Phenolic Insulation Test Procedures

Resources

Technical Data

- Atlas Fibre Co. Material Data Sheet
    - Samples obtained from this company
- Brand to be purchased from
    - Acculam LE Data Sheet
    - Acculam CE Data Sheet
    - Acculam G10/FR-4 Data Sheet
    - Summary Data Table
- http://www.laminatedplastics.com/linenphenolic.pdf
- P18102 Material Database

Safety Data

- Brand tested
    - Atlas Fibre Co. Phenolic SDS
    - Atlas Fibre Co. Glass Epoxy SDS
- Brand to be purchased from
    - Acculam Phenolfab SDS
    - Acculam Epoxyglas SDS
- “May give off toxic gases...when burning or heated to point of thermal decomposition.”
- “Use water, CO2, or dry chemical to fight fire.”

Equipment

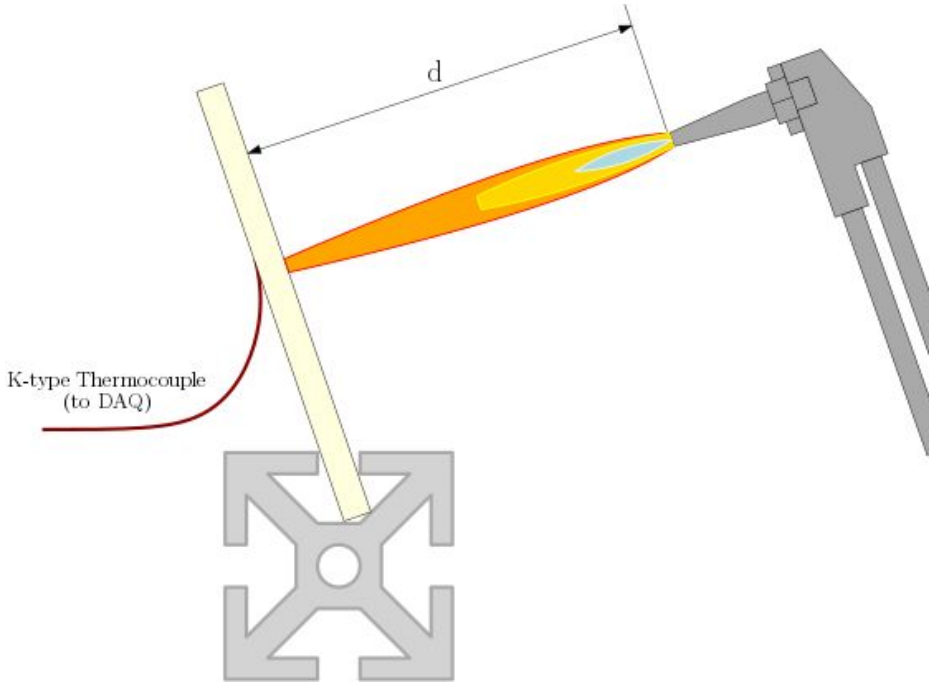
- 4” x 4” x ¼” Specimens
    - LE
    - CE
    - G10/FR-4
- Digital Scale (check Prof. Shu’s lab, or ME labs)
- Calipers or Fine-Ruled Scale
- Stopwatch
- Water
- Beaker
- Styrofoam Ice Box
- Hot Plate (can use Prof. Shu’s lab)
- Temperature Probe (can borrow from Prof. Shu)
    - **-40 to 400 °C** (-40 to 752 °F)
- K-Type Thermocouples (check with Prof. Kempski or in ME labs)
- Thermocouple DAQs (check with Prof. Kempski or in ME labs)
- Torch (check ME machine shop, or purchase)
- Mount/Stand for sample
- PPE?
- Ventilation system?

Tests

Non-Destructive Tests: Determine Thermal/Physical Properties

1. Mass/Density
    a. Mass sample on a scale
    b. Measure three primary dimensions of sample
    c. Calculate corresponding density
    d. **Repeat for each sample**
2. Thermal Conductivity
    a. Determined to be too difficult to test
    b. Values found from further research
        i. http://www.laminatedplastics.com/linenphenolic.pdf
        ii. http://www.matweb.com/search/DataSheet.aspx?MatGUID=8337b2d050d44da1b8a9a5e61b0d5f85
    c. 0.293 W/m-K for L/LE & C/CE
    d. 0.288 W/m-K for G-10/FR4
3. Specific Heat
    a. http://www.chemteam.info/Thermochem/Determine-Specific-Heat.html
    b. Mass sample
    c. Heat sample to known temperature
        i. Boil in water
        ii. Use box oven
    d. Pour water of known mass/volume and temperature into insulated container (calorimeter)
    e. Transfer sample to calorimeter quickly
    f. Record final equilibrium temperature
    g. Calculate specific heat based on temps, masses, and specific heat of water
    h. **Repeat for each sample** for a specified number of trials

Destructive Tests: Determine Effects of Hot Flame



1. Acquire Hot Flame
    - Oxy-Acetylene Torch
        - burns at **3200 °C to 3500 °C** (5800 °F to 6300 °F)
    - Propane Torch
        - burns at approximately **1980 °C** (3596 °F)
2. Measure Temperature of Hot Flame
    - Not possible so we will assume the temperatures given above
3. Determine time it takes for back of each sample to reach critical temp
    - Critical temp defined by the maximum temperature at which the chamber satisfies the Factor of Safety requirement (2)
    - Critical temp = **164 °C** (327 °F)
4. Determine temperature of back of each sample after 10 seconds of simulated burn time
5. Determine time it takes for flame to burn through each sample
6. Document the characteristics of burning sample
    - Does it auto extinguish?
    - Does is become soft when hot?
    - Does it smoke?
    - Does it burn, ablate or melt?
    - What is the rate of erosion?
    - Which sample performed the best overall?