40-Quart Cooler Design

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Progress Report

Document

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1. CLIENT IDENTIFICATION

Canyon Coolers is a high performance cooler company that has been operating since 2010, based in Flagstaff Arizona.
The companies' goal is to provide products that are extremely high in quality and design, while still maintaining an accessible price compared to their more famous and direct market competitors.
By doing so, the companies' profits have been growing steadily since its entrance in the high performance cooler market and this trend is projected to keep up in the future.
Canyon Coolers offers a wide variety of products, ranging from small and rather inexpensive 22 quart coolers, to extremely high performance, commercial grade, and 800 quart products.
All of the products the company markets are made in rotationally molded in Thailand due to large scale production economy reasons, and are then shipped to the United States of America via sea.
The company has been recently considered investing money into new cooler molds (this is where the major operating costs are associated), and has been looking into rotational molding companies based on Oregon and trough our team at NAU.

2. TYPICAL CONSUMER

Canyon Coolers attracts a wide range of outdoor sport enthusiasts. Some of the areas the company reports interest are hunting, fishing, camping, and white water rafting to name a few. The consumers can either be individuals with passions in either one of these areas, or businesses, such as outfitting groups. Either way the customer needs their product to perform under the tough conditions that are routinely encountered in undeveloped wilderness areas across the globe. Since these coolers are designed for maximum expose and maximum ice retention they attract the crowd that requires durability in their ice chest for an extended period of time. The Canyon Cooler is primarily responsible for maintaining goods at a stable, cool temperature, but it performs other functions that are vital to consumer needs. These coolers keep any moisture from entering the interior shell, prevent damage to the cooler hull and therefore maintain function after shock and impact, and provide an ease of use to the user. All of these factors are center focus for the business. Whether it is an individual's multi day adventure, a group's weekend vacation, or an outfitting businesses success, each relies directly on the performance of the product that Canyon Coolers delivers.

3. DESIGN GOAL & SCOPE

The minds behind Canyon Coolers have many ideas as to how to improve the product they deliver. The easiest place to start is in the details of the current dissatisfactions. Primarily, the coolers that the business receives from Thailand are exhibiting defects at a rate that is unacceptable. These defects range from minor blemishes in the finish of the cooler shell, to complete malfunction of key components. These defects cost the business valuable time and labor in the quality assurance process, and can also cost a loss in profit from handling exchanges and returns.

Another area Canyon Coolers has expressed some concern is in the lack of available features on their cooler models. In an ever-diversifying market, it is essential that the business stay at the forefront of innovation if they are to succeed. The problem exists in feature availability being limited to certain cooler models. Features are spread across several cooler families and therefore not one family of coolers contains the array of useful features that consumers are demanding.

Through conversations with the companies CEO it was determined that the smaller spectrum of coolers is the highest selling unit the company offers. These coolers range from 22 to 40 quart sizes. One in particular, the 40 qt. cooler, is in high demand. However, this particular product lacks in the quality and usability that Canyon Coolers wants out of its flagship product. One if its primary defects lie in its incompatibility with common uses. The design features ribs that join the cooler body to the lower lip that forms the shelf for the seal. This creates an obstruction for users that want to fasten the cooler in place utilizing the sides. The ribs on the existing 40 qt. can be seen in figure 1 below.

Figure 1 – side view of existing 40 qt.

Another primary flaw in the existing 40 qt. model is its inferior wall thickness, i.e. insulation. It contains about 1 inch of wall thickness in most areas of the body and about 2 inches in the lid. The rest of the coolers in the Canyon lineup feature walls of at least 1.5 inches, sometimes up to 2. The path for the capstone design project was created from these needs the client displayed.

4. DESIGN GOAL & SCOPE

The goal of this design project is to design a 40 qt. volume cooler with a maximum MSRP of $189.99 that offers seamless features and shares quality with the best products availible in the market.

The $189.99 price point originates from the current MSRP of the 40 qt. cooler. It is important to note that this cost is a selling price, so all fascets of design, manufacture, and assembly play a role in setting the price listed. This design project is extremely unique in that it is mold intensive. The team will be designing for mold manufacture in both injection and rotational molding. Various forms of experimentation and theoretical cimulation is planned for this semester inorder to verify the credibility of proposed designs. Physical testing is rendered obsolete due to the inability to produce functional prototypes of the cooler body, cooler lid, and phantom latch. Thourough engineering and frequent professional consultation will be vital to the success of design. Since mold production is an extremely pricey affair, it is recognized that the designs in production may or may not ever be fully realized. Taking this into acount, the ideal goal of the design project is to produce fully manufacturable CAD designs that are accompanied by detailed part descriptions,a

subsequent price estimate, and analysis reports substantiating the engineering. The idea in this approach is to supply the client with everything needed to put the 40 qt. design into production.

5. DESIGN AND PROTOTYPING

For the final design, there are a few tasks that need to be completed with a number of constraints. One of the main points of consideration is the CAD files of the cooler body and lid. A key feature of these CAD files is that they are the template for a mold and not the cooler, meaning that the CAD file is a design of the negative space that will be filled with plastic during the injection molding process. This entails that the design of the mold fit the requirements of the rotational molding process. The designs have to have a minimum of a 2.5° draft angle on all parts of the design to ensure that the cooler, once molded, will pull out of the mold without hanging up on any surface on the mold. This also means that the cooler design must have a parting line running around its entire perimeter. This is due to the fact that the mold consists of two portions that fit together to form the negative space for the plastic.

Because of these design features, the cooler is being designed with this in mind. The goal for the CAD file of the cooler is to have a fully manufacture-able cooler mold file by spring break that can be delivered to the client for decision to move forward and produce the cooler or to hold back and keep refining the design at this point in time. However, what the client is ready to move forward with is the 'Phantom Latch'. There have been two iterations using rapid prototyping and numerous numerical and computer simulated stress tests that have been completed on the latch and the client is ready to move forward and produce the design. This latch will not only be implemented onto the new cooler design but onto all of the client's existing coolers in order to improve functionality and minimize repairs and breakage of the existing latch.

6. TESTING OVERVIEW

After prototyping is completed testing begins. There are multiple steps to our testing phase of the project. Because of the nature of our project, we will not be able to test a full physical prototype. The testing will consist of analyzing the parts of the cooler that we can fabricate, the hinge and latch, and experimental tests to validate computer simulations.

First the existing 40qt canyon cooler will be tested. The methods of this test will be explained in the next section of this report. The purpose of this test is to collect data to compare the solid works simulations to real experimental numbers.

Next an accurate computer aided design model will be generated and SolidWorks thermal simulation will be conducted. The data from the real physical experiment will be compared to the data from the thermal simulation data. The thermal simulation can then be modified until an accurate model is completed, when the real data matches the simulated models.

Once the simulation is dialed in, it is possible to run the same simulation parameters on the new cooler that the group is producing. This will yield justifiable data on our newly developed 40qt cooler. This is important in our client's decision to manufacture the new design.

7. TESTING PROCEDURE

This test is to collect data on how the current 40qt cooler will perform. We will use this data to validate our simulations. Some real steady state values on how the current Canyon Cooler preforms will be collected.

The test will be conducted in a temperature-controlled environment, the thermo-fluids lab. We will be placing twelve type J thermocouples in strategic locations on the cooler. There will be one on the inside and outside of every face on the cooler including the lid. A visual of this can be seen in Figure 2

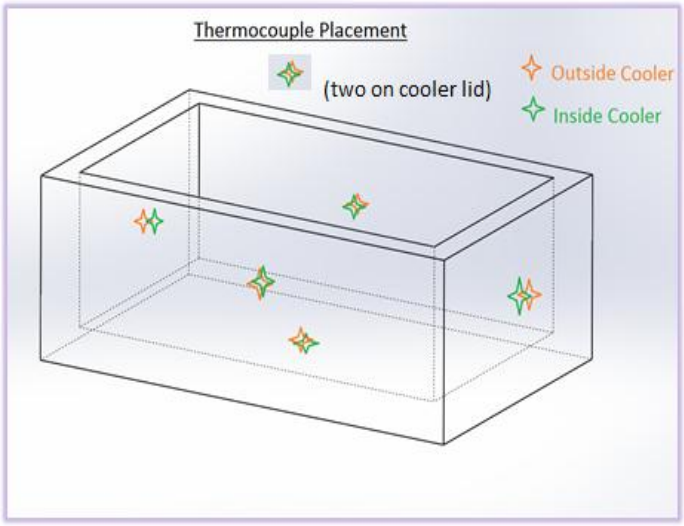

Figure 2: Thermocouple placement

There will be one fifteen-pound block of ice placed in the cooler. The experiment will run until steady state conditions are achieved and enough data is acquired.

The purpose of this experiment is to validate our thermal simulation. Also if and when a full cooler is produced this test is fully repeatable and the experimental data can be compared.

8. UPCOMING TASKS

For the spring semester the team has several tasks to accomplish. Most of the tasks are testing and analyzing the existing cooler. The client will use the data for improving future coolers and establish solid data for marketing purposes.

The tasks are:

1. Conduct experiments, stress/strain thermal expansion and heat transfer, to validate computer simulations.

As described in the analysis section above, this task is extremely important to the completion of the project. The analyses that need to be accomplished are the temperature test, and the temperature profile test.

2. Manufacturing research for injection and rotational molding

The client desires to make coolers to be manufactured in country rather than in Thailand. Hence the team decided to investigate cheap and efficient methods in making the cooler body by rotational molding, and parts by injection molding. There will be a scheduled trip to a manufacturer in Prescott, AZ, which is specialized in molding processing. The trip will discuss costs associated in manufacturing 40QT cooler along will all parts that come with it. Also, the team will work in finding a client for making the improved latch in injection molding.

3. Manufacture a fully functional "Phantom Latch"

As the client want to examine the latch physically after the prototyping is done, the team decided to develop a fully functional "Phantom Latch". The client is looking forward to provide feedback and recommendation once the latch is completed on time and on budget.

4. Develop a scaled down functional model of the improved hinge assembly.

This model will be dynamic. It features global variables, which are assigned to parameters that control the size on the hinge. The client will be able to adjust the size as desired for each model. The client will be provided with instructions on how to use the assembly.

5. Final cost analysis.

The cost analysis is vital for the project. The client will be provided a detailed bill of costs of materials and labor, as well as manufacturing.

6. Present to client and UGRADS.

At the end of the semester, the team will make a poster and present the project to the Undergraduate Research and Design Symposium. The client will receive an invitation, which will include the time, date, and location.

9. PROJECT PLANNING

Project planning is essential to completing any professional assignment. It pays off to be organized and know what and when things need to be done. Using Gannet chart we can organize our task and task relationships. Looking at the chart, it is easy to see that the project is still in its preliminary stages, starting to work on our CAD designs and modeling. The red bar represent the progress of tasks.

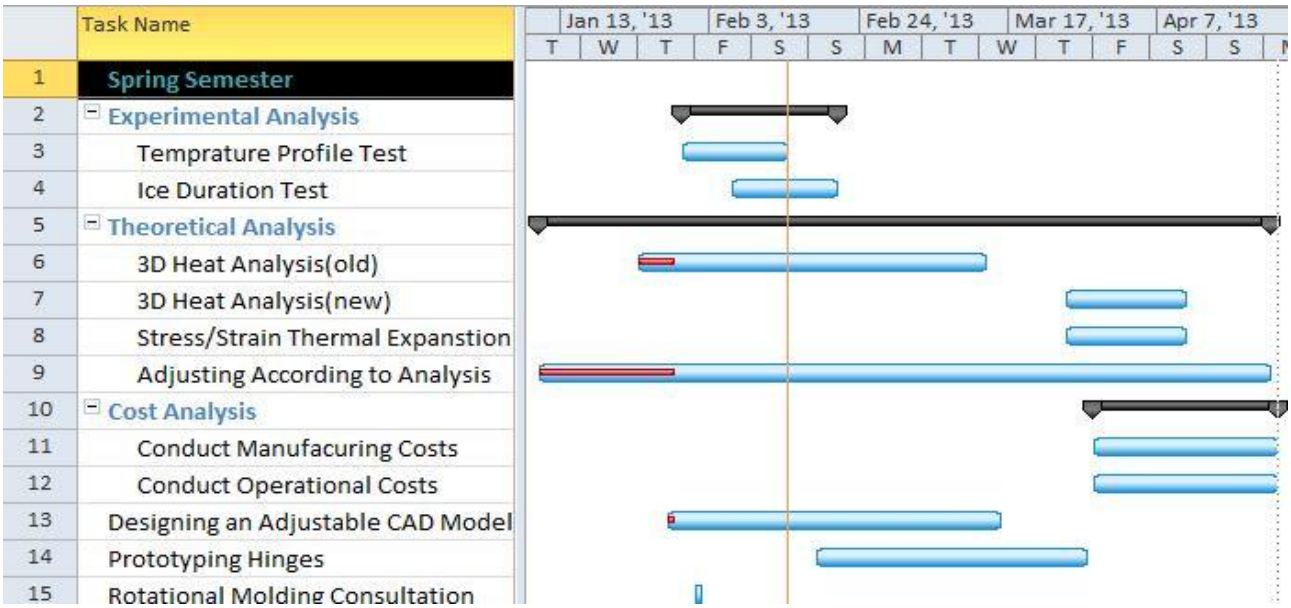

Figure 3: Gannet Chart

10. CONCLUSION

Designing a superior cooler is the client's overall goal. The client has told the team that the 40 QT cooler is the most selling, hence the team wanted to bring the best cooler to fully satisfy the client as well as customers. The sponsor, Canyon Coolers, is a small local business, and a product which economical and reliable is vital to the whole project. It is our goal to use CAD to create a cooler system that can have its proportions altered while maintaining it's primary function as our client desires.

11. REFERENCES

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