Calibration of High-Resolution Surface Tachometers

**Project Goals**
- Design and manufacture a portable device for the relative calibration of multiple surface tachometers.

**Project Background**
- Properly calibrated tachometers can detect small differences in surface velocity across a system.
- Used as diagnostic tool to reduce the downtime of systems.
- Currently a lathe used for calibration.
- Problems:
  - Cannot calibrate tachometers relative to each other
  - Not portable

**Ranked Customer Wants**
- Top 5 Design Specifications

<table>
<thead>
<tr>
<th>Metric</th>
<th>Target Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>% variation of speed</td>
<td>&lt; 0.05%</td>
</tr>
<tr>
<td>Size</td>
<td>&lt; 3' x 3' x 3' &amp; &lt; 90 lbs</td>
</tr>
<tr>
<td>Set up time</td>
<td>&lt; 5 minutes</td>
</tr>
<tr>
<td># of tachometers</td>
<td>at least 4</td>
</tr>
<tr>
<td># of attainable speeds</td>
<td>at least 3</td>
</tr>
</tbody>
</table>

**Final Concept**
- Tachometers mounted to make contact with disc
- Disc rotated using a motor and gearbox
- Multiple tachometers calibrated simultaneously to surface velocity of disc
- Motor speed selected through user interface

**Prototype**
- Motor connects to controller with user interface
- Gearbox
- Shaft and disc assembly
- Switch for speed selection
- Power supply
- Drive

**Evidence of Concept**
- Eccentricity Testing
  - Wheel and shaft rotated on v-blocks
  - Radius variation measured with dial gage
  - Confirmed radius variation will not cause speed variations above design specifications
- Position Testing
  - Tachometers of various sizes positioned on disc and shaft assembly
  - Confirmed that 4 tachometers of all sizes can be mounted simultaneously
- Complete System Test
  - Method:
    - Mount surface tachometer on rotating disc
    - Note speed variation in system
  - Tachometer speed variation with gearbox:
    - Large speed variations
    - Insignificant variations in speed

**Conclusion**
- Use of current gearbox creates unacceptable speed variations
- Modifications to system
  - Eliminate gearbox for direct drive system
  - Tachometers mounted directly to extended shaft