Injection Molding and Heat Transfer Homework for 2.810

1. a) Consider the open (aluminum) mold casting of a wax candle as shown in Fig. 1. Assume that L > D = 2 cm, the mold is at a constant temperature of 30C and the wax is poured at 100C. Estimate the time to cool the wax to 37C. Note that wax has similar thermal properties as polymers. Discuss what would the consequences be if L and D were of the same order.

b) Assuming L = D draw the solidified shape of the candle. Explain how this shape would evolve. If this were glass would there be any possibility of cracking? where? What is important about the different between glass and wax for this problem.

2. a) Consider the injection molding of the tape holder (wt. = 0.5 oz) which is shown in Fig. 2 and a copy of which has been given to your group. Examine the part closely, and then; 1) estimate the cooling time, 2) indicate any special features that would result in moving parts for the mold. were ejector pins used? 3) indicate the mold filling sequence and locations of the gate and weld lines (if any), and 4) please specify roughly the size of the injection molding machine needed to mold these parts using a 4 cavity mold.

3. Two conceptual designs for the tooling for the part shown in Fig. 3 (after eliminating the 0.25 in. ridge at the base) are show in drawings A) and B).

a) What would be the difference between these two approaches?

b) Do any features on these drawings violate DFM rules?

c) Draw in the location of the part immediately after opening the mold.

d) Please show where you would put a stripper plate and/or ejector pins on these molds.

e) Consider two different gating situations. On one draw the gate and sprue location if they are to remain connected to the part on die opening.

f) In another show the gate and sprue location if they are to separate from the part on die opening.

4. a) One noticeable difference between die casting tooling and injection molding tooling is the size of the runner system. Fig. 4 shows a multi-cavity die for die casting. Note that the runner system is quite large and changing in size. In comparison, the runner system for injection molding is usually of smaller and constant diameter. Can you explain why these are different? Is there a feature of the die casting die that is missing?

5. Show that eq'n 8.5 in Boothroyd et al reduces to our result

$$t_c \cong \frac{(h/2)^2}{\alpha}$$

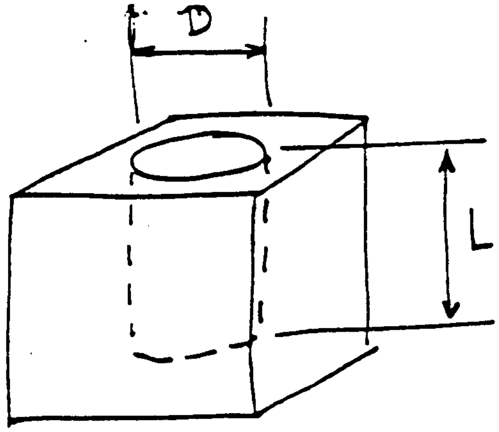


Fig 1
Open mold for candle casting

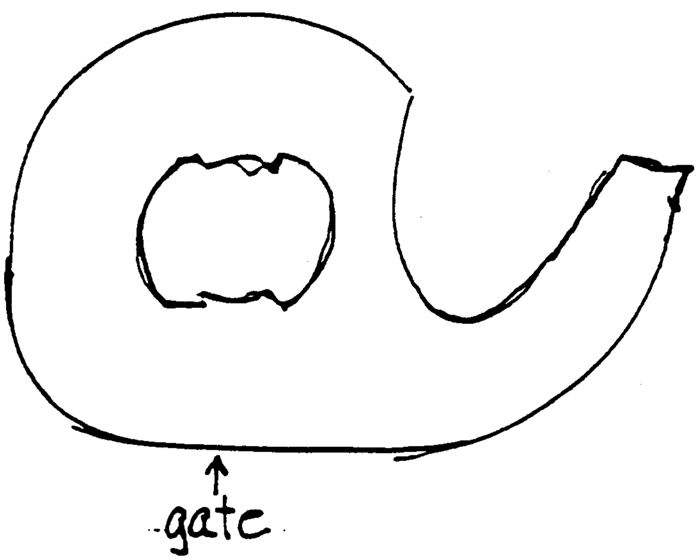
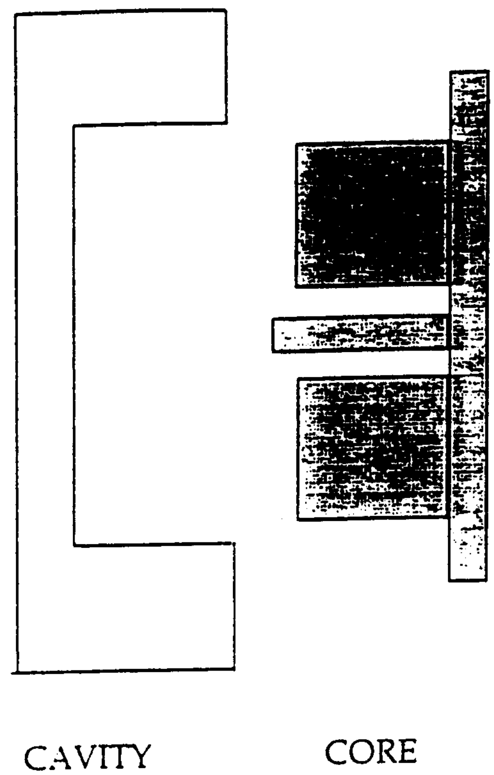
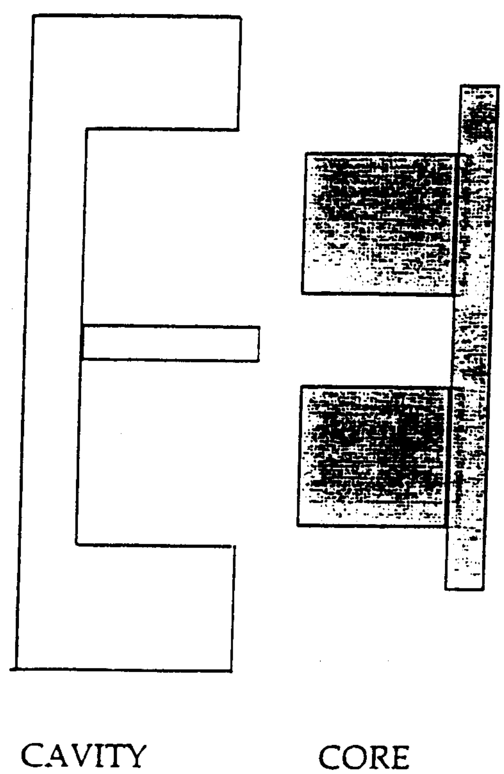


Fig 2
Tape Dispenser

A)



B)



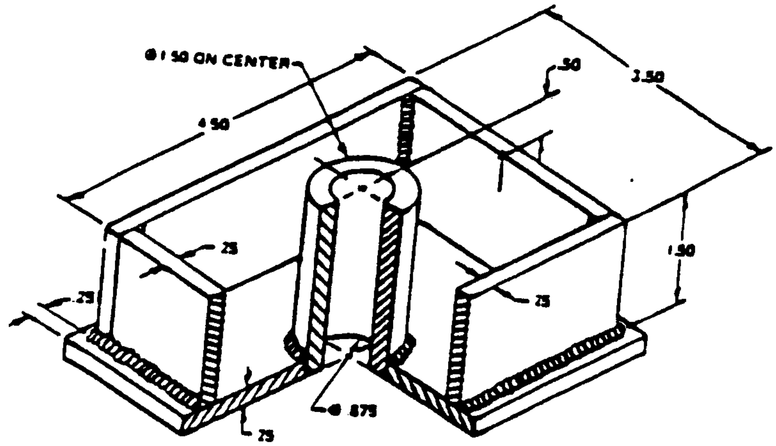
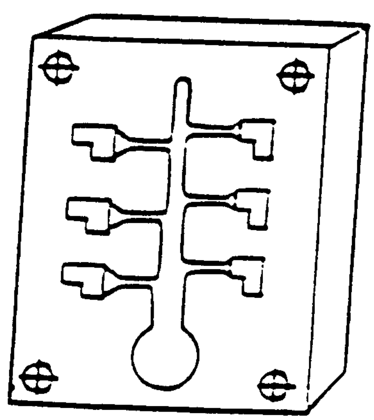


Fig 3

all dimensions in inches.



Multiple-cavity die

Fig 4
Multiple - cavity tool
~~for~~ die casting
(note runner size
compared to part size