MEAM 310
Spring 2004

CLASS PROJECT
25% of course grade

Portable Cooler Cup

Ever wished you could chill that room temperature soda and keep it cold as you take it with you on your daily errands?

The challenge:

Design a portable cooler cup performing this function that incorporates a thermoelectric module. You are free to use any materials, dimensions, or fabrication procedures that fit within the specifications and constraints below. Don't forget to include a heat sink—this will be needed to remove heat from the module.

Specifications:

- The cup must use one (1) ST-71-1.0-3.0 thermoelectric module from Advanced Thermoelectric These will be provided to you. The technical data sheet from the manufacturer can be found at: http://www.electracool.com/ST-71-1-3.pdf.
- The cup must be battery powered
- The cup must be capable of cooling 6 ounces of room temperature water to 45 °F (within an hour)

Available to each group (3-4 students per group):

- One (1) ST-71-1.0-3.0 thermoelectric module (will be provided)
- Thermal grease (to improve thermal contact between parts)
- $75 to spend on the project. Purchases will need to be coordinated through the business office. If you must purchase something on your own for the project (not recommended), be sure to save all receipts.
- The machine shop facilities in Towne, including tools and materials on hand

Resources:

- Terry Kientz (Electronics technician). He is an invaluable resource if you have questions on what machines and materials are available, which manufacturers to order parts from, etc.
- Bill Burns (Business office). He can help with the purchasing process once you are ready to order your parts.
- The resources we talked about in the design portion of the class (Thomas Register, library, parts catalogs, web, etc).

Evaluation:

Everyone in a group will get the same grade, so it is to your advantage to have everyone contribute equally. Projects will be evaluated three ways:

- [20%] Project homeworks. These are essentially progress reports.

- [40%] Project presentation and design competition. This is scheduled during our final exam period on **Tuesday, May 4th, 11am-1pm**. Here all groups explain and demonstrate that their designs meet the temperature requirement. Points will be deducted in proportion to any deviation of the measured temperature from the design temperature of 45° F. Students will also vote for the 'best design' among those presented and points will be added to the grades of the winners.
- [40%] Final project report. This is also due **Tuesday, May 4th**. It should include a full, professional-looking (i.e. bound in a nice cover and written like a professional report) and thoroughly complete written description of all stages of the design process.

Project homeworks (turn in one per group):

- **2/20 -- Project HW #1 due. Turn in:**
  - Names of group members (3-4 per group)

- **3/5 -- Project HW #2 due. Turn in:**
  - A list of 3 initial design ideas, with supporting sketches/drawings. Searching for information from various locations (web, company product catalogs, etc) may be helpful in generating your ideas. Keep track of all the sources of information you've used in your search -- these will be helpful to you in your final project report.
  - List of at least 5 criteria (beyond the design specifications) that you think will be important for a successful design (light weight, etc). Each criterion should be weighted (sum = 100%) in terms of its importance.

- **3/19 -- Project HW #3 due. Turn in:**
  - Analysis of the 3 ideas in terms of feasibility (Can you make chosen designs under budget, on time, and with the available resources? Is it likely that they will work?) as well as pros and cons for each of the ideas
  - Your choice of the best candidate design. This should be based on a
  - Decision matrix that includes the criteria and weighting factors above

- **4/2 -- Project HW #4 due. Turn in:**
  - Detailed analysis of top design. This will involve engineering calculations. Do your calculations indicate that the design will work? If not, modify the design until it does.

- **4/16 -- Project HW #5 due. Turn in:**
  - List of all parts that have been/will be ordered/purchased/used for the project and their prices
  - Rough sketch of your top design

More information on thermoelectric modules:

OVERVIEW

http://www.tellurex.com/cthermo.html
Good overview that includes installation tips. Also goes through design calculations for TEMs (very useful).

http://www.ferrotec.com/usa/thermoelectric/ref/index.htm
Another good overview.

http://www.melcor.com/handbook.html
List of links that gives a great comprehensive overview of TEMs. Includes general background information, installation tips, relevant formulas, reliability information, and more.

http://www.americool.com/basics.htm
Nice overview of TEMs. Also gives list of books on thermoelectricity that can be consulted for further information.

http://www.americool.com/moduleworking.htm
Inner construction of the TEM.

http://www.americool.com/install.htm
Nice set of instructions on how to install a TEM.

http://www.marlow.com/TechnicalInfo/technical_information.htm
List of links for several thermoelectric topics. Includes information on how to estimate heat loads and perform thermal calculations.

http://www.ferrotec.com/usa/thermoelectric/overview.htm

http://www.peltier-info.com/info.html

http://www.enertron-inc.com/pdf/Thermoelectric%20Cooling-basics.pdf

http://www.enertron-inc.com/pdf/Designing%20with%20Thermoelectric%20Coolers.pdf

FREQUENTLY ASKED QUESTIONS

http://www.melcor.com/faq.html

http://www.marlow.com/TechnicalInfo/frequently_asked_questions_faqs.htm

http://www.tellurex.com/12most.html
This one describes in detail the function of the semiconductor materials in TEMs.

THERMOELECTRIC APPLICATIONS

http://www.ferrotec.com/usa/thermoelectric/applications.htm

http://www.marlow.com/TechnicalInfo/te_applications.htm

PHOTOS

http://www.peltier-info.com/photos.html

THERMAL INTERFACE MATERIALS

http://www.peltier-info.com/tims.html

TEMPERATURE CONTROL

http://www.tellurex.com/ctemp.html
Background on temperature control.

WORKSHOP LINKS
The links below illustrate recent research activity in the area of thermoelectrics:

http://www.osti.gov/fcvt/darpa2002/darpa2002wkshp.html

OTHER LINKS OF INTEREST

http://www.peltier-info.com/
A clearinghouse for thermoelectric information.

http://www.peltier-info.com/books.html
List of books on thermoelectrics.

http://www.its.org/
International Thermoelectric Society link. Online forum for all types of thermoelectric information.

SOME VENDORS
www.americool.com
www.melcor.com
http://www.tellurex.com/
http://www.allelectronics.com/cgi-bin/category.cgi?category=775&type=store
http://www.ferrotec.com/
http://www.tetech.com/modules/
http://www.tedist.com/

http://www.peltier-info.com/manufacturers.html
Comprehensive list of vendors

http://www.marlow.com/TechnicalInfo/related_resources.htm
Vendors of some thermoelectric accessories and components.