

## After Use

- After use, switch off at the gas supply and leave to cool to room temperature.
- Once cool, disconnect the rubber tubing from the gas supply, disconnect leads to the loudspeaker and store the tube in a safe location.

## Suggested Experiments

- Try running the signal generator with alternative waveform shapes.
- Driving the speaker with a suitable amplifier will allow you to play music through the tube for a true light and sound display (strong rhythmic bass tracks work best!).
- By using a microphone and amplifier you could call up some standing waves of your own making!
- Explanation of Standing Waves. The wavelength of a standing wave can be calculated by measuring the distance between two anti-nodes and doubling this value.
- Calculation of the Speed of Sound in gas (methane):  
**velocity (v) = f.λ**  
*(The frequency is known from the signal generator and the wavelength can be measured as above. It should come out around 490m/s for Methane gas)*

## Acknowledgements

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Idea inspired by Ian Galloway at the Science Learning Centre South East in Southampton.



# RUBENS' TUBE

SO116140



## The Benchmark Rubens' Tube

Please read all these instructions before attempting to operate the Ruben Tube.

### Health and Safety

- The tube can become very hot. Avoid touching during operation and leave to cool to room temperature after use. Do not attempt to move the tube when it is hot – leave about 20 minutes after use for the tube to cool down.
- To prevent damage to the Rubens Tube from overheating it is recommended not to operate the tube for more than 10 minutes at a time/
- Try to avoid conditions resulting in flame patterns with unlit holes. Under these conditions unburned gas may be released into the room. Always operate in a well ventilated, draft-free environment.
- Avoid the combination of low gas pressure and high sound pressure when air can be drawn into the tube.
- Before conducting any experiment it is necessary for the teacher in charge of the demonstration to create a full risk assessment.

### Additional Equipment Required

- Signal Generator with a Low Impedance Output (e.g. Timstar code SI86185)
- Red Rubber Bunsen Tubing (TU16766)

### Operating Instructions

- Site the tube centrally on a bench, close to a gas supply (preferably a laboratory gas tap), with the row of holes uppermost.
- Connect the low impedance output of a signal generator to the loudspeaker terminals. Ensure the waveform selected is sinusoidal. Leave the signal generator off or set on zero output until the row of flames has been adjusted.
- Attach a length of rubber tubing from the gas tap to the Ruben Tube gas inlet pipe.
- Open the gas supply and light the gas issuing from the holes at the inlet end of the tube. Flames should transfer along the length of the tube as they ignite in turn. Ensure all holes are ignited.
- Adjust the gas tap until the pressure provides a uniform line of flames. Aim for the tallest flames possible *without flickering*.
- Switch on the signal generator and drive the speaker at a moderate loudness in the 100 – 1 000 Hz range until resonance can be heard (loudness increases close to a specific frequency). Try to optimise the resonance effect by small adjustments of the frequency until peak loudness can be heard and/or maximum effect on the flame pattern can be seen.
- By careful adjustment of gas pressure, amplitude and frequency, a standing wave pattern should be seen clearly.
- Resonance and standing wave patterns occur at several specific frequencies, separated from one another by a fixed frequency interval. By noting the value of this interval, further, higher frequencies may be predicted and demonstrated.
- Demonstrating the Ruben Tube in a darkened room will enhance the display!