

## Whoosh Tube

### **INTRODUCTION:**

Some teachers ignite methanol vapours in a plastic 20-L container. Although they take appropriate safety precautions, I have always been nervous about any combustion in an enclosed space. The "Whoosh Tube" is a dramatic and (I believe) safer alternative. Under the right conditions, it looks (and sounds) like you are holding a "Star Wars" light sabre.

### **CHEMICAL CONCEPTS:**

Combustion  
The Chimney effect  
Vapor pressure

### **MATERIALS:**

A long transparent, fire-proof tube. I have used glass tubes from 0.5 m to 2 m in length and from 2.5 to 3.5 cm inner diameter. Although expensive, Lexan polycarbonate tubing combines heat resistance with durability. With every tube, be sure that the tube is free from evidence of any cracks or strains.

2 rubber stoppers (one for each end)  
Small flameproof tray  
A candle in a sturdy holder  
A pair of insulated gloves  
Safety glasses  
Rubbing alcohol (70% isopropyl alcohol 30% water)  
A long stick and a "tube sock"

### **PROCEDURE:**

Place a solid rubber stopper in one end of the long tube.  
Drip 2 to 5 mL of rubbing alcohol down the inside of the tube.  
Close the alcohol container.  
Close the open end with a stopper and roll the tube around to distribute the liquid alcohol and mix vapors with air.  
Place a candle in a small metal tray on the floor and light it.  
Put on gloves and have the room lights dimmed.  
Remove the top stopper from the tube.  
Move the lower end of the tube over the tray to contain any liquid alcohol and quickly remove the bottom stopper.  
Position the end of the tube over the candle and ignite the vapors.

The flame will travel up the tube and flare at the top. Other flame fronts will move up and down inside the tube creating resonant sounds as they pass the middle (if you are lucky!).

When the combustion is finished, insert an old athletic sock on the end of the stick and push the "tube sock" to the other end of the tube, pushing out the combustion products while drying the tube.

A warm tube will show different flame characteristics than a cool one, leading to discussion of the temperature dependence of vapor pressure.

## SAFETY PRECAUTIONS:

**[ The following are points to consider but are NOT complete safety instructions. As with any demonstration involving combustion, the demonstrator must use appropriate professional judgement and practices. ]**

Using Rubbing alcohol slows down combustion and leads to more interesting effects than using methanol in the tube. Although the flame is hotter, this fuel is more likely to burn inside the tube and less likely to explode than methanol

Remember that the blue flame shoots up the tube AND OUT THE OTHER END!

Be VERY sure that it is pointed in a safe direction and is far away from your own face and hair.

Any excess alcohol liquid will probably catch fire in the metal tray under the candle. Move away from that area to avoid igniting your clothing while you are concentrating on the fire in the tube!

Be sure this fire is out before picking up the tray.

NOTE: Although, the vapours are burning vertically and the pressure is exerted mainly out the end of the tube, there is always a chance that the glass might fail. Be aware of this and anticipate not only the risk to your eyes and clothing, but also where the hot flaming glass might fall if the tube breaks. Never use a tube with an ID narrower than one inch (2.54 cm), and never use an excess of alcohol. Use a sock to swab out the tube for the next performance.

.....Never flush out the tube with oxygen or add oxygen to the vapor mixture.

## DISCUSSION:

This is a dramatic demonstration of combustion.

The class sees you standing there holding a column of flame...and is impressed.

The demo can lead to all sorts of discussions... including the function of chimneys and why you do not wrap yourself in a fire-blanket!

With care, different alcohols can be used in the tube and the changes in flame characteristics can be discussed. I have tried methyl, ethyl and propyl alcohols and the best results are definitely from "rubbing alcohol" (70% isopropyl, 30% water). If you use a Lexan tube, stick with Rubbing alcohol. Even pure methanol creates enough heat to crack the inner surface of this hard plastic tube.

The next logical extension is to try to mix metal salts to the alcohol to achieve coloured flames. I DO NOT recommend this. A standard flame test uses a very small volume of vapor. The tube generates a lot of waste gases as the alcohol burns. In an enclosed area, it could add unacceptable levels of metal ions to the air. I have tried adding strontium and copper ions under good ventilation conditions and have had disappointing results with each type of ion. The barely visible colours do not justify the health risk.

