To: Craig McDonald

CC: Steve Beyerlein


Date: 8/4/05

This report is to show the progress we have made on the latch and hinge re-designs. The contents of the report contain solid models and descriptions of the fore mentioned components. Each has a working description of its inner components. We are hoping for a design review mid-September.

We are asking that you review this report and make any necessary comments. For additional information our website is available [http://seniordesign.engr.uidaho.edu/2005_2006/refrigeratorraiders](http://seniordesign.engr.uidaho.edu/2005_2006/refrigeratorraiders). If you have any questions or comments regarding this report, please contact the team at refrigeratorraiders@uidaho.edu. We appreciate the funding put forward for this project. Our team is excited to see a completed product, we have learned a great deal.

Sincerely,

Refrigerator Raiders

(Enclosure)
Executive Summary

PREMCO is looking to redefine their existing product line. Our proposal is to redesign and re-innovate the hinge and latch that PREMCO currently sell. The hinge and latches that we are designing show a sleek an innovative look. Showing little or no-resemblance to PREMCO’s former products each will meet or exceed the needs that have been set forth by PREMCO. The most important being a sleek streamline look. The new look will help them to sell more products because their latch no longer looks out of date, and is easier to operate. Their new hinges will be the first on the market of this kind of hinge. The cam and spring lift will be self contained inside the hinge base and will not add an external extending piece. Each design will cut PREMCO’s cost because each will use smaller working components and have fewer casting parts. Pressing forward and making a prototype of our designs is very important so we can see how each will perform. This will give us as well as PREMCO, a preview of their new streamlined latches and hinges. Currently we have detailed computer generated models of the new hinge and latch. Per recent conversation we are working at redesigning the internal latch mechanism. We have built a test stand for hinge testing. This will be used to analyze our hinge design under different loading conditions up to 150lbs.
Latch / Hinge Redesign

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August 4, 2005
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1.0 Background

PREMCO Machine Company has been manufacturing commercial freezer hinges and handles since the late 1940’s. Their latch design has not changed for almost 50 years, and they do not have a prominent hinge line. Their competitors have been redesigning latches to be more sleek and smaller than PREMCO’s original latch, and they have the corner on the hinge market. The problem that PREMCO faced was that the old latch design was not streamline enough to generate enough sales for the company, and hinge sales are not what they need to be. Freezer makers are no longer buying PREMCO’s out-dated latch. They are switching to PREMCO’s competitors sleeker looking design. These other latches also happen to be easier to open and have integrated cylinder locks inside them. The solution that PREMCO has come up with is to completely re-design their current latch and create a completely new hinge design.

2.0 Problem Definition

The problem faced is to redesign PREMCO’s existing hinge and latch setup. The new designs cannot look exactly like the competitors. Each design must be new and innovative and have a streamline look. PREMCO wants a completely new hinge idea along with an ultra sleek latch.

Hinge:

Musts
- Reversible for left or right side attachment.
- Carry a minimum load of 300 lb. per pair.
• 4 or 3 hole pattern of competitors.
• Countersunk holes for 1/4” screws.
• Offset height from flush to 1 ¾ in.
• Be aesthetically pleasing.

**Should**

- Reach offsets of 1 7/8 and 2 in.
- Available with or without spring kit.
- Blades should be able to be lifted off of hinge.
- Cam, or non cam lift design.
- Nylar bushings.

**Latch:**

**Must**

- Self-closing action.
- Hole footprint of competitors.
- With or without cylinder lock.
- Countersunk holes for ¼ in. screws.
- Strike that ranges from flush to 2.5 in. offset.
- Inside safety release mechanism.

### 3.0 Concepts Considered

#### 3.1 Hinge

3.11 Adjustable Blade

At the start of the project many ideas were tossed around. At PREMCO’s request the hinges needed to be adjustable if possible. The first couple ideas were based around this request. The first concept was to make an adjustable hinge by the means of a double blade design. This was impractical because of the mold costs that would be involved in such a complex design.

3.12 Screw Adjustable Hinge
The next initial concept was that of screw type adjustable insert. This could be placed on the outside of the hinge base and could be used to adjust the blade height forward or back. This idea was very good in concept but would require too many moving parts on the hinge base which made it un-practical.

3.13 Interchangeable Inserts

The next idea that was discussed was the idea of exchangeable inserts. Going with this idea made the most sense since it involved no more moving parts than the competitors design. It also seemed the easiest to achieve.
3.14 Shim Adjustment

Another idea that was introduced a little later was the idea of shims being placed on the outside of the hinge base. This also involved no more moving parts and easy molding. These two ideas for the hinge were presented to the customer with continued enthusiasm.

The two main hinge concepts that were pursued were the shim design, and the adjustable insert design. Each of these would have a cam lift system that could be spring loaded or non spring assisted. Both of these could be reversible as well as adjusted. The insert design would consist of a nylon composite insert that would have the cam-lift components located at certain distances on the insert. There would be only a few inserts and two blades that would fill a range of 1 1/8 – 2 in. in 1/8 in. increments and also have a flush setting. The good thing about this design is that one size bolts are needed to mount this hinge. The con to this design is that the insert used could fatigue because of its size, breaking could become a possibility. The shim design would also have a cam-lift system that could be spring assisted or non-spring assisted. This concept would contain shims that would sit behind the hinge base. These shims would come in 1/8 in., ¼ in., and ½ in. this would enable all heights except 2 in. for this an additional 1/8 in. plate would be required. This design would also include two blades, one for flush mounting.
and another for the shimmed requirements. The pro to this design is that it will not have an insert to fatigue and fail. The con to this design is the fact that longer mounting bolts will have to be used increasing the stress on the bolts.

3.2 Latch

3.21 Mini-Van

The latch also started with many concepts. PREMCO’s request for the latch was to make it very similar to their competitors. The first latch concept was a pull out handle integrated with the latch, similar to some mini-van handles. Involving too many internal moving parts this idea was rejected. Another concept that was introduced that was similar to the mini-van was a handle with the latching button on the handle itself. This idea also had too many internal moving parts and was not practical.

3.22 Mini-PREMCO

The next design was a mini-PREMCO latch that incorporated the lock into the handle. This idea was a good choice and was pursued.

![Figure 3.22 - Mini-PREMCO](image)

The main design for the latch was the mini-PREMCO design. The inner workings of the latch would be very similar to the competitors, but would be shrunk and stretched to fit the new outer design. The first concept that was produced had a lot of similarities to the original PREMCO design as can be seen. PREMCO did not like this design and had a few changes they wanted to be put in. These included no gap between handle and latch body, latch handle must lie in a channel, and some dimensioning requirements. From this, two alternative concepts were introduced seen on next page. Each of these had the changes from the previous design.
4.0 Concept Selection

The design that our team decided to go with on the hinge was a combination of the two insert and the single insert idea. The design consists of an insert that has a set screw on the bottom of it with a cam and spring all internal. As the screw is tightened the tension in the spring will increase. The goal behind this being if a manufacturer did not want a spring assist hinge that the screw could be loosened all the way. Also this will aide in the closing of larger heavier doors. The way the design sits at the moment three bases will be used along with a single insert that can be rotated 180 degrees to reach all the offsets that the customer needs.

The design that was chosen for the latch was the design that our customer liked very much. The design vaguely resembles the competitors latch. The major difference is the arch that the lock is placed upon. This sets it off from the competitors latch. This design should be easy to manufacture and easy to assemble. There are few moving internal parts. Inside the latch there are a total of 3 springs, a slider bar all connected by
push inserts. These internal parts should be easy to purchase and manufacture which would lead to low cost for our customer.

Our two designs look very promising a lot of thought and effort went into choosing the best one. A chart is provided in Table 4.0. The design process is an evolutionary process. Throughout this process our designs have changed considerably. Minor changes and improvements are only natural during such a process the end result of the latch and hinge combination that we have chosen may end up with slight modifications as a result of this process.

5.0 System Architecture

5.1 Hinge

The design for the hinge that was chosen consists of many parts. The first is an insert which can be flipped. This will allow 2 offsets for each of the three bases. Three bases that will be need to cover all of the required offsets. The sizes that will be covered for each base are base 1 will cover 1 1/8 and 1 1/2, base 2 will cover 1 1/4 and 1 5/8, and base 3 will cover 1 3/8 and 1 3/4. Another key feature is that there will be only 2 blades. This will cut PREMCO’s molding costs, because only 2 molds will have to be made. Key feature number three is a self-contained cam-lift system. A spring is placed inside the hinge base and is hidden from the outside. This gives the hinge base a bigger look, but it shows its innovation. This is shown below. This feature was important to PREMCO because it will be the only type on the market. As mentioned previously the internalized spring will be adjustable to allow for the hinge to be used as a spring or non-spring assist according to the costumers’ preference. The spring will be adjusted using a sex bolt that will run through the hinge, and will be adjusted with a Philips head screw driver with the bolt head located on the top of the hinge insert.

Another feature that is vitally important is the fact that each hinge must be reversible such that a freezer manufacturer can use the hinge on either side of their door. Each blade will also be reversible. This way one blade will be able to be used on either the left or right side of the door. The reversibility will be done by having the female hex portion running through the blade, and then flipping the blade 180 degrees and upside
down to swing the opposite direction. The whole will be covered on the top by a cap that will be removable for when the blade is flipped. The hinge base will match the threee hole pattern of one of the competitors. The way that the base is designed it will also be large enough to cover up the four hole pattern of the other competitors. This will allow for the base to cover up the competitors holes if placed on a unit that has an existing four hole pattern. This will make for quick replacements and improvements for freezer owners. Each hinge will also support the minimum of 150 lbs per hinge. This way with a 300 lb door only two hinges will be needed.

PREMCO will build the hinge using high pressure die cast zinc that is chrome plated for the insert and Hinge base. The Cam Lift Cylinder and Cam Lift will be made of a Nylar material, and the screw and spring will be purchased separately. For our prototype design, we will machine the Insert and Hinge Base out of Aluminum. As for the Cam Lift parts we will be ordering the same Nylar material that PREMCO will use on their finished product. This prototype will allow us to test the functionality of the hinge to ensure that all features work as expected and meet the expectations of set by PREMCO.

5.2 Latch

The design for the latch that was chosen was done for several reasons. First and foremost was the outer shell design. We completely redesigned the outside look. We shrunk the outer shell to accommodate PREMCO’s need. It now has a sleek streamline
design, with an easy to open latch. As you can see below, the handle and body have shrunk considerably. The ease of opening was important to PREMCO so it was a major milestone we had to meet. Another reason this design was chosen was for its locking mechanism. A cylinder lock is now located on the latch just before the handle. This lock can be used or can be replaced with a filler cylinder so that it looks smooth. This will be able to be disabled if a person gets locked inside the freezer/refrigerator. People will be able to get out of a locked freezer but people will not be able to break into the freezers. Another key design feature that our latch has is the same hole pattern as PREMCO’s competitors. This will allow freezer owners to switch out freezer components without having to re-drill holes. The latch also contains a self closing action; this means that if someone shuts the door softly and it doesn’t have enough power to shut the door all the way even the slightest pressure will make the latch close.

Along with the latch, a strike must be designed to keep the freezer door shut. The design for the strike was chosen so that it would cover a range from flush to 2.5 in offset. The strike base should mirror the end of the base of the latch for aesthetic reasons. As well, the hole pattern must be the same as the competitor’s, so that PREMCO’s strike can replace the competitor’s. The strike consists of a base and a position. The base is
attached to the freezer with three ¼-inch screws, and the position is attached to the base with two ¼-inch screws. The strike can be set to reach multiple offsets very easily by unscrewing the position and resetting it for the desired offset.

![Figure 5.3](image)

**Figure 5.3**

*Latch and Strike*

1-Strike
2-Latch

### 6.0 Fall Work Plan

<table>
<thead>
<tr>
<th>Task Name</th>
<th>Week of</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Finalize Hinge Drawings</td>
<td>Aug 22nd</td>
</tr>
<tr>
<td>2 Brain Storm Internal Latch</td>
<td>Aug 22nd</td>
</tr>
<tr>
<td>3 Molder Contact and Meeting</td>
<td>Aug 22nd</td>
</tr>
<tr>
<td>4 Latch Test Stand</td>
<td>Aug 22nd</td>
</tr>
<tr>
<td>5 DFMEA of Hinge</td>
<td>Aug 29th</td>
</tr>
<tr>
<td>6 Prototype of Hinge</td>
<td>Sept 12th</td>
</tr>
<tr>
<td>7 Prototype of Latch</td>
<td>Sept 28th</td>
</tr>
<tr>
<td>8 Testing of Prototypes</td>
<td>Oct 24th</td>
</tr>
<tr>
<td>9 Modifications from Testing</td>
<td>Oct 24th</td>
</tr>
<tr>
<td>10 Final Report Completion</td>
<td>Nov 11th</td>
</tr>
<tr>
<td>11 Final Meeting With PREMCO</td>
<td>November</td>
</tr>
<tr>
<td>12 Snapshot</td>
<td>December</td>
</tr>
</tbody>
</table>

![Figure 6.0](image)

**Figure 6.0**

*Schedule*

As you can see we have many tasks ahead of us next semester. One of the main tasks ahead of us is our molding restrictions. Since we have no idea what our molding and casting specifications need to be, our first goal is to talk to a molding manufacturer and a casting manufacturer. In doing so, we can get specifications on Draft Angles, Space Optimization, Fillet Requirements, and Ribbing issues. Another fabrication issue
we are going to have to get some research on is the nylar fabrication process. How it works and how much it costs to machine. We also need to get some cost estimates for PREMCO. This will show us as well as them how much these parts are going to cost to get molded. One last thing we might consider is some market research. Find out who is going to buy these latches and hinges.