ThermaGlove
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• Passive heating for fingers and hands using fluid circulation powered by arm movements

• Designed for winter athletes

• Allows for warmth and dexterity
Market

- Sailors/Rowers/Cyclists
  - $90 million in the USA
- Other Winter Athletes
  - $336 million in the USA
- People Who Work Outside in the Winter
User Research

• Approximately 80% of sailors interviewed were dissatisfied with their current winter sailing gloves

• ThermaGlove: $40

• Typical heated gloves: $100-$200

*sample size of ~20
## Product Contract

<table>
<thead>
<tr>
<th>Customer Need</th>
<th>Product Attribute(s)</th>
<th>Engineering Specification(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Can keep hands warm outdoors</td>
<td>Heat transfer ability</td>
<td>Provide 7-10W or heat from arm to hand</td>
</tr>
<tr>
<td>Minimally impede dexterity</td>
<td>Thickness</td>
<td>Glove thickness is 1-2 mm on palm and bottom of fingers</td>
</tr>
<tr>
<td>Can keep hand warm with minimal effort</td>
<td>Pumping capability</td>
<td>Flow rate $\geq 0.3$ ml/s, Should feel “Easy to pump”</td>
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<tr>
<td>Unobtrusive</td>
<td>Size</td>
<td>Should weigh max 8 oz resemble a regular glove/sleeve</td>
</tr>
<tr>
<td>Aesthetics</td>
<td>Form factor</td>
<td>Average of 4 (out of 5) on a Likert scale</td>
</tr>
<tr>
<td>Stay Dry During Use</td>
<td>Waterproof</td>
<td>Moisture Vapor Transmission Rate of 25,000 g/(m^2*24hrs)</td>
</tr>
<tr>
<td>Comfortable</td>
<td>Shape/Lining/Waterproof</td>
<td>Average of 4 (out of 5) on a Likert scale</td>
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Will your fingers feel warmer using ThermaGlove?
Thermodynamic Calculations

• Threshold for detecting an increase in skin temperature is 0.20°C

• Rate also influences sensation (0.5°C per minute is barely recognized while 0.1 °C/s is definitely recognized)
Mockup
How will fluid be distributed?
Pumping Mechanism & Valves
Mockup
Moving Forward

• Testing other fluid pumping methods/optimize current method

• Integrating fluid distribution system into gloves and sleeve

• Choosing glove and sleeve materials

• Testing with users