If a team fails to present at the designated arena in the time given, 10 points will be deducted for each minute late. If a team does not arrive at the designated arena 2 minutes after the scheduled time, the team will be considered disqualified for that round.

A warning is given for the 1st false start (when a player starts the robot before the "Go" order made

by a judge), under which circumstance the robot must return to the base area and wait for judge's "Go" order to restart. Timer will reset. However, the team will be disqualified for a second time false start.

Dropping parts intentionally as part of the task-completing strategy is considered as a foul, and the team will either be given a warning, point deduction or disqualification depending on the circumstance.

Warning will be given to the team if the player or robot damages task model, intentionally or unintentionally. No points are given for the task if such damaging occurs, even if the task is completed.

The players may not be in contact with the task model or the robot once it leaves the base area. If such contact occurs, the situation will be treated as a "restart" (see section 3 for "restart" details).

Warning will be given to the team if the player disobeys the instructions of the judge or argues with the judge. If the team fails to take warning seriously and continues to violate the rule, the team will be disqualified. Should there be any dispute, the team should contact the chief judge after the round is completed with written appeal.

Players may not communicate with coach or parents without the permission of the chief judge. Depending on the contents of communication, teams may be disqualified for such violation.

## **8. Team Ranking**

Teams are ranked based on the overall score received within each division.

When two teams have the same total score, ranking will be based on the following factors in that order:

- (1) Total time used for all rounds.
- (2) Total number of contacts with the robot outside of the base (fewer contact is desired)
- (3) Total number of tasks completed.
- (4) The weight of the robot (lesser weight is desired)

## **9. Miscellaneous**

Any modifications to this Rule Book will be posted as "Important Notice" on the 2017 WER official website (<http://www.wer2017.org/>).

During the contest, the Judge Panel will determine any issues not address in the rulebook. Contest Organizing Committee entrusts the Judge Panel to interpret and revise the rules.

The contest rules will be guidelines for the Judge Panel. During the contest, judges should have the

final ruling rights. The judges won't replay the recorded matches. Should there be any questions concerning the judges, a student participant will present a written appeal to the chief judge after the round is completed. The Organizing Committee will not address complaints made by coaches or parents.

## Annex Scoring Sheet

WER Contest Scoring Sheet			Round#
No.		Team Name	

Task		Points	Score
Obtaining Energy Block	The robot takes 1 energy block back to the base.	30	
	The robot takes 2 energy blocks back to the base.	60	
Bridge construction	The robot turns the handle to connect the decks and the gap between the two decks is less than 3/16" (5 mm).	40	
Fan repairing	The robot tilts the fan back to perpendicular position in relative to the ground.	40	
	The robot tilts the fan perpendicular to the ground and then turns the handle to rotate the fan blades for more than 1 cycle.	60	
Iron ore mining	The robot moves the iron ore out of the model area.	20	
	The robot moves the iron ore out of the model area and back to the base, and the projection of the iron ore enters the base.	40	
Additional Task 1	See announcements during the competition.	100	
Additional Task 2	See announcements during the competition.	100	
Additional Task 3	See announcements during the competition.	100	
Autonomous Operation Reward	40 – (number of restarts) * 10. The score should be no less than 0.		

Total Score	
Single round completion time	

**Remarks on disqualification:**

**Judge:**\_\_\_\_\_ **Scorekeeper:**\_\_\_\_\_

**Players:**\_\_\_\_\_

**Chief Judge:**\_\_\_\_\_ **Data Entry By:**\_\_\_\_\_