

Project #2
 Due Date: Wednesday, 27 October 2010

CAD for Manufacturing & Statistical Methods

The purposes of this project are: (1) to connect computer-aided mechanical design and manufacturing processes, (2) to improve your appreciation of the capabilities and limitations of basic machining processes – turning, milling, and drilling – through hands-on experience with manual machines, and (3) to analyze a real design and manufacturing problem with CAD tools. Working in teams of 2~3 students, you will make from the supplied cylindrical brass stock a device of great practical utility: a corkscrew.

The drawing below specifies geometric dimensions for the corkscrew which comprises a body, a headpiece and the screw itself (the screw dimension will be determined later pending on the available ones we can buy form the market). You will only machine the body and headpiece – the screw will be soldered into the head piece. Please note that the body is intended to slide through the hole in the headpiece forming a handle that affords a firm grip. The accurate mating of these parts is thus very important. In addition to the process sheets, you should consult with the machine shop supervisors on any questions that may arise. The drawings also include a circular groove on the headpiece as an embellishment.

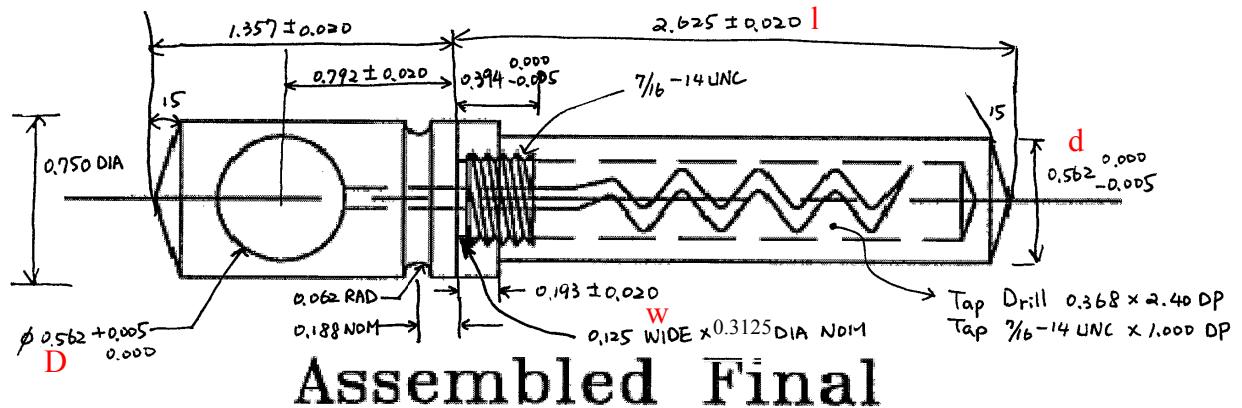


Figure: Assembled corkscrew

Part A: Please draw typical “manufacture” diagrams using CAD software for “headpieces”, “corkscrew body” and other diagrams that may help the understanding of the corkscrew for the manufacturing process.

Part B: Please complete the fabrication of your part by the deadline announced in class.

Part C: This part of the problem is to conduct failure analyses of the corkscrew you have manufactured. You need to estimate where and how much the external loading may come from, where the corkscrew may fail, what is the safety factor for the current design and possible means to improve the design.

Part D: Instructions will be giving on the measurement of key dimensions, and the data from each team will be collated and made available to the entire class for statistical analysis according to instructions that will be supplied. Each team should submit a report outlining their execution of the various stages of the project. Calculations and drawings may be hand-written, but must be neat and legible. You should incorporate the following items:

- Title page including names, course, and date
- A one-paragraph abstract summarizing the methods used and results obtained in each phase of the project
- A brief description of the procedure used to manufacture the part in the machine shop, indicating problems you may have encountered and how you remedied them, useful insights you obtained, etc.
- A detail description on the failure analysis, including your assumptions.
- A detailed account of the statistical manufacturing-tolerance analysis
- A conclusion in which you assess your results as a whole, and suggest possible improvements to the design on manufacturing process.

Statistical Analysis

Based on the supplied measurement data from all teams, you should perform the following statistical analysis of the manufacturing tolerances:

1. Plot a histogram for the body diameter (measured by micrometer), using the *individual* measurements made by each team.
2. Plot a histogram for the body diameter (measured by micrometer), using the *average* measurements made by each team.
3. Comment on any differences that you observe between the histograms from (1) and (2).
4. Computer means and standard deviations from the dimensions D, d, w, l using the average value from each team (use the micrometer, rather than the caliper, measurements).
5. Assuming 3σ tolerance for D and d, estimate the 3σ tolerance for the clearance $c = D-d$.
6. Assuming that c is normally distributed, find the % of parts with clearance in the range $0.5C \leq c \leq 2.0C$, where C is the mean clearance.

You may use a spreadsheet, such as EXCEL, to facilitate your plots and calculations. Incorporate all your results in the project report.

Measurement Data Sheet

Team Name _____

Team Members _____

The dimensions to be measured on your machined part are the body length l , the body diameter d , the hole diameter D , and the collar width w (see the figure above). The number of individual measurements – at different positions/orientations – for each dimension and the instrument to be used, are indicated in the table below. Once you have filled out the blanks, please return the completed sheet to your GSI (only one sheet per team). Please note that measurement instruments: m = micrometer, c = calipers, hg = height gauge, quote all values in inches to 4 significant digits.

	#1	#2	#3	#4	average
D (c)			-----	-----	
d (m)					
d (c)					
w (m)					
w (c)					
l (hg)		-----	-----	-----	