Abstract

When camping, it is often useful to have an elevated, flat surface for cooking, games, and other activities. The current market offers several designs that are made from lightweight aluminum which can also be folded for portability. Surveys taken by frequent campers showed that potential customers wanted a table that is lighter than those currently available. Upon using the benchmark product, those surveyed commonly stated a desire for a sturdier table as well. Our goal was thus to make a lighter, sturdier, and more compact table, without greatly increasing the complexity of the design.

Design Objective

To find the best design, multiple ideas were generated. Cardboard and aluminum cut-outs were made as proof of concept, and then modeled on SolidWorks and Abaqus. The ideas were ranked based on the performance requirements from the PDS, and the design which best met these prioritized design goals was developed. The design needed to be modified to ensure the PDS requirements were met on frequent occasions.

Light weight and compactness were the main goals of this project. In order to reduce the size of the table, the tabletop folds in half, which was accomplished through the use of C-channel beams. The C channels also reduce the overall weight by using less material to provide similar strength to the benchmark design, whose channel dimensions were determined during the design process to maintain the benchmark bar strength.

Analysis

Our table’s beam design was analyzed in Abaqus to ensure that it could meet our design requirement of holding at least a 20 lb midspan point load with a safety margin of 2x. In the Abaqus stress plot below, the maximum stresses occur at the bottom of the side walls, with a value of only 15 ksi - less than half of the yield stress of the 6061 aluminum used. The 2x safety factor has been maintained, a design requirement carried over from the talking with the benchmark’s manufacturing engineer.

The design was further tested by loading a proof of concept beam, which only failed after undergoing a 50 lb midspan load (see Figure 1).

Results

<table>
<thead>
<tr>
<th></th>
<th>Benchmark</th>
<th>New Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load Capacity</td>
<td>20 lb</td>
<td>25 lb</td>
</tr>
<tr>
<td>Collapsed Volume</td>
<td>294 in³</td>
<td>188 in³</td>
</tr>
<tr>
<td>Weight</td>
<td>1925 g</td>
<td>1530 g</td>
</tr>
<tr>
<td>Surface Area</td>
<td>468 in²</td>
<td>405in²</td>
</tr>
<tr>
<td>Locking Legs</td>
<td>X No</td>
<td>√Yes</td>
</tr>
</tbody>
</table>

Table 4. Performance comparison between benchmark and new design.

Conclusion

Through the use of bent aluminum and a folding design, we were able to reduce the weight and folded dimensions of the camp table while maintaining strength. The addition of locking features to the legs with these greater physical characteristics will have our table design competitive and outselling other tables currently in the camping market.

Acknowledgments

David Burgett (Director of Product Development, GSI Outdoors)
Steven Leguette, Nicole Holstrom, Andy and David Bothman,

References

2010 McMaster-Carr Supply Company. www.mcmaster.com
GSI Outdoors. www.gsioutdoors.com