2.72 shaft blank exercise

The aims of this exercise are to measure and understand the (a) accuracy/repeatability of a lathe, (b) part deflections during turning, (c) the difficulty associated with meeting tight tolerances, (d) to fabricate the blank for your shaft and (e) to measure your shaft's geometry.

Names: __________________________  __________________________  __________________________
                                                                                      __________________________  __________________________  __________________________

Group: _______                                                                 Total: _______

Material: 12L14 steel  Surface finish: 16 µinch

All dimensions in inches; drawing not to scale

Step 1: Calculate the lateral bending stiffness of the shaft when its full length is cantilevered.

\[
K_{\text{lateral}} = \frac{EI}{L^3}
\]

Step 2: List 3 errors that could affect shaft dimensions during turning, identify them as systematic / nonsystematic.

<table>
<thead>
<tr>
<th>Error</th>
<th>Systematic</th>
<th>Nonsystematic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>03</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Step 3: Meet with shop manager to discuss how to make your shaft

Step 4: Make a process plan (see work sheet in the Appendix of syllabus) for the shaft, obtain shop manager’s approval on the plan and schedule a time with him to machine your group’s shaft.
Step 5: Before you finalize the shaft’s geometry, you must run experiments wherein you will cut features into the stock (make sure they won’t interfere with the final geometry of the part) and measuring them. First we will measure the diameter of 10 closely spaced plunge cuts (go 0.05” deep using the dials only) near the shafts cantilevered end and report the mean and standard deviation. Explain how these numbers relate to the accuracy and repeatability of the lathe.

1. ________mm  2. ________mm  3. ________mm  4. ________mm  5. ________mm
6. ________mm  7. ________mm  8. ________mm  9. ________mm  10. ________mm

μ: ________

σ: ________

Comments:

Step 6: Make four plunge cuts, that are 0.05” deep, near the shaft’s free end such that they are on a pitch of ½”. Comment on the relationship between the shaft’s stiffness/deflection and the difference in measured diameters.

1. ________  2. ________  3. ________  4. ________

Comments:

Step 7: Make the shaft according to the print on page 1.

Step 8: Measure the final dimensions of the shaft as best as possible given the gages that you have access to. Provide numbers that demonstrate the possible error in your measurements.