ILC Dover, the world’s leader in softgoods engineering, has developed a method of transporting and containing pharmaceuticals using robust polymer bags, the DoverPac® system. Team ILC Dover was tasked with redesigning the hand tool that is used to “crimp” the DoverPac®. The current tool does not provide sufficient mechanical advantage. ILC desired a new tool design with a manufacturing plan.

**Problem Background**

ILC Dover, the world’s leader in softgoods engineering, has developed a method of transporting and containing pharmaceuticals using robust polymer bags, the DoverPac® system.

**Current Tool**

Crimps for DoverPac®

**Key Wants and Metrics**

- **Input Force**: 59 lbs
- **Mech. Advantage**: 6:1
- **Cost**: $250
- **Grip Span**: 3.5 in.

**Cost Overview**

<table>
<thead>
<tr>
<th>Component</th>
<th>Method</th>
<th>Material/Investment</th>
<th>Cost</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Handle &amp; Head</td>
<td>Machined From Steel</td>
<td>Brass</td>
<td>Steel</td>
<td>E-rings, split pins, accessors, Wise</td>
</tr>
<tr>
<td>Rack</td>
<td>Cast Steel</td>
<td>Torsion Spring</td>
<td>180 Deg Angle</td>
<td>Spring</td>
</tr>
<tr>
<td>Gear</td>
<td>Cast Steel</td>
<td>48 D.P., 20 DEG. Pressure</td>
<td>#416</td>
<td>Brackets</td>
</tr>
<tr>
<td>Pins</td>
<td>Machined</td>
<td>Stainless Steel Rack</td>
<td>48 D.P., 20 DEG. Pressure</td>
<td>#416</td>
</tr>
<tr>
<td>Rings</td>
<td>Cast Steel</td>
<td>Torsion Spring</td>
<td>180 Deg Angle</td>
<td>Spring</td>
</tr>
<tr>
<td>Screws</td>
<td>Cast Steel</td>
<td>Torsion Spring</td>
<td>180 Deg Angle</td>
<td>Spring</td>
</tr>
<tr>
<td><strong>Production Cost (Major Costs)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Labor hours</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Machining</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>**Material》</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Parts Cost</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Cost</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Manufacturing Process Selection**

A major portion of this project is the manufacturing processes involved in creating the parts. Since this is a retail product, cost is of high importance.

**Performance and Validation**

**Experiment Set-Up**

**TEST 1: Mechanical Advantage**

- Tool is clamped to the edge of a table with the handle hanging over the side
- Between the heads, a load cell is placed to measure the open force
- A series of weights are to be placed on the handle
- Plot input force vs. output force to determine MA

**TEST 2: Maximum Input Force**

- Device was placed in an Instron machine, and the force at the crossbeam was measured along the stroke length of the device.
- The peak where the crimp reaches full closure can be noted as the maximum input force needed.

**Results**

The Aluminum Prototype has a mechanical advantage of 6.3:1 and closes all crimp sizes within desired force target value.

**Concept Generation**

These initial concepts derived from benchmarking at a hardware store, the previous tool, and creative mechanisms to achieve the desired mechanical advantage and motion.

**Detailed Design**

The above figure displays the first iteration of the LOC'D. The motion required to close the crimps results from a ratchet and pawl system driving a pinion gear, which in turn drives a rack. The specific shape of the heads allows the crimps to be closed with the linear motion provided by the rack moving forward. Additionally, there is a release system that allows the user to disengage the pawls after closing.

**Head Design**

The heads were specially designed to hold the crimps in place and provide support while pushing them closed. The crimps sit side by side in the heads.

**Linear Drive System**

The ratchet and the gear are connected to the main pin by a keyway, which fixes their motion. A pulling pawl in the handle causes the ratchet to spin from a squeeze on the handle. After a squeeze, the handle is opened and the pawl “skips” back to the next latching point.

**Later Iteration**

**Prototyping**

**Ergonomic Model**

- Grown in a 3-D Printer
- Given to range of students with an ergonomics questionnaire to evaluate
- Several iterations were performed

**Mechanical Model**

A “2-D” simplification of the actual tool – this prototype demonstrates the motion and mechanical function of the LOC'D.

A final prototype with both ergonomic and mechanical features will be grown from engineering polymer (not shown here).

**Concepts**

- Gear Train
- Crimps & Casing
- Springs
- Pins
- Steel
- 60.00
- 1
- Device was placed in an Instron machine, and the force at the crossbeam
- Gear Rack
- Pinion,
- Ratchet
- Grown in a 3
- Pinion Gear
- 5.00
- Model
- Grip
- Between the heads, a load cell
- A series of weights are to be
- 30.00
- Load Cell
- 30.00
- [xxxx]
- this prototype demonstrates
- Cost per Part/Hour
- 25.49
- …
- Several iterations were performed
- Total Parts Cost
- Total Cost
- 222.96
- The Aluminum Prototype has a mechanical advantage of 6.3:1 and closes all crimp sizes within desired force target value.