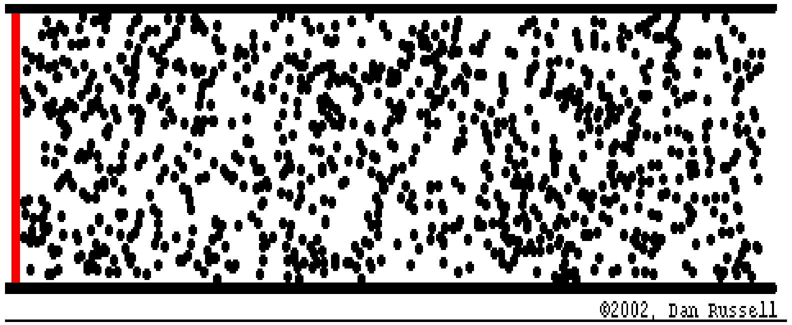
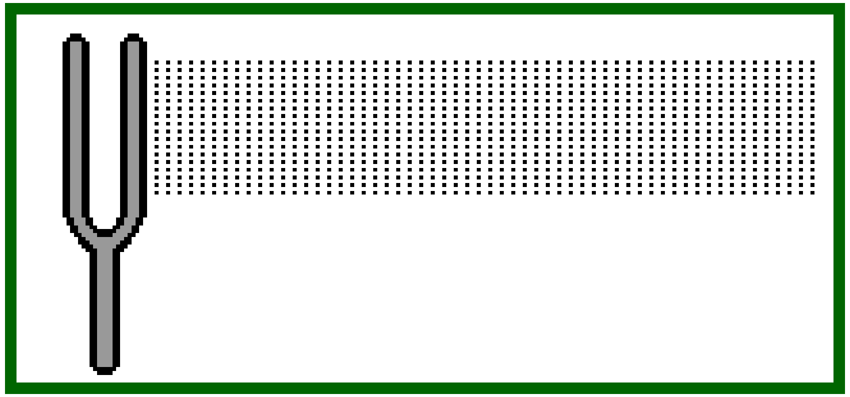
WHAT IS SOUND?

- Sound can be defined in two ways. [Physical or psychophysical]

  - ✓ Sound can be defined as a *wave motion* in air or other *elastic media*.

  - ✓ Or as excitation of the hearing mechanism that results in the *perception* of sound.





TRANSMISSION OF SOUND

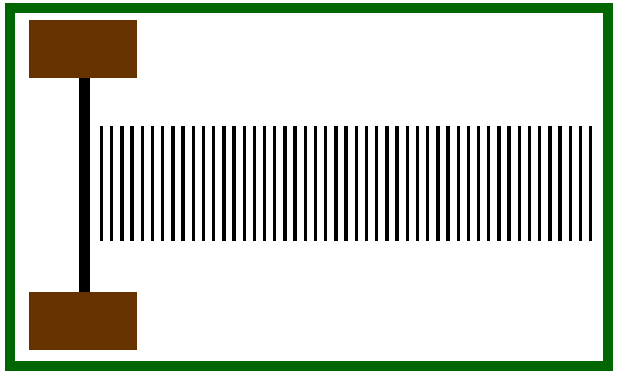
- Requires a medium with elasticity and inertia (air, water, steel, etc.)

- Movements of air molecules result in the variation of sound pressure causing the propagation of a sound wave

HOW SOUND IS PRODUCED?

- Energy in the form of sound is produced when a vibrating surface or object is contact with the air.

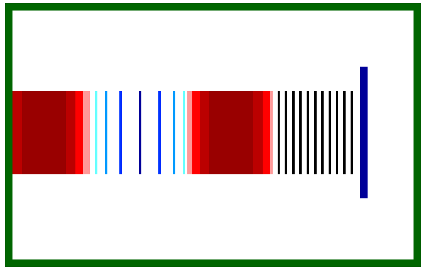
- Sources of sound
  - *Vocal*
  - *Plucked strings*
  - *Air column*
  - *Vibrating plate*



HOW SOUND IS PERCEIVED?

- Physical stimulation of the ear by the sound wave.

- Physiological and psychological processing and perception in ear and brain (psycho-acoustics) resulting from nerve impulses stimulating the acoustic cortex of the brain.

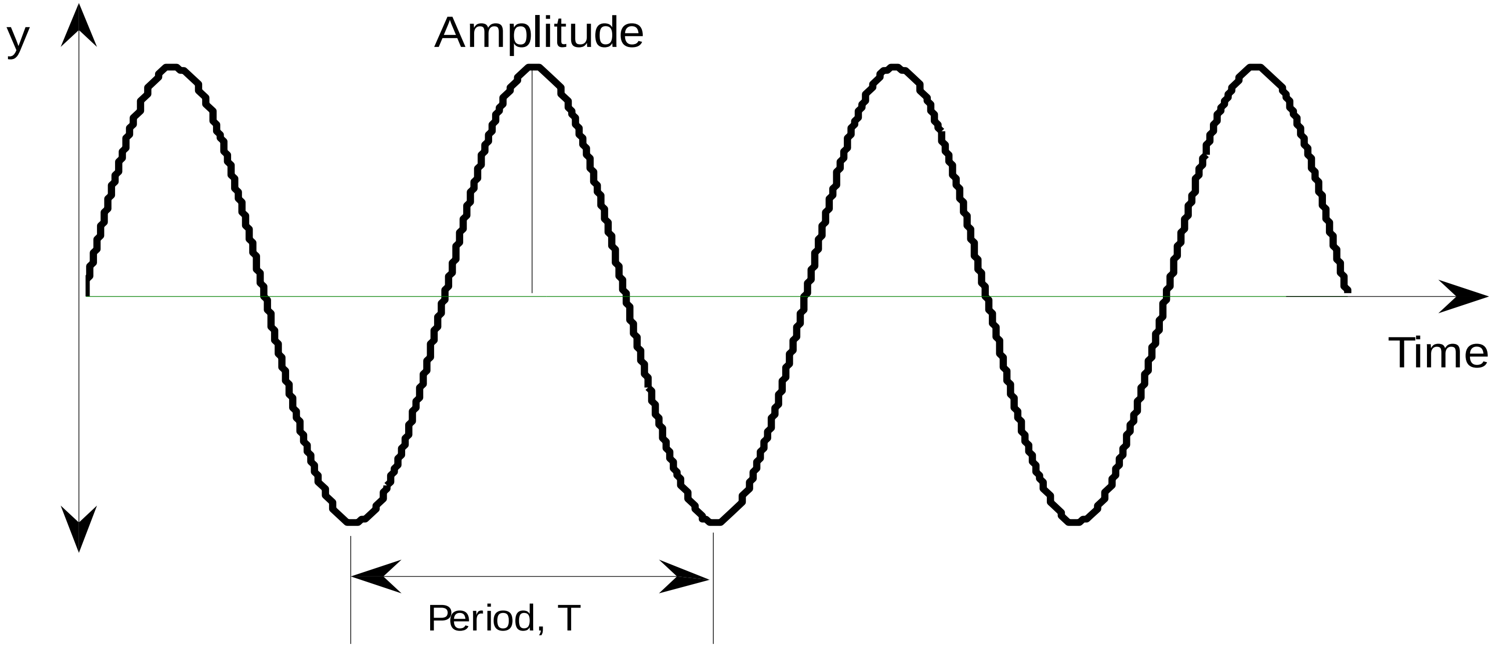


PROPERTIES OF SOUND

- **Amplitude**
- **Period**
- **Frequency**
- **Speed**
- **Wavelength**

PROPERTIES OF SOUND (CONT..)

- **Amplitude**



For a simple sine wave it is easy

PROPERTIES OF SOUND (CONT..)

Period (T)
is the time it takes to complete one full cycle

Frequency (f)
is the number of times per second a complete wave passes a point. The number of cycles per second is termed Hertz (Hz).

The period and the frequency are simply related by the following equation

$$T = \frac{1}{f} \quad \text{(seconds)}$$

PROPERTIES OF SOUND (CONT..)

Speed (c)

of sound in air is governed by density and air pressure which in turn relates to temperature and elevation above sea level.

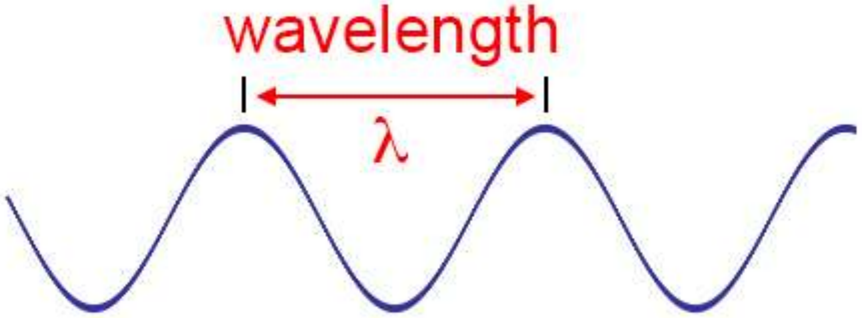
- **The speed of sound in air is approximately 343 m/s. Sound travels about 1 kilometre in 3 seconds.**

PROPERTIES OF SOUND (CONT..)

Wavelength (λ)-

is the length of one complete cycle, and is measured in metres (m).

It is related to the frequency (f) and speed of sound (c) by:
Wavelength (λ) = c/f metres



SOUND-MEASURING APPARATUS AND TECHNIQUES

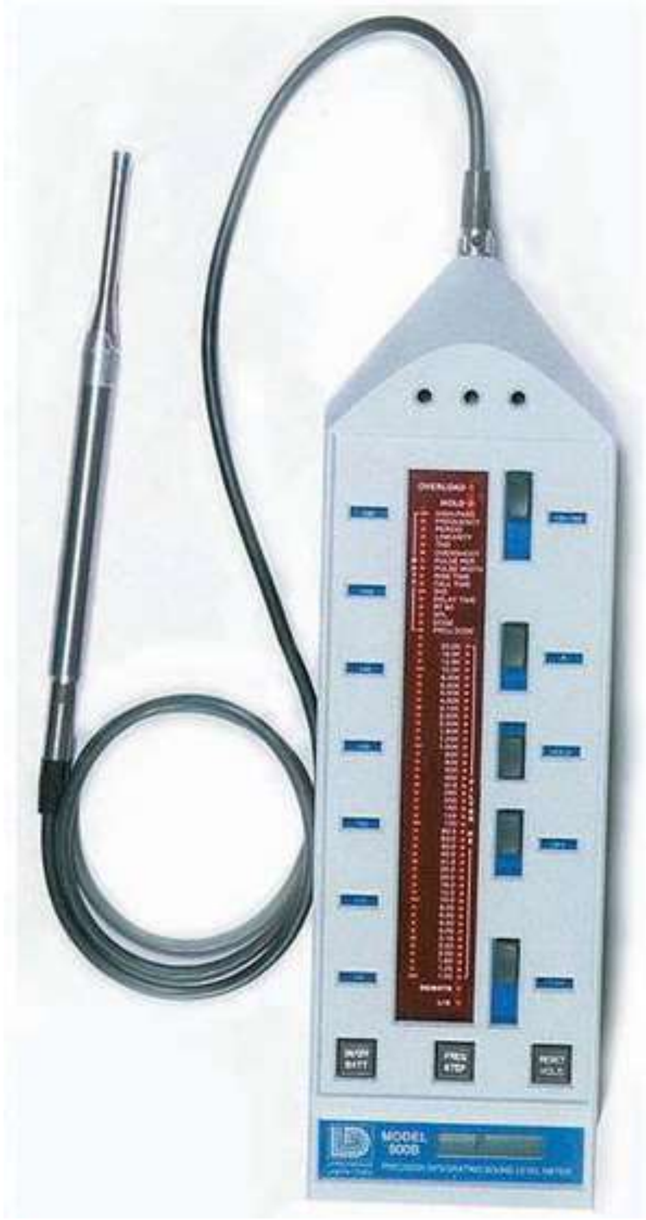
SOUND-MEASURING APPARATUS AND TECHNIQUES

- Measurement of the parameters associated with sound use a basic system made up of a detector-transducer (the microphone), intermediate modifying devices (amplifiers and filtering systems), and read-out means [a meter, CRO(Character Read Out), or recording apparatus].

- Most sound-measuring systems are used to obtain psychoacoustically related related information. Elaborate filtering networks also provide the basis for analyzers, devices for separating and identifying the various frequency components or ranges of components forming a complex sound.

Sound level meter with microphone extension, Although long discontinued, this has been a standard of the industry for firearm sound measurements.

pressure meter with microphone extension cord, preamplifier and microphone.



MICROPHONES

- ❖ Most microphones incorporate a thin diagram as the primary transducer, which is moved by the air acting against it. The mechanical movement of the diagram is converted to an electrical output by means of some form of secondary transducer that provides an analogous electrical signal.

- ❖ Common microphones may be classified on the basis of the secondary transducer, as follows:

1. Capacitor or condenser
2. Crystal
3. Electrodynamic (moving coil or ribbon)
4. Carbon

The capacitor or condenser microphone is probably the most respected microphone for sound measurement purposes.

We can use this formula for find out the output voltage:

$$E = Qd$$

Where,

E = The Voltage

Q = The charge provided by the polarizing voltage (relatively constant)

d = The separation of the plates.

SCHEMATIC OF THE CONDENSER-TYPE MICROPHONE

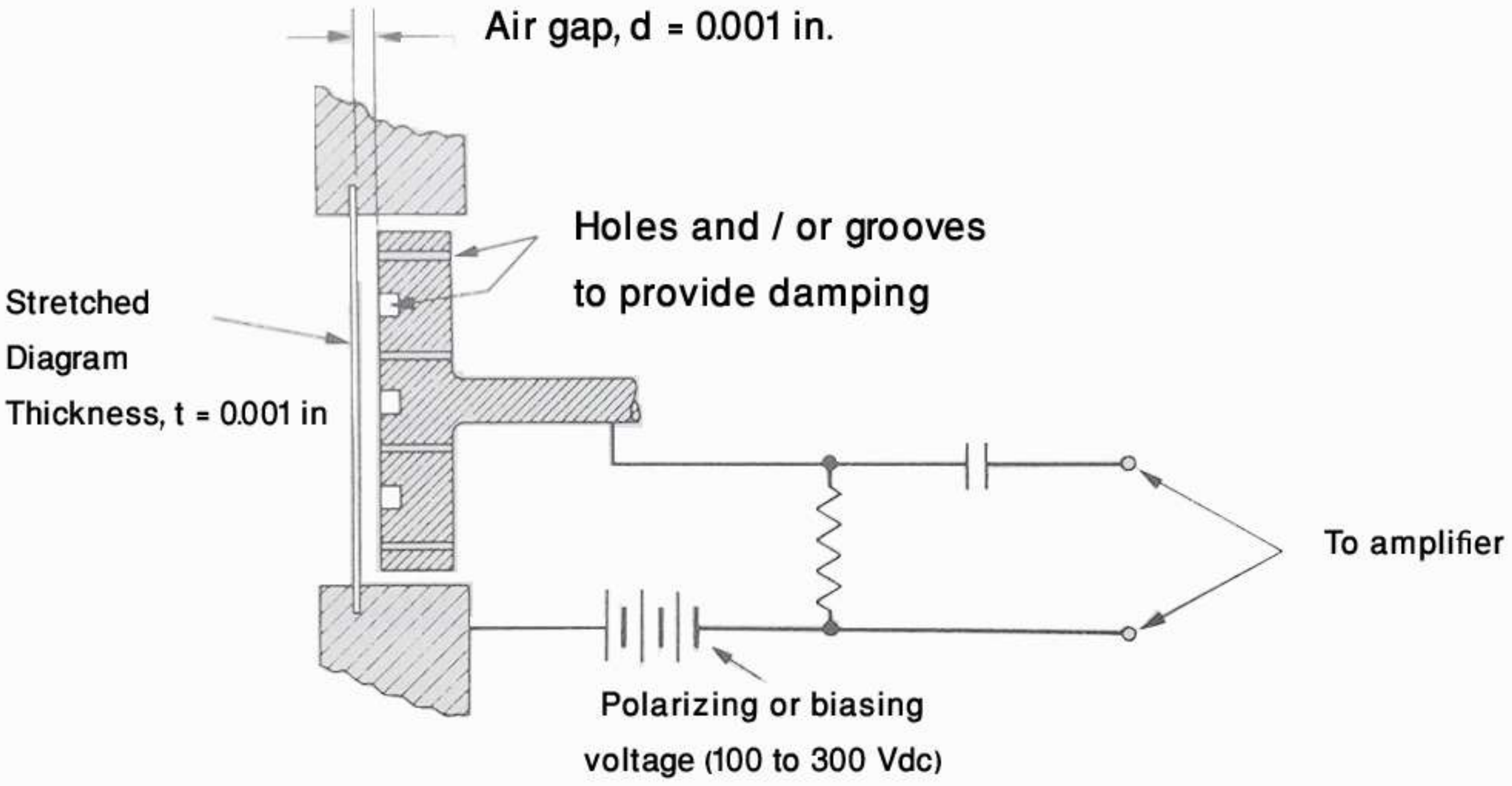


Fig: Schematic of the condenser-type microphone.

MICROPHONE SELECTION FACTORS

An ideal microphone used for measurement would have the following characteristics:

- ❖ Flat frequency response over the audible range.
- ❖ Non directivity.
- ❖ At the lowest sound level to be measured, output signal that is several times the system's internal noise level.
- ❖ Minimum dimensions and weight.
- ❖ Output that is unaffected by all environmental conditions except sound pressure.

THE SOUND LEVEL METER

The basic sound-level meter is a measuring system that senses the input sound pressure and provides a meter read-out yielding a measure of the sound magnitude.

The sound may be wideband, it may have random frequency distribution, or it may contain discrete tones. Each of these factors will, of course, affect the read-out.

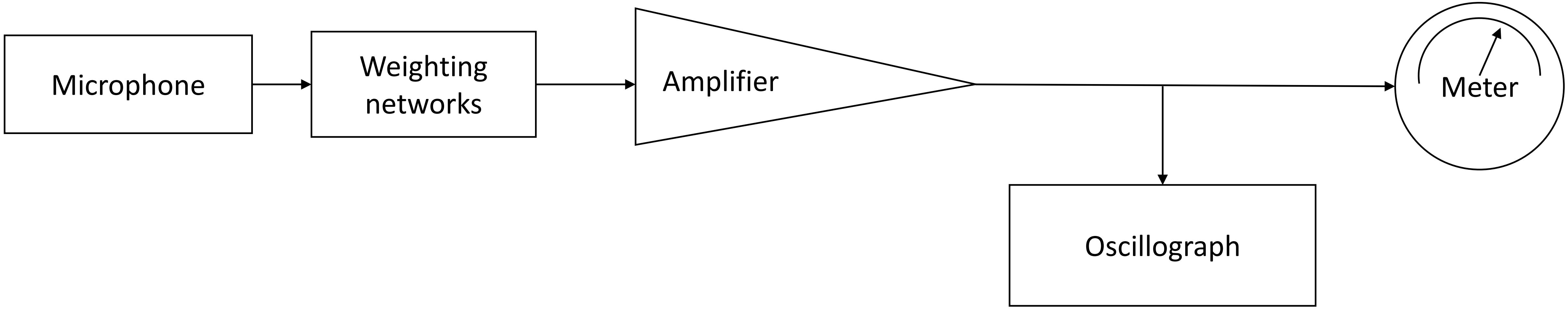


Fig: Block Diagram of a typical sound-level meter, or sound-level recorder

THE SPECTRUM ANALYZER

A spectrum analyzer measures the magnitude of an input signal versus frequency within the full frequency range of the instrument.

Spectrum analyzers usually display raw, unprocessed signal information such as voltage, power, period, wave, shape, sidebands, and frequency. They can provide you with a clear and precise window into the frequency spectrum.

Major blocks in a spectrum analyzer are:

1. RF input attenuator
2. Mixer
3. IF (Intermediate Frequency) gain
4. IF filter
5. Detector
6. Video filter
7. Local oscillator
8. Sweep generator
9. CRT display