2.72 Elements of Mechanical Design

Spring 2009

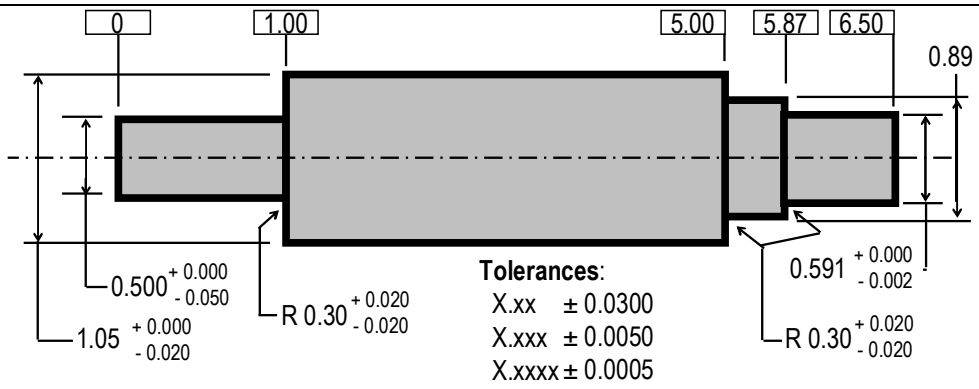
2.72 shaft blank exercise

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: _____



Tolerances:
X.xx ± 0.0300
X.xxx ± 0.0050
X.xxxx ± 0.0005

All dimensions in inches; drawing not to scale

Material:	12L14 steel		**Surface finish:**	16 µinch

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

$K_{lateral}$: _____ N/µm

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

	Error	Systematic	Nonsystematic
	Thermal		X
01			
02			
03			

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.