**Backpack Pressure Cooker**

Nicholas Judy  Donald Lopez  Edward Reams  Robert Stuart

**Abstract**

The problem addressed was to save backpackers weight by creating a lightweight pressure cooking pot to elevate cooking temperatures (to decrease cook times) and therefore decrease pack weight by reducing the stove fuel needed. A pot design (figure 1) was created that can maintain up to 100 kPa of gauge pressure which can increase cooking temperatures by more than 50% while still being light weight and easy to store. A proof of concept model was also created.

**Important Design Features Include:**

- Lid which locks and seals onto the pot by use of intermeshing flaps
- Simple variable pressure blow off valve
- Heat sink and curved bottom to improve heat transfer

**Material Selection**

All of the metal in our product is made from the same bulk material, Aluminium alloy 7055 T77511, which was selected by use of material comparison plots (figure 2) and criteria such as: high yield strength, low density, high thermal conductivity, and low cost. The aluminium surface will be hard anodized in order to make the pot and lid food safe. The gasket material, silicon rubber, was selected because of its operating temperature and compatibility with food preparation uses. The handle is made of Polyphenylene Sulfide because it is lightweight and has a low thermal conductivity.

**Design Development and Goals**

The initial design had fewer yet wider flaps for the locking mechanism; but after FEM analysis showed excessive stress concentrations at the flap corners we realized that more and narrower flaps would work better. We also changed the initially flat bottom surface to a concave one to prevent pot deformation. The major design challenge was to conserve weight while safely achieving high pot pressures. Our design specifications required the pot to:

- Be light weight
- Maintain high pressure for higher cooking temperature
- Have a quick boiling time
- Be easy to pack

**Results**

Suggested design for a pot with pressure cooking capabilities (20-100kPa) to increase boiling temperature by as much as %50, with a low weight, enough volume to cook for two people, and an overpressure safety factor of 3.5. Higher cooking temperatures, quick boiling times and light weight allows the user to carry a lighter pack due to the use of less fuel when cooking. A proof of concept model was also created to show the pressure valve assembly and functionality.

**Acknowledgements**

Thanks to Mike Sevier for help with ABAQUS analysis.

**References**


---

**Figure 1. Solid Works model and exploded views of our assembly and the pressure valve.**

**Figure 2. Preliminary material comparison chart. Material categories with white text and red background were selected to be analyzed more in depth under the next selection criteria.**

**Figure 3. Outside and inside view of quarter section of pot and lid, under twice maximum operating pressure. Deformation scale: 15X; maximum stress: 280MPa. Von Mises stresses displayed.**

**Figure 5. Plot of the boiling temperature of water with respect to atmospheric pressure. The red region show the functional pressure and temperature range of the Magma Force and blue region the Platinum Classic Pressure Cooker both at 1,897 meters elevation. [1]**

**Table 1: Benchmarking Data**

<table>
<thead>
<tr>
<th></th>
<th>Platinum Classic Pressure Cooker</th>
<th>Magma Force MSR Alpine Guide Cookset</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time to Boil</td>
<td>~ 4 minutes</td>
<td>4 minutes</td>
</tr>
<tr>
<td>Max. Temp.</td>
<td>117 °C</td>
<td>121 °C</td>
</tr>
<tr>
<td>Weight</td>
<td>2.186 Kg</td>
<td>0.541 kg</td>
</tr>
<tr>
<td>Volume</td>
<td>3 L</td>
<td>2 L</td>
</tr>
</tbody>
</table>

---

**Figure 4. Plot of Boiling Temperature of Water Vs. Pressure**

**Environmental Pressure Region**

- Sea Level (elev: 0m)
- Lake Tahoe (elev: 1,897m)
- Mt. McKinley (elev: 6,145m)

**Extra Pressure Region**

- Mt. Whitney (elev: 4,418m)
- Mt. Everest (elev: 8,850m)