

# **WATERLOO** **ENGINEERING**

**Senior Team Design  
Competition Problem**

Spring 2012  
Waterloo Engineering Competition  
July 6-7

**GENERAL RULES**

1. All questions regarding the competition problem must be asked during the welcome and briefing session. No questions will be answered during the design and build stage.
2. Teams are not allowed to leave the building unless they have submitted their prototype and presentation to competition staff.
3. All communication devices must be turned off throughout the duration of the competition.
4. Wireless on laptops must be turned off. Violation of this rule will result in immediate disqualification.
5. Visitors are not allowed throughout the design and build stage. Violation of this rule will result in immediate disqualification.
6. Teams may only use materials they have purchased in the shop.
7. Final prototype and presentation materials must be submitted to the submission desk prior to 12:30am, July 7<sup>th</sup>, 2012. It is the team's responsibility to bring its deliverables from the design area to the submission desk.
8. Competitors may not use the blackboard when delivering presentations.
9. Keep work spaces clean. Tidy up at the end. Penalties may be applied to unclean work areas at the end of the design and build stage.

**SCHEDULE**

The schedule of the Senior Team Design competition is as follows:

Friday, July 9	5:45 p.m. – 6:00 p.m.	Sign-In	RCH 101
	6:00 p.m. – 6:30 p.m.	Welcome/Briefing	RCH 101
	6:30 p.m. – 12:30 a.m.	Design/Build	Various Assigned Classrooms
	12:30 a.m. – 12:30 a.m.	Submission/Debriefing	RCH 101
Saturday, July 10	7:45 a.m. – 8:00 a.m.	Sign-In	RCH 3 <sup>rd</sup> Floor
	8:00 a.m. – 12:30 p.m.	Presentation/Demonstration	RCH 301

Volunteers will give instructions to teams on when and where to get their pizza, which will be available at some time between 9:00p.m. - 10:00p.m. Please remind the competition coordinators and volunteers of your dietary restrictions and/or allergies.

Dress code for presentation and demonstration is business casual.

There will be a question period after the problem is presented. No questions will be answered during the development and build stage to ensure fairness in the competition.

**THEME**

The theme of the Spring 2012 Senior Team Design is the Postal Crisis Aversion Mission.

**SCENARIO**

With the recent postal strike a lot of extra mail had to be sorted, resulting in overtime work for the postal workers. Due to the high cost of overtime pay, the national postal service is looking for automated solutions to assist with the mail sorting process.

At every postal branch, mail is initially sorted into 2 piles; one for local mail, and the other for other destinations. This pile is then mailed to a centralized provincial location for further sorting. A mail sorting machine should be designed to take letters from one main stack and put them into one of two piles.

**OBJECTIVE, REQUIREMENTS & CONSTRAINTS**

Design a sorting machine which can be remotely controlled through a minimum of one metre of wire/cable. It must be able to move letters from a central stack into 2 specified areas, depending how the letter is marked. The location of the piles can be moved to wherever is most convenient for your particular machine. However, they must be a minimum of 15 cm away from the original mail pile (this makes it easier to install in any post office depending on their own office layouts). The letters may not be damaged in the sorting process.

The remote control and the attached cable must not have direct physical impact on the mail sorting machine, i.e. motion of any kind by pulling the machine is not allowed. Only one person is allowed to operate the remote control at any time; another person can hold up the cable to prevent physical interference. Teams are not permitted to touch the machine during the demonstration. The cost of the design prototype may not exceed \$8,500.

**PROTOTYPE TESTING RULES**

A portion of the terrain will be available for teams to perform prototype testing. Each testing period is 10 minutes, and is signed-up for on a first-come-first-serve basis.

**Reservations**

Each team may only have one reservation at any time, and must use up the testing period before reserving the next one. Teams may only reserve whichever time slot is available next (i.e. teams may not specify a time).

**Cancellations**

Teams are allowed to make cancellations to reservations. A cancelled time slot then becomes the next available testing period, and can be reserved by whichever team makes the reservation next. Time slots after the cancellation will not be bumped up.

**Consumable Items**

Some items are consumable, for example: batteries. Teams are responsible for purchasing enough of these consumable items from the shop during the design and build phase to successfully complete the presentation and demonstration.

**SHOP RULES**

1. A maximum of two (2) people per team may be in the shop at any time.
2. All sales are final. Be sure to verify purchased items and quantities before leaving the shop.
3. Teams may not trade building materials. Violation of this rule will result in immediate disqualification for both teams.
4. The competition shop will keep track of the official expense forms. However, teams are encouraged to keep track of their own Purchase Requisition Form to have an idea of how much they have spent. The shop will not tell teams how much they have already spent.
5. The shop will close 30 minutes before the development and build stage ends.

**DELIVERABLES**

At the end of the six- (6) hour development and build stage, each team is required to submit the following items:

1. A working prototype of the machine
2. A PowerPoint presentation
3. Purchase Requisition Form (both sheets)

**MARKING SCHEME**

The following marking scheme is specific to the Spring 2010 Senior Team Design competition and will be used by judges during presentation and demonstration.

<b>Design &amp; Performance</b>	<b>65%</b>
Letters successfully delivered (first 10)	6.5% each
Letters successfully delivered (more than 10)	2% each
Letter in the wrong pile	- 4%
Not able to move at all†	- 60%
Sorting machine requires positional adjustment	- 5% each time*
<b>Presentation</b>	<b>25%</b>
Design Process	6%
Meet Constraints & Criteria	6%
Quality & Flow	6%
Highlights & Usability	5%
Prototype Critique	2%
Cost below \$2500	+ 10%*
Cost over \$8500	- 20%*
<b>Originality</b>	<b>10%</b>
Daring/Outside the Box	4%
Creativity	3%
Uniqueness	3%
<b>Teamwork</b>	<b>5%</b>
Knowledge	2%
Workload Distribution	2%
Compatibility	1%
Positivity	+ 1%*
<b>TOTAL</b>	<b>100%</b>

In case of a tie in total marks, the teams will be ranked based on their points scored in Design & Performance.

Completed marking sheets will not be disclosed to competitors; however, if teams wish to know their strengths and weaknesses for improvement in future competitions, judges will be available after the competition for questions.

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\* The  $\pm$  signs denote bonus or penalty points, respectively. Lowest possible score for each marking category is zero (0) points.

† The WEC marking scheme explicitly states that a machine not being able to move constitutes as a design fail. Be sure to keep this in mind when competing at the OEC, as the same rule applies but is not stated in the marking scheme.

**MATERIAL LIST****Electrical Items**

Motor –Small	\$850
Motor –Large	\$1,500
ON/OFF/ON toggle switch	\$150
Battery holder 4-AA cells	\$20
Battery holder 8-AA cells	\$35
AA Battery	\$17
Stranded wire 22 AWG	\$3/10cm
Solder	Free
Electrical Tape	\$8/cm

**Miscellaneous**

Rattrap	\$200
Foam board (custom size)	\$11/cm <sup>2</sup>
Popsicle stick	\$60
Nail	\$20
Toothpick	\$4
Styrofoam Ball	\$100
Plastic straw	\$50
Rope	\$10/cm
Cotton twine	\$3/cm
Plastic spoon	\$50
Pot pie pan	\$350
Muffin cup	\$20
Aluminum foil	\$20/cm
Sand paper	\$50/cm
Medium zip tie (15 cm x 0.4 cm)	\$60
Small zip tie (10 cm x 0.3 cm)	\$40
Elastic band	\$40
1/4" Dowel	\$35/cm
7/16" Dowel	
3/16" Dowel	
3/8" Dowel	
1/2" Dowel	
Duct tape	\$8/cm
Steel Wire (Un-insulated)	\$20/cm



Super glue	\$80
Hot glue stick	\$50
Paint Roller (Small)	\$250
Double Sided Tape	\$15/cm
Plastic Fork	\$50
Clothes Pin	\$100
Masking tape	\$7/cm
Pipe Cleaners	\$100/each
Skewer	\$20/each
Wheels and Axle	\$500/set
Wheel	\$300 Each
Dump Truck Bucket	\$500
Balloons	\$60
Eye hooks	\$20
Binder clips	\$40
Paper clips	\$10
Thumb tacks	\$20
Magnets	\$50

**PURCHASE REQUISITION FORM**

Team Number: \_\_\_\_\_

Team Member #1: \_\_\_\_\_

Team Member #2: \_\_\_\_\_

Team Member #3: \_\_\_\_\_

Team Member #4: \_\_\_\_\_

Item	Unit Price	Quantity	Total Price	Volunteer Initial

**PURCHASE REQUISITION FORM (continued)**

Team Number: \_\_\_\_\_

Team Member #1: \_\_\_\_\_

Team Member #2: \_\_\_\_\_

Team Member #3: \_\_\_\_\_

Team Member #4: \_\_\_\_\_

Item	Unit Price	Quantity	Total Price	Volunteer Initial