

Flame Tube Alex Hunt

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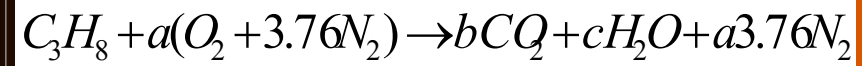


Application

- Creates ideal environment for flame stabilization
- Flows of air and fuel mix together and flow through a long cylindrical tube
- Mixture is ignited at top of tube
- Flame is stabilized in the tube by adjusting flow rates of air and fuel entering tube

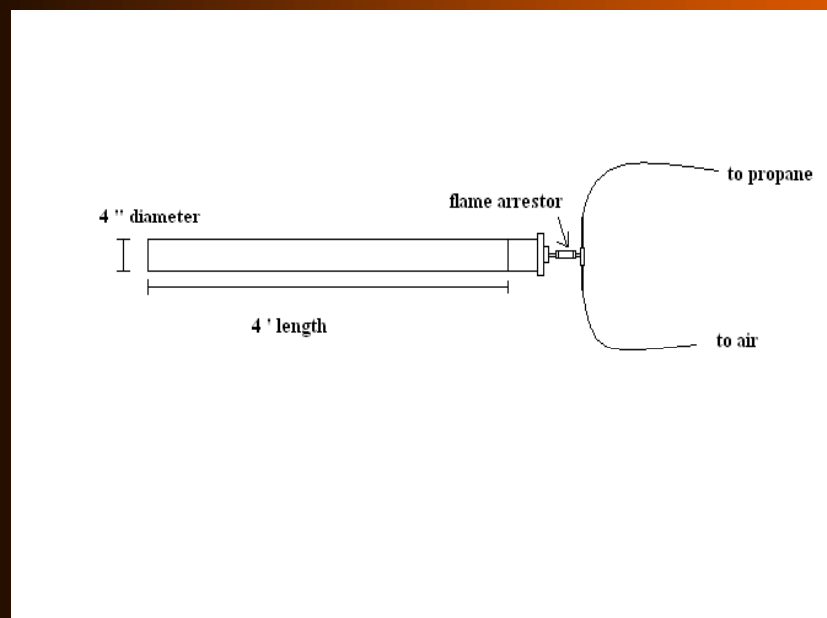
Theory

- Combustion within the flame tube is a reaction between air and a hydrocarbon, propane in this case
- Unbalanced reaction



- In order to begin analysis, reaction must be balanced for stoichiometric conditions

Experimental Setup



Flame Stabilization

- Combustion inside flame tube based on pre-mixed combustion theory: Fuel and air supplied to the tube simultaneously at different volumetric flow rates
- Once the air-fuel mixture is ignited, a flame with thickness and laminar flame speed propagates down the tube consuming the air-fuel mixture
- The flame is stabilized in the tube by adjusting the air and fuel flow rates
- The flame speed is then equal to the speed of the air-fuel mixture entering the tube

Flame Speed

- Since the flame is stabilized in the tube, the flame speed is equal to the speed of the air-fuel mixture entering the tube
- Flame speed is related to the flow of the air and fuel and the cross-sectional area of the tube

$$S_L = \frac{Q_{air} + Q_{fuel}}{A_c}$$

$$S_L = \text{FlameSpeed}$$

$$Q_{air} = \text{Flowrate (air)}$$

$$Q_{fuel} = \text{Flowrate (fuel)}$$

$$A_c = \text{Cross - Section}$$



Fig.1 Lift-off occurs when the fuel flow is lean

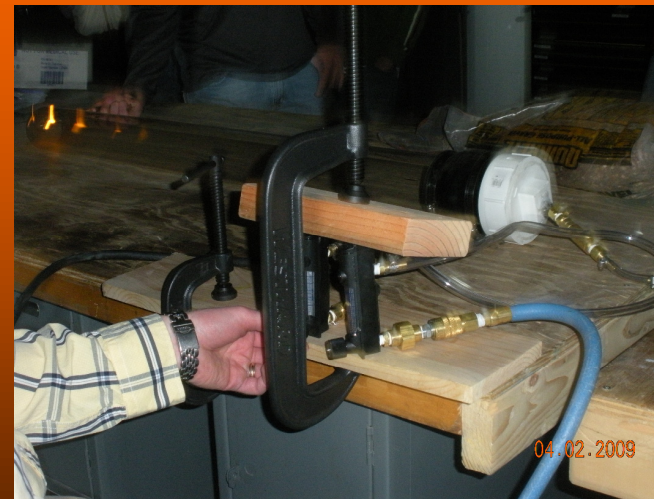


Fig. 2 Variable area flow meters are used to control the flow of both propane and air



Fig. 3 Flame stabilization occurs when the flow of both propane and air is stoichiometric