IEEE Robot Competition

The IEEE region 5 sponsors a robot competition each year. Here is the web site for the event.

There is no additional information about what this competition will involve at this point.

Attached is last year's write up.

http://ewh.ieee.org/reg/5/

Capstone Proposal

Autonomous Robotics with Image Recognition and Movement Encoding

Objective

The goal of this Senior Capstone Project is to design a fully autonomous robot to perform the specific tasks described in the 2008 IEEE Region 5 Robotics Competition (attached) using Image Processing algorithms and movement encoding within its wheel design. This project will be broken into two semesters, which will each have specific objectives to ensure the completion of a well-performing autonomous robot for use in competition. The ultimate ending to the project will be to compete in the annual IEEE Region 5 Conference Robotics Competition.

The objective of the first semester (Fall) will be to design a robot to the specifications of the previous year's competition rules, until the official rules are released around the end of September, where adjustments to the project will be made if any of the rules change. Near the end of the first semester, most of the parts will be ordered and tested and all of the mechanical design of the robot will be completed and tested. The mechanics will include chassis, arm, storage system and wheel/roller design and placement.

The objective of the second semester (Spring) will be to add any sensory components and work on the programming and logic of the robot. This semester will include extensive testing to ensure that the robot is ready for competition and for a good placement.

Special Notes

- For all test subjects, all participating students must complete any special processes and documentation needed by the Klipsch School of Electrical and Computer Engineering and NMSU.
- The Klipsch School of Electrical and Computer Engineering will be asked to provide an adequate lab for this capstone.
- This capstone will be entirely run by students and will be supervised by a combination of Dr. Robert Paz and Dr. Charles Creusere.
- If needed, funding from previous donors to the NMSU IEEE Robotics team, may be asked, which include Dow Chemical Co. and Lockheed Martin.
- The Capstone Students who work on this project will not be required to compete with the robot, however, if they wish to do so they will be required to do up to 4 hours of community service to ensure funding from E-Council and ASNMSU, through IEEE Representation. This funding will provide more than half of the needed costs of the trip.
- If students wish to compete, they will be required to become a member of IEEE with a student fee of $25 for an annual or $15 for a 6-month membership before going on the conference trip.

- Many components can be used from previous IEEE Robotics Competitions.
- A student from the Mechanical Engineering Department may be chosen to be used on this team as support for the mechanical design of the robot, to be advised by the dynamics expertise of Dr. Ou Ma. If a student is not chosen, the supervision of Jesse McAvoy, a graduate student of dynamic systems, will be used.

This system will include

1. Two motors for driving.
2. An integrated motor driver, with PWM inputs, current sensing, and H-Bridge capabilities.
3. A very powerful mechanical arm capable of lifting 400 grams or more.
4. An image processing system (CMU Cam or small handheld computer capable of MATLAB processing with computer cam)
5. Spatial sensors, encoders, detectors in order to detect, weigh, and place a small metal can and recognize position of the playing field, according to the specifications of the 2008 IEEE Region 5 Robotics Competition.
6. A storage system capable of holding and sorting three small cans.

Budget

Minimum estimate $500
Maximum estimate $1500

Currently we have no (absolute) sponsors and would like assistance from the Klipsch School of Electrical and Computer Engineering.

As stated above, many components are purchased from previous competitions and entail close to $1000 or more of electronics and other materials.

Time of the Capstone

6 credits – all to be completed in the Spring 2008

Current Team Members

Marcus Safar	**EE**	**marcussafar@gmail.com**
Chance Mccoy	**EE**	**cmccoy@nmsu.edu**

Open to maximum of two other students for this specific robot, however, other teams may form to compete with another robot.

Scope of Work

Specific tasks are as follows:

1. Develop requirements and schedule
2. Develop system design and budget.
3. Build the main skeleton of the robot.

4. Design logic and test robot.
5. Demonstrate use of the robot at competition.

Electrical Engineering Content
Electronics
Digital Design
Digital Signal Processing
Systems Control
Power

Mechanical Engineering Content
Dynamics

Schedule/Milestones
Biweekly
Progress Report via email; include documentation of completed subtasks where appropriate
Fall Semester
Design of mechanics, purchase of more than 90 percent of components needed for total robot.
Spring Semester
Sensory components added, logic programmed, intensive testing performed.
End of Spring Semester
Final Interim report and presentation, Prototype Demonstration, Final Design Review, Compete in IEEE Robotics Competition

Evaluators

Dr. Robert Paz	rpaz@nmsu.edu
Dr. Charles Creusere	ccreuser@nmsu.edu

2008 IEEE Region 5 Student Robotics Contest

I. The Contest Venue

The contest will be held in the ballroom of the Intercontinental Hotel, on the Plaza in Kansas City, MO. The space is large and reasonably bright. The ballroom floor is carpeted. One-fourth of the space will be used for competition rounds and will be partially partitioned to minimize distraction. The competition space, however, will be "open" to contestants and spectators throughout the event. Lighting is a combination of incandescent (chandeliers and "cans") and fluorescent. The hotel's web site has photographs of the ballroom:
http://www.ichotelsgroup.com/h/d/ic/1/en/hotel/mkcha?_requestid=178956

II. Eligibility of Teams and Members

The Student Robotics Contest has been designed, over the years, as an event for undergraduate students. However, teams that desire to compete with graduate students and/or others may notify the IEEE Kansas City Section, enter a team and compete separately from the undergraduate teams. Undergraduate teams may NOT include any non-undergraduates.

In any case, all team members must be "signed up" for the regional meeting.

III. Theme of this Contest

There is considerable public and professional concern with the handling and storage of hazardous materials. This year's contest is designed to test the teams' design of robots that can manipulate these materials without human intervention.

One essential task is to classify these materials by weight. Thus, three will be three different container weights to simulate empty, full, and partial casks. The containers are designed to represent the "casks" used to store some hazardous materials, such as low-level nuclear reactor products.

The course, or track, is intended to represent a closed storage area, with newly-arrived casks at one end and storage spaces at the other. Lines are provided to assist the robots in performing their tasks.

IV. The Course (Track)

A. There are two components which comprise the Course: the Board, or Track, and the Casks.

B. The Board: (see Appendix A)

Most of the board (track) will be fixed, as shown in the drawing in Appendix A. It will consist of two 4'x8' sections, joined along the long edge, to make an 8'x8' track area.

Three storage bins will be affixed to the flat track for run 3 (discussed below). These bins will be painted red, yellow, and green, inside and out.

C. The Casks: (see Appendix B)

There will be (only) three casks used in the competition. One (empty) will weigh 63 grams. Another cask will be weighted to a total of 126 gm. The third cask will be weighted to a total of 189 gm. A key part of this contest will be to determine the weight of each cask, prior to placement at its destination. However, extreme accuracy is not the objective.

V. Robot Construction

Except for pre-programming (discussed below), and starting (manual or remote), the robot must be completely automomous. For the 2008 competition, multiple-robot designs will not be permitted. Use of commercial "kits" or parts is not encouraged, but is not forbidden.

As in previous years, the robot must be no taller than 36", have "plan" dimensions not to exceed 16"x16", and weigh less than 50 lbs. Each robot must be equipped with a visible (red) "kill" switch – on the top surface – to stop any renegade behavior. Motion may be by any means available. The robot may determine the weight of a cask in any manner, as long as nothing is left on the track at the completion of a run. The casks may be lifted or scooted, but not "thrown".

A weight display, if employed (see "Success Measurement" VI-D, below), should have (approximately) 0.75" characters and show the weights in even grams. Preferably, all three weights should be listed, top to bottom, in the sequence the casks are picked up. If another display technique is employed, the sequence number shall be shown in addition to the weight. The display should persist until the robot removed from the track.

VI. Tasks Performed

A. General

Each robot will be asked to move pseudo hazardous-material casks from their incoming positions to their final positions. The final positions will be determined by the weight of each cask. The weight can be determined by any means.

The scoring algorithm has been designed so that success in performing the tasks <u>correctly</u> will be the most important criterion. Speed in performing the tasks will be secondary. Additional (bonus) criteria will be (in order of importance):

- Displaying the weight of each cask.
- Remote (wireless) starting. This may consist of radio, infrared, or other (non-audible) means.

B. Starting Position and pre-Programming

Pre-programming (in response to sequence information provided by the judges) must be done "off" the course, prior to placement of the robot. The robot shall be placed on the course directly in front of the middle (#2) box, facing toward the center cask at the other end of the course. Team members may not step on the course prior to their run. (It may be necessary to retrieve a robot at the end of the run. If so, only one team member, in stocking feet, will be allowed on the course.)

The casks will be placed by the judges approximately on the center of the A,B,C squares at the opposite end of the course, oriented as shown in Figure 1 of Appendix A.

The team will be given one minute for pre-programming and one minute for robot placement for each run.

C. Competition Rounds

There will be three rounds of competition. Eligibility for the third (final) round will be limited to the ten best-scoring teams in either of the first two rounds. Teams may "sit out" their turn in either of the first two rounds.

In the first two rounds, the task will be to simply place the casks on the numbered squares in the specified weight sequence. As an example, the lightest cask might go to square #1, the heaviest to square #2, and the other to square #3. The weight sequence will be provided to the team by the judges, prior to the run, by three single characters. (In the above example, L,H,M – for lightest, heaviest, middle.) The order (sequence) of pickup is not important; any cask may be moved and placed in any order.

For the third round, the numbered boxes will have “storage bins” placed over them, and the robot must insert the correct cask completely inside the storage bin. Again, a weight sequence will be provided by the judges. For this round, the robot will need to recognize colors, as the storage bins will be colored (red, green, and yellow). The weight sequence will be provided as before, but the <u>position</u> of the colored bins will be selected <u>after</u> pre-programming has been completed (and the robot placed on the course). For example, a sequence of “M-R,L-Y,H-G” might be provided, the robot pre-programmed by the team, <u>then</u> the three bins placed “R,Y,G” on the “1-2-3” target spaces by the judges. The robot would be required to take the middle-weight cask to the red bin, the lightest-weight cask to the yellow bin, and the heaviest cask to the green bin.

D. Success Measurements

The run time will be from the time the start command is given by the judge to the time the last cask is released by the robot. A maximum time for any run is 3 minutes.

In the first two rounds, success will be achieved if the correct cask (by weight) is placed on the numbered square. “On”, in this case, will mean that any part of the cask touches any part of the square, looking from directly above. Each successfully-placed cask will deduct 50 points (seconds) from the elapsed time of the run, with an additional bonus of 50 points for correctly placing any two of them and 100 points for correctly placing all three.

In the final round, success will be achieved if the correct cask (by weight) is placed entirely within corresponding storage bin. A one-half credit (25 points) will be given if part of the cask is inside and part outside the bin. (The bonuses described above will apply to either full-credit or partial-credit placements.)

Additional (bonus) credit of 15 points will be provided if a robot’s on-board display shows the weight of each cask in the order it is picked up.

Additional credit of 10 points will be provided if the robot is started remotely at the judges' "start" command.

Robots that meet the qualifying dimensions prior to a competition run, but fail to meet those dimensions at the end of the run will be penalized +50 points. (During the run, parts of the robot may extend in any direction.)

Robots will be disqualified for the run if:

- The robot leaves the surface of the course.
- Any cask is removed from the course.
- Any cask is damaged. (Damage would include dents and/or removal or chipping an end piece.)
- Any storage bin is moved or damaged.

NOTE: There is no edge "wall" on the competition track. Therefore, the robots should be designed to stay on the track and/or withstand a fall of about 5 inches if they fail to do so.

VII. Scoring/Timing

As in golf, the lowest score is the best result.

Each team will start each run with 300 points, equivalent to seconds of time. The run time will be added to the starting number; then credits for correct placement of casks, correct display of weights, and remote starting will be deducted to compute the final score for the run. For example, if team XYZ's robot completes the run in 50 seconds, places two casks correctly, displays all weights correctly, and was successfully remote-started, their run score would be:

	300	starting points
plus	50	time of run
minus	100	correct placements
minus	50	bonus for two correct placements
minus	15	three correct weights displayed
minus	10	remote start
	175	points for the run

VIII. Judging

All decisions by the judges during the course of the competition are final.

IX. Questions and Comments

Please direct your questions/comments to: ronan@ieee.org

Appendices

Appendix A. *Track and Storage Bins*

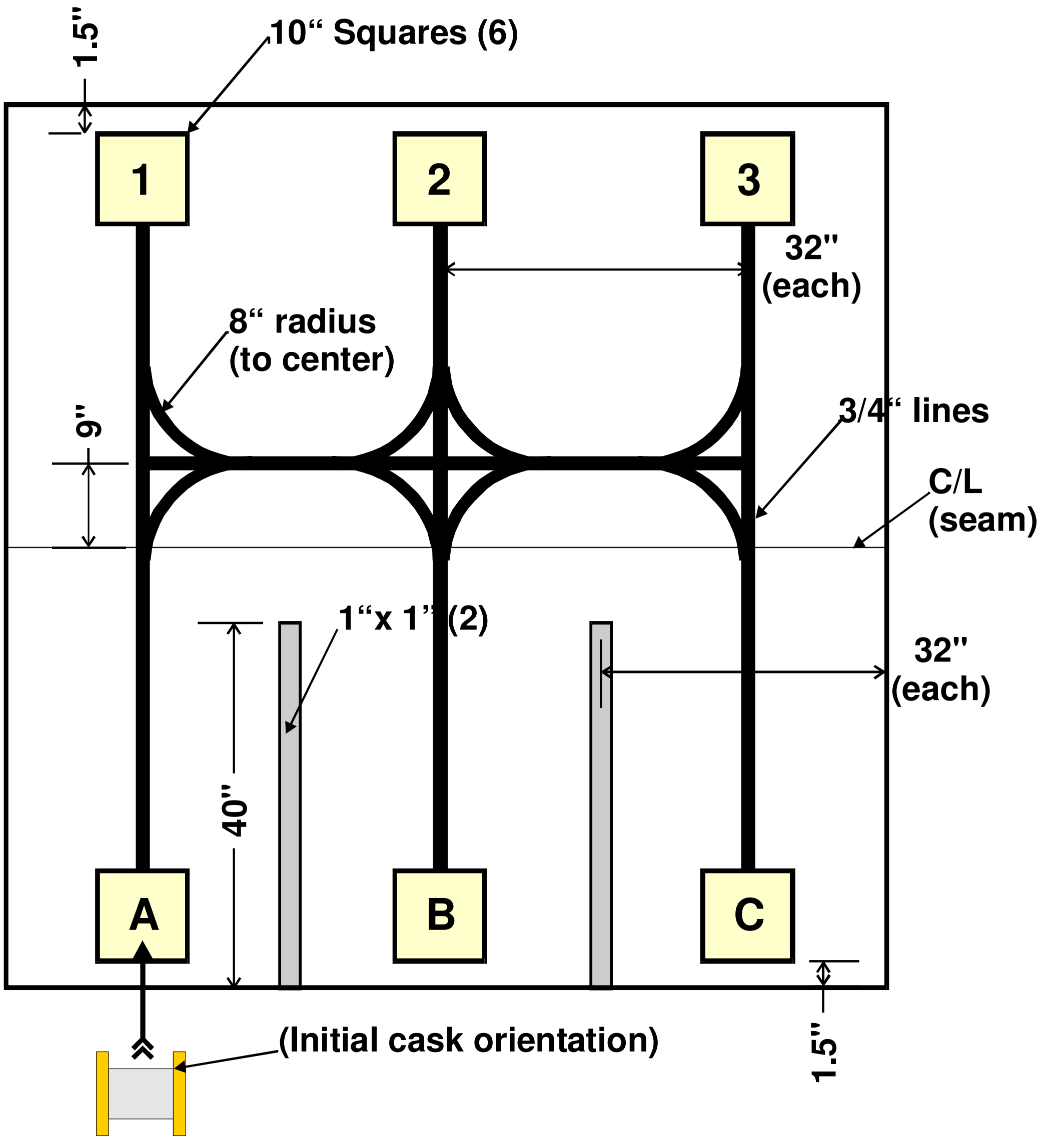


Figure 1 – Track

The track (course) will be 8' square; made from two 4'x8' panels. Track construction will be done by cementing white "tile board" to ¾" tongue-and-groove underlayment board. The tile board will furnish a smooth surface to the robot, while the tongue-and-groove feature of the underlayment will help keep the center joint as flush as possible.

There are two 1"x 1" walls between the three receiving stations. They will be painted white *(Rust Oleum gloss protective enamel 7792 Gloss White).* The storage bins will have a floor that will require lifting the casks, and will be attached to the track with "Ultra-mate" Velcro® (about 1/8" thick). Otherwise, the entire track is flat. The ¾" black lines will be made from "flat black" (3-mil) vinyl, computer-cut by a sign-making firm.

Note: The data file for cutting the line material is on this website, labeled: *"IEEE 2008 Robot Competition Track.dxf"* and may be used freely by anyone. A local firm may be willing to make (and install?) the lines for your practice track as an "in-kind" donation. Alternatively, practice-track lines may be fabricated from black vinyl tape or painted on the track surface. A .pdf version of the lines is also on the website, labeled: *"IEEE 2008 Robot Competition Track without hatch.pdf"*.

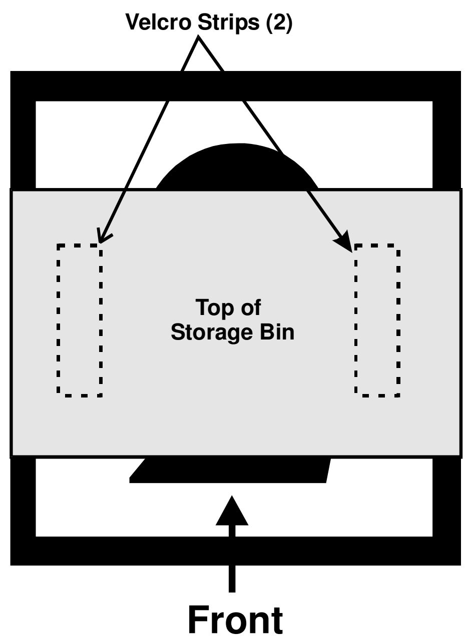
Remember, if your practice track is a little "rougher" than the competition track, your robot will perform better in competition than it does "at home"! Tile board has a definite sheen; be sure your sensors can handle that.

The storage bins will be fabricated from wood (1/4" poplar, often called "hobby" lumber) and will have dimensions as shown in Figure 1a. They will be painted red, green, and yellow as follows:

Red:	Sunrise Red, Rust-Oleum™	7762-830
Green:	Hunter Green, Rust-Oleum™	7738-830
Yellow:	Sunburst Yellow, Rust-Oleum™	7747.830

The storage bins will be placed (by the judges) over the numbered squares as shown at right.

Detailed storage-bin construction is shown below (Fig 1a).



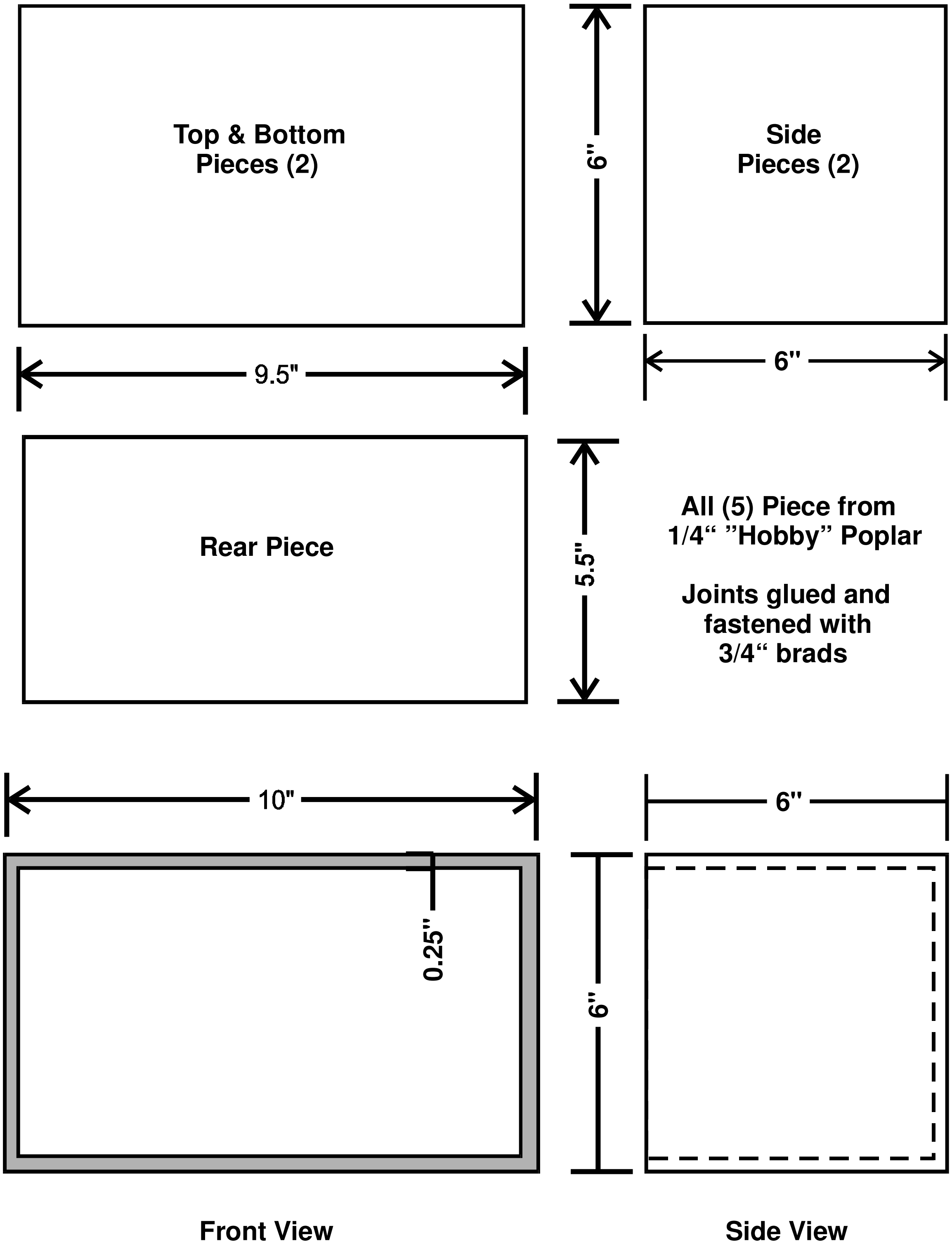


Figure 1a – Storage Bin Construction

Appendix B. *Casks* (See Figure 2)

There are three casks in the competition, with three different weights. The heaviest cask will weigh three times the "empty" weight, and the middle cask twice the empty weight. The empty cask weighs 63 gm (±3).

The casks will be assembled from one Campbells® condensed soup can and four ¼" pieces of "foam board". Each end consists of one flat piece, and one with a hole in the center, cemented together, such that the "cask" takes on the dumbbell shape shown in Figure 2.

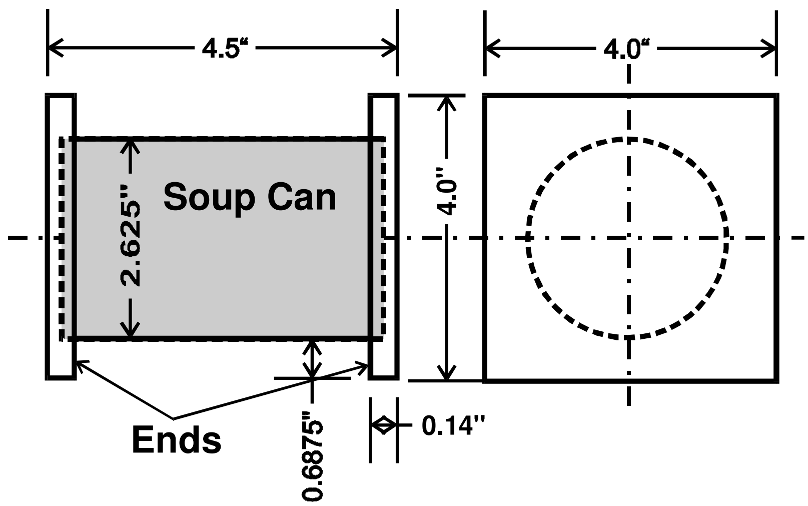


Figure 2 – Cask

Note: Foam board is available from any (picture) frame shop, usually in 3/16" thickness. The ¼" material is less common, but should not be hard to find. Your local frame shop should be able to cut the 4" square pieces for you at a nominal cost.

The can will be painted gray *(RustOleum Automobile Primer, 2081 Light Gray Primer)*. One end is removed; the other left intact. Therefore, the empty cask is slightly heavier on one end than the other. Weight added for the heavier two casks will be added as symmetrically as possible.

Glue used to make the casks will be Gorilla® brand.