DESIGN OF A LOCKING OVAL CARIBINER

Objectives: The primary objective of this laboratory is to design a locking oval caribiner using tensile testing data generated through experiments. The secondary objective of this laboratory is to compare these data to published data.

Background: Carabiners (Figure 1) are used in mountaineering and rock climbing to secure ropes. They are generally loops with "gates" through which ropes are inserted. Opposite the gate is the spine. Locking carabiners have gates that positively lock, therefore, the spine and the gate can be relied upon to carry load.

Materials Properties Data: Each group is to perform three tests to failure on specimens of a single material obtained from your instructor. Each group must then share their derived data with the other groups. Tests are to be conducted with a PASCO stress-strain apparatus (Figure 2) as described in their handout to be supplied by your instructor. Record the "crosshead" Young's modulus crosshead (E_c) derived from the load-rotary sensor data, and record, as applicable, the proportional limit σ_{pl}, yield strength σ_Y (upper, lower and/or 0.2% offset), ultimate strength σ_U and breaking strength σ_B. Discuss the types of material responses observed, i.e., ductile or brittle. Compare properties to published values.

Design Problem: You are to specify a diameter d such that the maximum stress in the caribiner remains less than or equal to the endurance limit for the material chosen. The caribiner must support a load of 15 kN in the closed gate configuration. The endurance limit may be estimated as 50% of the ultimate strength for steels and 40% of the ultimate strength for aluminum and copper alloys. Other considerations should guide your design as well. You may use a material that you did not test in this lab.

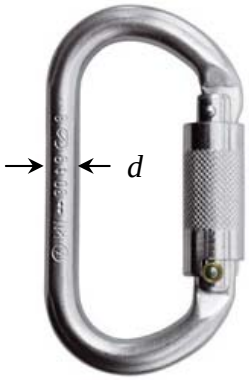

Figure 1. Locking oval caribiner. Image: camp-usa.com.

Figure 2. The stress-strain apparatus. Image: pasco.com.