Chapter 2
Solutions

Problem P2.1: Give three examples of engineered products that must be circular in shape and explain why. Any ball is not allowed as an answer!

Examples include:

- DVD's
- CD's
- manhole covers
- railroad advance warning signs
- wheel (for flat roads)
- axles
- bullet cross-section (balanced for stable flight)
- European speed limit sign
- any shape with minimized arc length/surface area for given area/volume
- optimized pressure vessel cross sections
- US coin
- lens (part of circle)
- optimal nozzle/diffuser (no edge effects)
- optimal capillary tube
- optimal suction cup
- traffic circle
- thrown pot (on potting wheel)

Problem P2.2: Give three examples of engineered products that must be triangular in shape and explain why.

Examples include:

- yield signs
- the triangle instrument
- billiards rack
- knife blade (cross-section)
- supports for finishing wood (pyramids or cones, must come to a point)
- splitting wedge
- handicap ramp viewed from side (to meet code)
- three equally spaced instances per rotation cam
- 30°-60°-90° or 45°-45°-90° drafting triangle
- one of six identical pieces that can be assembled into a hexagon
- chisel point

Problem P2.3: Give three examples of engineered products that must be rectangular in shape and explain why.

Examples include:

- A size (or any other standard size) sheet of paper
- four equally spaced instances per rotation cam
- football/soccer field (civil engineered)
- US speed limit sign
- US dollar bill

Problem P2.4: Give three examples of engineered products that must be green in color.

Examples include

- fake plant/turf (imitate actual plant)
- John Deer product (branding)
- Cameron Compressor (branding)
- Green (traffic) light
- European recycling bin
- Kermit the frog paraphernalia (branding)

Problem P2.5: Give three examples of engineered products that must be black in color.

Examples include

- Background for one way signs and night speed limit signs
- theater bins/supports (disappears in dark)
- stealth fighter (better “bounce” characteristics)
- ninja suit (stealth at night)
- black paint
- black ink
- backing for solar water heating
- negative electric cables

Problem P2.6: Give three examples of engineered products that must be transparent.

Examples include

- Contact lenses (over pupil portion)
- glasses (spectacles)
- (camera) lens (any tint causes loss of quality/information)
- Microscope slide and slide cover

Problem P2.7: Give three examples of engineered products that have a specific minimum weight, but no specified maximum weight and specify the approximate minimum weight.

Examples include:

- Helium balloon holder (minimum weight will depend upon how many helium balloons are being held)
- non-wedge based door stop (minimum weight based on friction coefficient)
- racecar (minimum weight based on racing regulations)
- competition bike (minimum weight based on racing regulations)

Problem P2.8: Give three examples of engineered products that have to be precisely a certain weight, and provide the weight.

Examples include:

- balancing weight for car wheel
- coins (weight used to count coins in some automated machines)
- precious metal coins (weight dictates worth)
- exercise weights (15 lb weight must be 15 lb)

Problem P2.9: Give three examples of engineered products that fulfill their designed purpose by failing or breaking.

Examples include:

- saw stop mechanism (http://www.sawstop.com/)
- crumple zone in car
- bumper (foam insert) in car
- bike helmet
- frangible bullets (split up when they hit anything other than flesh) to protect bystanders
- stress indicating paint has fluorescent dyes capsules that split under known deflections (http://www.newscientist.com/blog/invention/2007/10/stress-sensitive-paint.html)
- Some meds are packaged in glass bottles that you break to open
- Cover on a “pit trap” breaks when weight is applied
- Fire suppression sprinkler detection device (solder connect melts or glass connection shatters)

Problem P2.10: Give three examples of engineered products that are designed to work well over a million times.

Examples include:

- Roads
- Bridges
- Engine components (if each Otto cycle is a “use”)
- Fuses
- Door hinges
- 3-D shutter glasses (the shutters)

Problem P2.11: List three products that can be used equally well by people with and without visual impairments and explain why.

Examples include:

- Silverware
- Chairs
- Drinking Cups
- Headphones
- Bed
- Drawers
- Emergency response necklace (one button, worn around neck to locate) http://inventorspot.com/articles/one_touch_911_dialer_calls_help_you_30719
- Sight and sound cross walk guides
- Fire alarm (day to day use, not installation and maintenance)
- Automatic doors (and other motion detectors)

Problem P2.27: For the magnesium camera body shown, provide an explanation for which processes you think were used in its manufacture and why.

Figure P2.27

This was most likely manufactured using a die cast procedure because of the material and geometric detail in the pieces including a number of inclusions. Certain features could have been machined, and some polishing/grinding operations may have been used.

Problem P2.28: For the aluminum structural member shown, provide an explanation for which processes you think were used in its manufacture and why.

Figure P2.28

Photo courtesy of 80/20 Inc.® www.8020.net

This was most likely manufactured using an extrusion process because of the material and constant cross section geometry of the member. Shorter pieces could be die cast, although longer pieces are most certainly extruded. Machining could be another option for very small pieces, although machining would be much more time consuming for a part like this.