

ULTRASONICS

The sound waves are divided into 3 categories depending up on their frequency:

1. Audible or sound waves: frequency between 20 Hertz and 20 kilohertz
2. Infrasonic waves: frequency less than 20 Hertz. These are not audible to human beings
3. Ultrasonic waves: frequency greater than 20 kilohertz, usually up to 500 megahertz. These are also not audible to human beings

Therefore, ultrasonic waves are longitudinal waves having frequencies greater than 20 KHz.

Properties of ultrasound waves:

- Ultrasonic waves are mechanical in nature and longitudinal in character.
- Ultrasonic waves have very high frequency or very small wavelength.
- These waves are highly energetic due to their high frequency.
- The velocity of propagation is equal to the wavelength times the frequency of the waves, $v = \lambda \cdot \nu$
- The velocity depends on medium density and elastic properties.

Formula: $v = \sqrt{E/\rho}$; where E = Young's Modulus, ρ = density

- Ultrasonic waves can be transmitted over a long distance without loss.
- Hard and homogeneous materials transmit ultrasonic waves more efficiently
- Optical laws like reflection, refraction, interference, diffraction, etc. are observed in ultrasonic waves to a small extent just like light waves.
- Ultrasonic waves undergo reflection at a boundary and the reflection coefficient is given by

$$R = \frac{Z_2 - Z_1}{Z_1 + Z_2}$$

Applications of ultrasonic waves

1. Flaw detection
2. SONAR exploration (sound navigation and ranging)
3. Cleaning
4. Soldering, welding, cutting, drilling
5. Medical field
6. Ultrasonic mixing