

ASCELLS

**RUBENS'
TUBE**

LA50-550

**PLEASE ENSURE ALL USERS
OF THIS APPARATUS HAVE
READ THESE INSTRUCTIONS
CAREFULLY**

INSTRUCTIONS FOR USE

RUBENS' TUBE LA 50-550

INTRODUCTION

This apparatus provides a dramatic visual presentation of wave motion based on the original apparatus designed by Henrich Rubens in 1905.

There are various safety precautions to be observed and these should be studied carefully before use.

The system uses the high and low pressures in a sound wave to vary the gas pressure and hence the flame height in the tube.

SAFETY PRECAUTIONS.

- * **Always wear eye protection.**
- * **Use a safety screen between the apparatus and students.**
- * **Use low gas pressure.**
- * **Use in an open area where there are no flammable materials.**
- * **Observe sensible precautions with naked flames.**
- * **Do not use for extended periods in excess of 15 mins. to avoid excessive temperatures.**
- * **AFTER USE**
- * **The main tube will be hot and should be handled with care.**
- * **Flush through with air to remove residual gas before storing.**

CONNECTING TO THE GAS SUPPLY

Natural gas or bottled LPG Propane or Butane can be used.

Connect the gas inlet pipe via a “Bunsen Burner” tube to the gas supply. Ensure that any tubes used are free from leaks and that the tube makes a gas-tight seal at both ends.

The gas pressures used are low to give best results. Use a gas flow similar to that used for a small Bunsen flame.

If the apparatus has been in frequent operation use the small drill provided to clear all the tube holes of carbon accumulations before turning on.

CONNECTING TO THE SIGNAL SOURCE

There are two 4mm sockets at the loudspeaker end which are used to connect the apparatus to a suitable source. A signal generator provides single constant frequencies. Use the loudspeaker terminals and either sine or square wave output. Best results are obtained in the 300—500Hz region (see later).

Music also gives interesting results. Modern MP3 players (typically with a 3.5mm stereo output jack plug) give moderate results but are best used with an amplifier. Suitable amplifiers can be found in some signal generators. Otherwise you will require an amplifier with a loudspeaker output (not headphone output) of 1 to 2W power. The best music to use has strong bass rhythms.

FIRING UP

With all the safety precautions in place and audio source connected (turn the output down to zero amplitude initially) turn on the gas very low and hold a flame above any gas hole. The flame height should be about 5cm. Light all the flames to obtain a uniform row of flames.

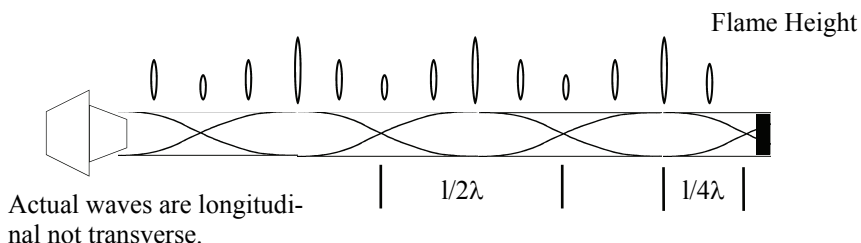
Increase the audio source amplitude and the flame heights will vary depending upon the source used. Best results are with gas flame heights in the region of 5 to 10cm and moderate amplitude signal sources. Try different music to get the best results and adjust the gas pressure so suit. See over for signal generator hints.

USING A SIGNAL GENERATOR

A signal generator provides a variable a.c. signal which is converted into longitudinal waves by the loudspeaker. Longitudinal waves consist of low and high pressure areas and these give pressure differences at the gas flames controlling their height.

Best results are obtained when there is a stationary wave in the tube. For this to occur the tube length has to relate to the signal frequency so that waves are reflected from each end of the tube in such a way that constructive interference occurs and nodes and antinodes occur in fixed positions.

The wavelength can be determined by measuring the distance between nodes or anti-nodes (see diagram below) and the speed of sound in gas determined from the equation $v = f \cdot \lambda$



Adjust the frequency of the source to get a good stationary wave with three or four nodes visible. For λ about 60 cm and $v = 300\text{ms}^{-1}$ the frequency is in the region of 500Hz.

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