ME317, Design For Manufacturing
Exam 2
January 25, 2007

Name:

Campus Box:

Score:

Please show all your work. Partial credit depends on how well you can justify your answers.
This is an open-book / open-notes exam.

Problem 1 (9 points)
Consider possible parting lines for the sand cast pillow block base (bearing support) shown below. **If we assume NO cores**, rate these parting lines as Relatively Inexpensive, Possible but Expensive, Impossible. (figures are taken from hishapes.com)

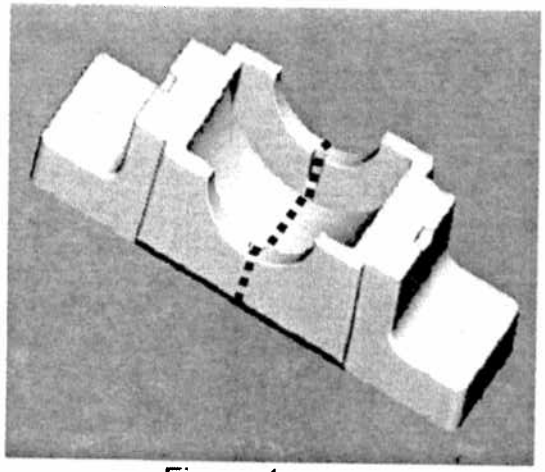


Figure 1

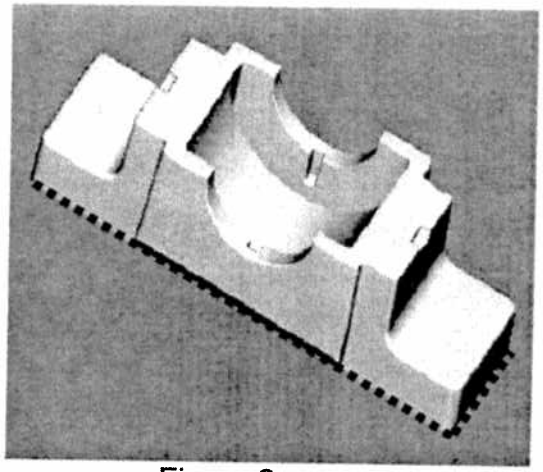


Figure 2

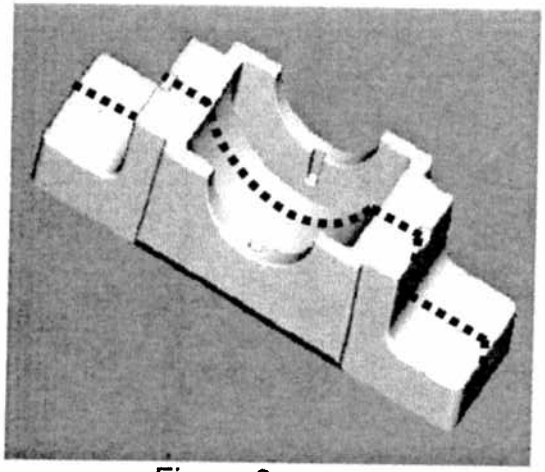


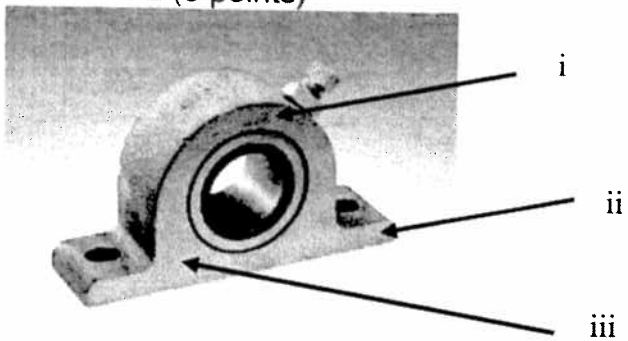
Figure 3

Parting Line as shown in Figure 1: a) Relatively Inexpensive b) Possible but Expensive c) Impossible

Parting Line as shown in Figure 2: a) Relatively Inexpensive b) Possible but Expensive c) Impossible

Parting Line as shown in Figure 3) a) Relatively Inexpensive b) Possible but Expensive c) Impossible

Problem 2 (8 points)



Consider the sand cast pillow block shown above. The most likely location for porosity problems is in the interior directly behind point (circle one): i ii iii

Your boss wants to convert pillow block fabrication from sand casting gray cast iron (with typical sand cast tolerances and at a medium production rate) to die casting.

a) If you consider Material only, you would say (circle one):

Yes, die casting cast iron is just as easy as sand casting cast iron.
No, die casting molds for cast iron are likely to be prohibitively expensive.

b) If you consider tolerances only, you would say (circle one):

Yes, die casting can easily hold the same tolerances that are typical for sand casting.
No, die casting can't hold tolerances as tightly as sand casting.

c) If you consider production rate only, you would say (circle one):

Yes, die casting production rates are as fast or faster than sand casting.
No, production rates for die casting are mush slower than for sand casting.

Problem 3 (27 points)
Please refer to the print on the next page to answer the following questions. Assume that the part is fabricated using a milling process.

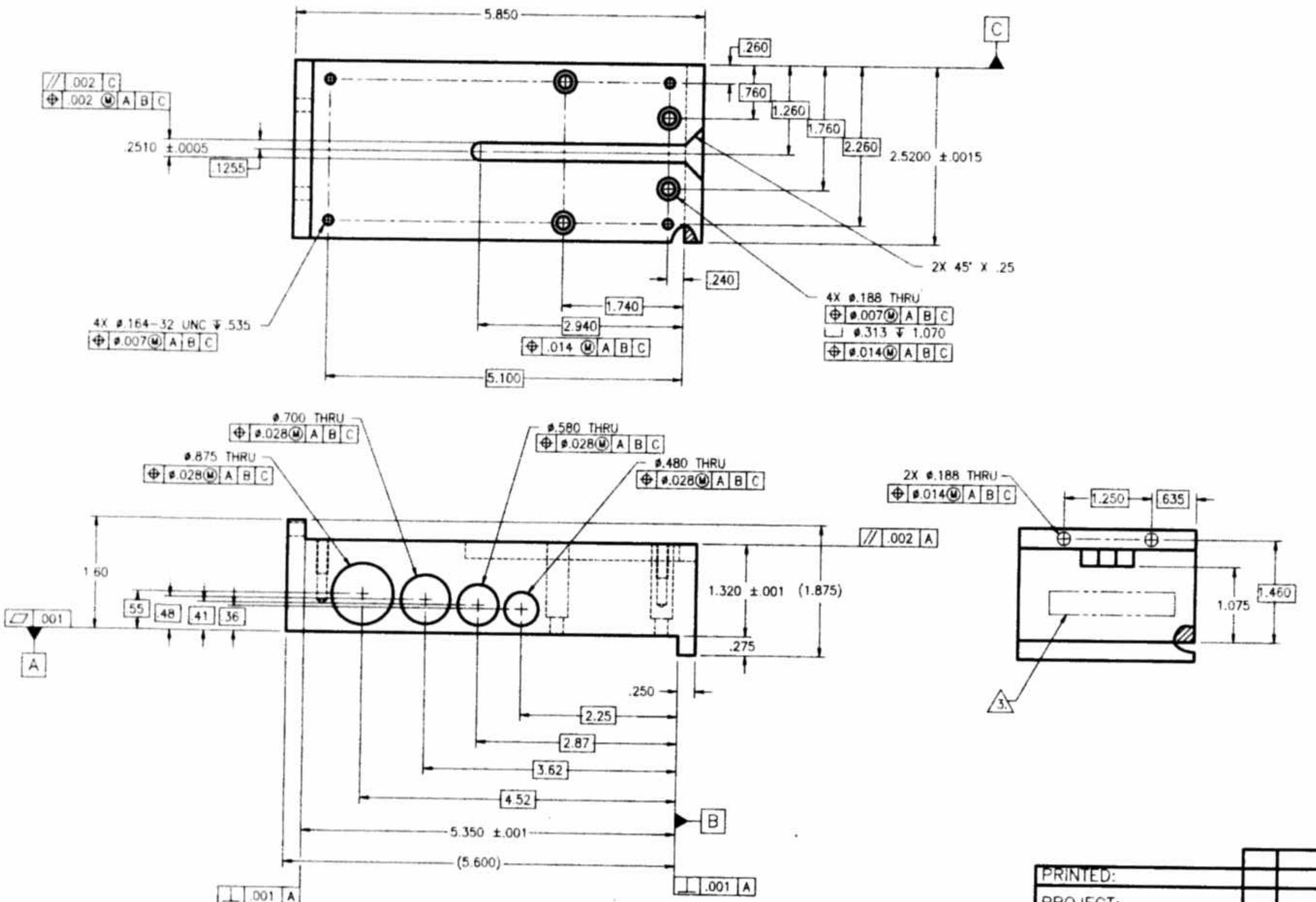
What material is specified for this part? (5 points)

What is the surface roughness specification for this part? Please be sure to also indicate the units for the surface roughness specification. Is that within the normal capabilities of a milling operation? (6 points)

What –if any- are the significant difficulties associated with milling this part? (8 points)

What is the nominal specified depth of the slot that has a width of 0.2510 inch? Please be sure to indicate the units. (4 points)

What is the smallest diameter that the 0.875 inch hole shown in the front view can have and still be within tolerance? Please use the appropriate units. (4 points)



DO NOT SCALE DRAWING

NOTES:

1. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
2. PART TO BE FREE OF BURRS AND SHARP EDGES.
3. (△) INK STAMP PART NO. & REV. LEVEL IN AREA INDICATED.

UNSPECIFIED LIMITS ALL DIMENSIONS IN INCHES	
FRACTIONS ± 1/32 DECIMALS .XX ±.015 .XXX ±.005 HOLE ø .XX ±.005 .XXX ±.003 .001 ANGLES 0°30' BENDS ±2° PERPEND. ⊥ .003/IN CONCEN. ◎ .003/IN	STRAIGHTNESS &/OR FLATNESS: .005/IN THREADS: EXTERNAL-CLASS 2A INTERNAL-CLASS 2B ANGLES,BENDS,& INTERSECTIONS:90° MACHINED SURFACES: 63 OR BETTER
SAMPLES MUST BE APPROVED BY ENG. PRIOR TO STARTING PRODUCTION	

ASSY	NEXT ASSY

APPROVALS	DATE
DRWN: DRAWN	DATE
CHKD:	
ENGR:	
MATL: AL. 6061 - T6	
FINISH: MIL STD 171 FINISH 7.3.3	

PRINTED:

PROJECT:

REV	ECO #	APPR	DATE

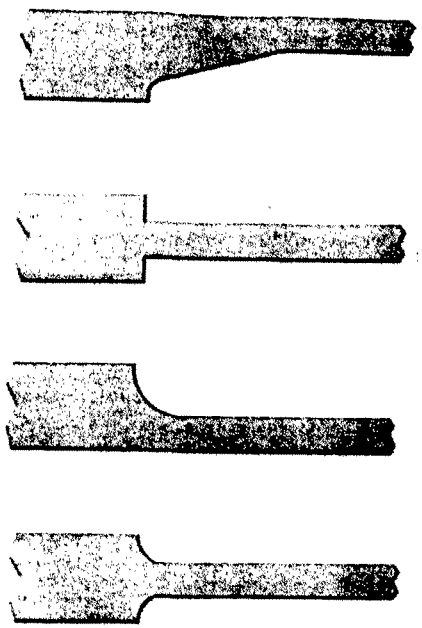
SIZE C | FSCM 64869 | DRAWING NUMBER | REV 0

SHEET 1 OF 1 | SCALE: 1:1

TITLE: MOUNTING PLATE (UPPER) - FRAME ASSY 3 AXIS HP

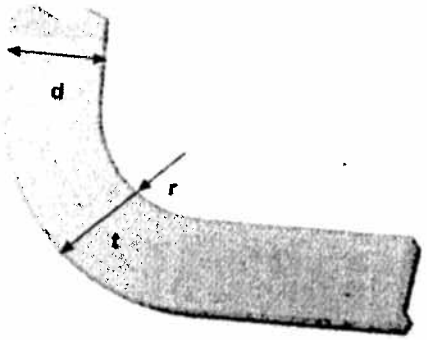
FLIR Systems Inc.
16505 SW 72nd Ave
Portland Or 97224

Problem 4 (5 points)
Consider an investment casting design with thick-to-thin wall transitions. Given the choices below, rank the choices from 1 to 4, with '1' being the best and '4' being the worst.

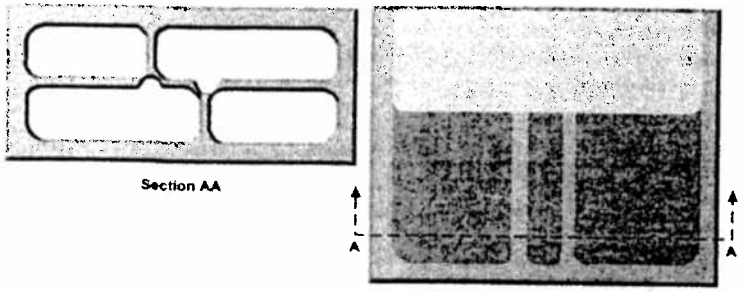


Problem 5 (5 points)
Assume an investment casting design has a thick-to-thin transition similar to the one you circled as '4'. What kinds of problems do you expect from this?

Problem 6 (5 points)
A sharp corner is generally a poor design for a casting. The cross-section below shows a preferred design. What recommendations can you provide for r (the distance from the center of the radius to the inner surface of the material) and t (the distance from the center of the radius to the outer surface of the material) in terms of d (the material thickness)?



Problem 7 (5 points)
You need to design a casting that includes interior walls for a cast part. Do you prefer thicker or thinner interior walls, compared to the exterior walls? Why do you prefer this choice?



Problem 8 (12 points)
An investment casting plant is set up to include wax injection, ceramic investment, casting and finishing departments. Consider a worker in the finishing department whose job entails grinding gate contacts from castings. One day during his routine he discovers pockets of shrink that extend into the physical body of the part. He sets down his air-powered hand grinder on his bench and walks to the casting department (nearly a one mile walk) to find out if there is a pouring temperature problem which could be possibly responsible for the observed shrink. The foundry workers explain that the pyrometers that they use to determine the metal temperature are out of calibration and are the likely cause of the shrink. A scheduler standing nearby explains that this is not a problem since they have over-produced the particular part that the grinder was grinding to cover the possible lower yield.

From a perspective of using Lean Manufacturing to improve the operation of this plant, select two of the "seven wastes" and explain how this situation illustrates them.

First Waste Example:

Second Waste Example:

Problem 9 (15 points)

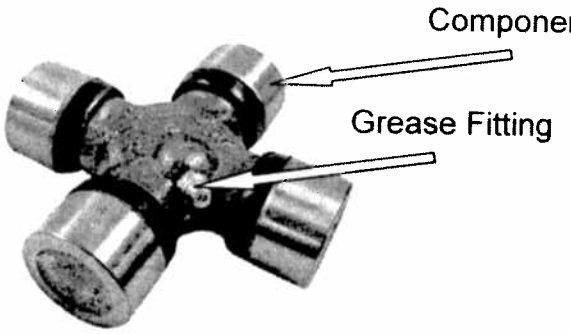


Figure 4

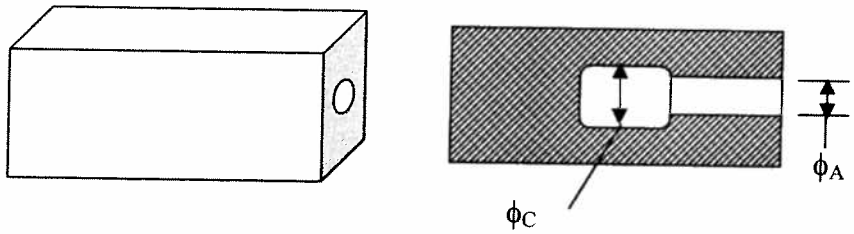


Figure 5

The grease fitting shown (Figure 4) is screwed into a hole that was drilled and tapped into a component of a universal joint that appears to be a casting or a forging. List any challenges that may be present for the drilling operation.

The company you work for is making the shape shown above in Figure 5. It is a rectangular block with an internal cylindrical chamber (diameter C) at the end of a hole with diameter A. The decision has been made to use a lathe to generate the internal features.

The best way to hold the workpiece in the lathe is with a

a) Collet
b) Three jaw chuck
c) Four jaw chuck
d) Other (name) _____

The best way to create the internal features is to

a) First drill diameter A, then use a boring bar to enlarge the hole to diameter C
b) First drill diameter A, then use a reamer to enlarge the hole to diameter C
c) Use a stepped drill to create diameters A and C simultaneously.
d) Other (describe) _____

Problem 10 (9 points)

For which rapid prototyping process does the material start out as a liquid? (circle one)

Fused Deposition Modeling

Selective Laser Sintering

Stereolithography

What file type is required by most rapid prototyping equipment? (circle one)

filename.dxf

filename.par

filename.stl

filename.doc

Is it possible to create parts with undercuts using the stereolithography process?