Massachusetts Institute of Technology
2.008: Design and Manufacturing II

Problem Set 4

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We would like to distribute our favorite solution for each problem to the class as the official solution so please strive for clarity and elegance.

Problem 4-1. Welding Speed

(a) Plot welding speed as a function of weld pool depth for depths s = 1mm to 25mm at two preheat temperatures, $T_p = 70$F and $T_p = 700$F. Plot the two curves on the same graph [consider using a spreadsheet to do this]. Show any formulas that you derive.

(b) Explain what the point of this exercise is, ie., how does this shape how you design a part and the process that you use to make the part when welding is involved.

Problem 4-2. Cutting model

(a) Estimate the rate of production for the part in Figure 1 using the parameters from the following table. You may assume the part enters the cutting process as a rod that is 2.3 inches long at a radius of 1 inch. Plot the amount of power (in hp) required during the cutting of turning of this part.

w	Width of Cut	0.100 in
f	Feed Rate	0.020 in/rev
α	Rake angle	10 deg
ω	Spindle speed	400 rev/min
μ_f	Friction specific Energy	0.10 hp/min/in^3
μ_s	Shear specific Energy	0.40 hp/min/in^3
C	Taylor tool constant	350
n	Taylor tool exponent	0.45
t_c	Cost per tool	$20

(b) What is the tooling cost per part as a function of ω? [Note, the velocity changes during the two passes]. Use a spreadsheet to plot the tool cost vs V_c for values from 350 rev/min to 450 rev/min.

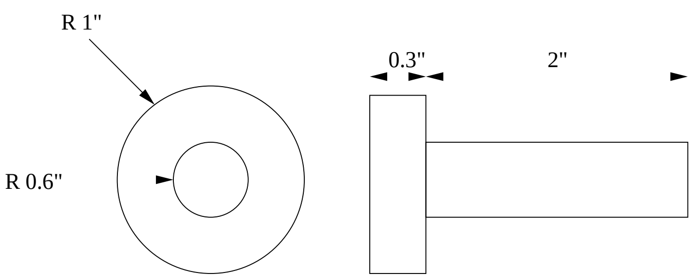

Figure 1: Milled Flange