Donald P. Shiley School of Engineering
University of Portland
ME 403/503 – Engineering Design, Product Realization
Fall 2016

Due Tuesday September 6 at the beginning of class.

1. You are working in a high precision industry. There is a requirement for a structure to keep two objects precisely spaced from each other (nominal spacing is 30 inches) in an atmospheric test chamber. The temperature in the chamber that this structure is placed can vary from 20ºF to 110ºF. Design a structure to separate the two objects that minimizes the variation in separation due to temperature changes. The load is a maximum of 1kg. Be specific about material selection – include relevant properties and cite where you obtained the properties. Determine the change in separation when temperature goes from 20ºF to 110ºF. Remember, good designers are able to think "outside the box." The design should be simple (few parts), inexpensive, reliable, and easy to maintain. You may use any of the following materials, but no other: A36 steel, SAE 4340, 2024-T351 aluminum, 6061-T6 aluminum, 7075-T651, Ti-6-4 (titanium alloy with 6% aluminum, 4% vanadium), alumina (aluminum oxide, Al_2O_3), polyethylene, and polyvinyl chloride (PVC).

2. **Definitions – answer the following as used in experimentation:**
   a) What is the difference(s) between an "experiment" and a "test"?
   b) Define "error."
   c) Describe the two basic types of experimental error.
   d) What are primary causes of random errors and what are the negative effects of random errors?
   e) What are primary causes of random errors and what are the negative effects of systematic errors?
   f) How can the effect of these two types of error be mitigated?
   g) Think of an experiment that has one discrete variable and one continuous (name them).
   h) What is meant by "extraneous variables" and give an example of an extraneous variable in your imaginary experiment.

3. You are working as a test engineering for a company in town (ASKO). One the metallurgist thinks she has developed a new alloy (referred to as "Alloy X") that is stronger than their tried-and-true Alloy W. You do a tensile test on a sample of Alloy X and you measure the yield strength to be 91.4kpsi. Since you have been using Alloy W for years, you know its yield strength in 88.7kpsi. Should the metallurgist get to park in the Employee of the Month parking spot? In other words, is Alloy X stronger than Alloy W? What may be wrong with reaching a conclusion – how might the experiment be improved in order to answer the question?