E1: Uniaxial Tensile Test

1. **Objective:**

   The objectives of this experiment are to ascertain the following in specimens made of aluminium and mild steel that have undergone uniaxial loading. Also, compute:
   (a) The maximum tensile stress.
   (b) The modulus of elasticity
   (c) The percentage reduction in cross section and hence strain to failure assuming plastic incompressibility
   (d) Construction of the true-stress vs. true stain curve.

2. **Theory/Background (related to the experiments):**

   In this experiment, a dog-bone shaped specimen is tested using a Universal Testing Machine (UTM) to measure its load and displacement under various conditions, such as tension, compression, bending, and shear. The UTM has a capacity of 100 KN and consists of two motor-driven screws that carry the upper beam, on which a load cell is mounted to measure the applied force. The crosshead displacement is measured using a linear variable differential transformer (LVDT). The load-deformation curve is plotted and strain is measured using an extensometer. The provided mechanical extensometer consists of two lever arms that are 20 mm apart and attached to the specimen using an elastic band. The relative motion of the lever arms is recorded by an amplifier circuit, which outputs a voltage that is converted to displacement using a calibration sheet. Engineering strain is calculated by dividing the displacement by the gauge section's original (20 mm) length, and the engineering stress is calculated using the load cell's measured force and the material's initial cross-sectional area. The true stress and strain data are calculated from the corresponding engineering stress and strain, and the material's properties are then extrapolated.

3. **Equipment Required:**
   (a) Venier calipers
   (b) The Universal Testing Machine
   (c) Ruler
   (d) Extensometer

4. **Experimental Method:**
   (a) Measure the diameter "d" of the specimen at several points and calculate the average diameter.
   (b) For uniformity, set the gauge length L equal to 5d and calculate L (in this case, L is set to 20 mm).
   (c) Mark the center of the specimen and two additional points on either side, at a distance of 10 mm from the center.
   (d) Mount the specimen on a Universal Testing Machine (UTM) and select an appropriate load range and crosshead velocity.
   (e) Continue loading the specimen until it breaks and collect data from the UTM and the extensometer, which measures strain versus time.
   (f) Fit the broken parts of the specimen together and measure the distance between the marked points, as well as the cross-sectional area and use these measurements to calculate the percentage elongation at failure

5. **Expected outcomes:**
   (a) Plot the engineering and true stress-strain curves.
   (b) Calculate the value of young's modulus of elasticity (in GPa).
   (c) Compute the yield stress and ultimate tensile stress.
   (d) Measure and calculate the percentage elongation and percentage reduction in cross-section area.
   (e) Compare the experimental values of elastic modulus with values given in data book