Through which medium does sound travel fastest solid liquid or gas

Distance traveled during a time drive from a sound wave that propagate through an elastic means for other uses, see the speed speed (disambiguation). Sound MeasurementScharacteriacTicisticSysschbolsÂ ¢ Platform Speed Pressure Pressure Pressing PL, SPL, Slip Particle Shift, Â «Sound Intensity - I, SilÂ ¢ Sound PowerÂ ¢ P, SWL, LWA Energy Energy Dense Dense Dense Dense Energy Dense Sounds Expert Expert Frequency Bargain Loss TLVTE The sound speed is the distance traveled by a unity of a sound wave as it propagates through an elastic half. At 20 ° C (68 Â ° F), the speed of the sound in the air is about 343 meters per second (1.235 km / h; 1,125 ft / s; 767 mph; 667 kN), or a kilometer in 2, 9 I know a mile in 4.7 s. It depends strongly from the temperature and from the vehicle through which a sound wave is propagating. At 0 Â ° C (32 Â ° F), the sound speed is 1.192 miles / h, 741 mph. [1] The speed of sound in an ideal gas depends only on its temperature and its composition. The speed has a weak dependence on the frequency and by the pressure in the ordinary air, deviating slightly from the ideal behavior. In the colloquial speech, the sound speed refers to the speed of sound waves in the air. However, the speed speed varies from substance to substance: typically, sound travels more slowly in gases, faster in liquids and faster in solids. For example, while the sound wanders at 343 m / s in the air, travel at 1.481 m / s in water (almost 4.3 times faster) and 5.120 m / s in iron (almost 15 times faster). In an exceptionally rigid material like the diamond, the sound travels at 12,000 meters per second (39,000 ft / s), [2] Â ¢ â‚¬ "about 35 times its speed in the air and on the fastest can travel in normal conditions . The sound waves in solids are composed of compression waves (just like in gas and liquids), and a different type of sound wave called cut wave, which occurs only in solids. The cutting waves in solids usually travel to Speeds different compared to compression waves, as exposed in seismology. The speed of compression waves in solids is determined by the compression of the medium, module and density and density. The speed of the cutting waves is determined only by the module And from the density of the cut of the solid material. In fluid dynamics, the speed of sound in a fluid (gas or liquid) is used as a relative measure for the speed of an object that moves through the medium. The relationship between The speed of an object at the speed of the sound (in the same vehicle) is called the MACH number of the object. The objects that move at speeds superior to sound speed (Mach1) is said to travel to supersonic speed. History Sir Isaac Newton's 1687 Principia includes a calculation of sound speed in the air as 979 feet per second (298 m / s). This is too low about 15%. [3] The discrepancy is mainly due to neglecting the effect (therefore unknown) of the rapid floating temperature in a sound wave (in modern terms, the compression of the sound wave and the expansion of the air is an adiabatic process , not an isothermal process). This error was later rectified by Laplace. [4] During the seventeenth century there were different attempts to measure the speed of the sound with precision, including the attempts of Marin Mersenne in 1630 (1,380 Parisian feet per second), Pierre Gassendi in 1635 (1,473 Parisian feet per second) and Robert Boyle (1,125 Parisian feet per second). [5] In 1709, Reverend William Derham, Upminster Rector, published a more accurate measure of sound speed, at 1,072 Parisian feet per second. [5] (Parisian foot was 325 mm. This is the longest standard of the standard "international foot" today, which was defined In 1959 as 304.8 mm, making the speed of the sound at 20 ° C (68 Â ° F) 1.055 Parisian feet per second). Derham used a telescope from the Tower of the Church of San Laurence, Upminster to observe the flash of a rifle at a distant rifle, and then measured the time until he heard the gunshot with a half-second pendulum. The measurements were made of shots by a number of local premises Including the northern Church of Okendon. The distance was known from triangulation, and therefore the speed that the sound had traveled was calculated. [6] Basic concepts The sound transmission can be illustrated using a model consisting of a series of spherical objects interconnected by Springs. In real material terms, the spheres represent the molecules of the material and the sources represent the obligations between them. The sound passes through the system by compressing and expanding the springs, transmitting acoustic energy to nearby spheres. This helps to transmit energy into turn to the adjacent sphere springs (bonds), and so on. The speed of sound through the model depends on the rigidity / rigidity of the sources and the mass of the spheres. As long as the spacing of the spheres remains constant, the most rigid springs / bonds transmit energy faster, while the larger spheres transmit the slowest energy. In a real material, the rigidity of the sources is known as "elastic module" and the mass corresponds to the density of the material. Since all other equal things (Ceteris Paribus), the sound will travel more slowly in spongy and fastest materials in more rigid ones. Effects such as dispersion and reflection can also be understood using this model. [Necessary quote] For example, the sound will travel 1.59 times faster in nickel than in bronze, due to the higher rigidity of nickel at about the same density. Likewise, sounds travel about 1.41 times faster in light hydrogen gas (protous) that in heavy hydrogen gas (deuterium), since Deuterio has similar properties but double density. At the same time, the "compression type" sound will travel more quickly in solids than liquids, and faster in liquids than gases, because the solids are more difficult to compress than liquids, while liquids, in turn, They are more difficult to compress of gases. Some textbooks mistakenly affirm that the speed speed increases with density. This notion is illustrated by presenting data for three materials, such as air, water and steel, each has a very different compressibility, which is more than compensating for density differences. An illustrative example of the two effects is that the sound travels only 4.3 times fastest in air water, despite the enormous differences in the two-media compressibility. The reason is that the greater density of the water, which works to slow down the sound in water relative to the air, almost compensates for the differences in compressibility in the two media. A practical example can be observed in Edinburgh when the "gun" of a part "is shot at the eastern end of Edinburgh Castle. Standing at the base of the western end of the castle rock, the sound of the gun can be heard through The rock, slightly before arriving from the air route, partly delayed by the slightly longer route. It is particularly effective if a multi-gun greeting as "the Queen's birthday" is fired. The compression and cut-impulse waves of Pressure or wave of compression type (longitudinal wave) are confined to a plane. This is the only type of sound wave traveling in fluids (gas and liquids). A pressure type wave can also travel in solids, together to other types of waves (transversal waves, see below) Cross wave that strikes initially confined in a plane. This additional type of sound wave (additional type of elastic wave) travels only in solids, eg RchÃ © requires a lateral cutting movement that is supported by the presence of elasticity in the solid. The side cutting movement can take place in any direction that is at a right angle towards the direction of the wave trip (only a cutting direction is shown here, at an angle right to the plane). Furthermore, Right angle cut direction can change over time and distance, resulting in different types of polarization of cutting waves in a gas or liquid, the sound consists of compression waves. In solids, the waves are propagated as two different types. A longitudinal wave is associated with compression and decompression in the direction of travel, travel, It is the same process in gas and liquids, with a similar wave of the compression type in solids. Only compression waves are supported in gas and liquids. An additional type of wave, transverse wave, also called cutting waves, occurs only in solids because only solids support elastic deformations. It is due to the elastic deformation of the medium perpendicular to the direction of march wave; The shear-deformation direction is called "polarization" of this type of wave. In general, transversal waves have as a pair of orthogonal polarizations. These waves (compression waves and the different polarization of cut waves) can have different speeds at the same frequency. Therefore, they arrive at an observer at different times, an extreme example being an earthquake, where the sharp compression waves arrive first and rocking transversal waves seconds. The speed of a compression wave in a fluid is determined by the comprimitivity and the density of the medium. In solids, compression waves are similar to those of fluids, depending on compression and density, but with the additional cutting factor of cutting module that affects compression waves due to exhausted elastic energetic loads that are able to influence voltage And effective relaxation in a compression. The speed of the cutting waves, which can only take place in the solids, is simply determined by cutting module of the solid material and the density. Equations The speed of sound in mathematical notation is conventionally represented by C, from the Latin Celeritas means "speed". For fluids generally, the speed of sound C is given by the newtonÂ ¢ laplace equation: c = k si, {displaystyle c = {sqrt {frac {k_ {}} {rho}}},} Where KS is a rigidity coefficient, the iso-andothropic mass module (or the mass elasticity module for gas); I {DisplayStyle Rho} is the density. Therefore, the speed of the sound increases with the rigidity (the resistance of an elastic body to deformation from an applied force) of the material and decreases with an increase in density. For ideal gases, the large K module is simply the gas pressure multiplied by the adiabatic adiabatic index, which is about 1.4 for the air in normal pressure and temperature conditions. For general status equations, if classical mechanics are used, the speed C speed can be derived [7] as follows: Consider the propagation of the sound wave at speed V {DisplayStyle V} through a tube aligned with the x { DisplayStyle X} Axis and a cross-sectional area of a {DisplayStyle A}. In the time interval T D {DisplayStyle DT} It moves length D X = V D T {DisplayStyle DX = VDT}. At scheme, the mass flow rate m e = i v a {displaystyle {dot {m}} = rho va} must be equal to the two ends of the pipe, then the flow mass j = i v = cost. A V D I = A I D V {DisplayStyle J = RHO V = COST, RMTARROW VD RHO = -. Rho dv}. For the second law of Newton, the gradient force provides acceleration: DVDT = Â ¢ 1 ID P DX Â ¢ d = P (A I DV) DXDT = (VD I) V Â ¢ V 2 to Â¡C 2 = d p di {displaystyle {begin {aligned} {frac {dv} {dt}} & = - {frac {1} {rho}} {frac {dp} {dx}} RIGHTARROW DP & = (- RHO DV) {frac {dx} {dt}} = (vd rho) v ^ \ ^ ^ ^ {2} and amb c ^ {2} = {frac {dp } {d}} end {aligned}}} and then: c = (Â ¢ pa i) s, {displaystyle c = {sqrt {left ({frac {p partial} {partial Rho}} Right) _ {s}}},} where p is pressure; I {DisplayStyle Rho} is the density and the derivative is taken istropically, which is, in parity of entropy s. This is because a sound wave travels so fast that its propagation can be approximated as an adiabatic process. If the relativistic effects are important, the sound speed is calculated by the equations of relativistic Euler. In a medium The sound speed is independent of sound frequency, so the transport speeds of energy and sound propagation are the same for all frequencies. The air, a mixture of oxygen and nitrogen, is a dispersive non-dispersive However, the air contains a small amount of CO2 which is a dispersive means, and causes air dispersion to ultrasonic frequencies (> 28 kHz). [8] In a dispersive half, the speed speed is the function of the sound frequency, through the dispersion relationship. Each frequency component propagates to its speed, called phase speed, while the energy of the propagates disturb the group speed. The same phenomenon occurs with luminous waves; See optical dispersion for a description. Dependence on the property of the medium The speed of the sound is variable and depends on the own properties of the substance through which the wave travels. In solids, transversal speed (or cut) waves vary depending on cutting deformation under cutting effort (called cutting module) and the density of the vehicle. Longitudinal (or compression) solid waves depend on the same two factors with adding a compressibility dependence. In fluids, compression and density only of the medium are important factors, since fluids do not transmit cutting stresses. In heterogeneous fluids, like a liquid filled with gas bubbles, liquid density and gas comprimitivity affect sound speed in an additive way, as demonstrated in the hot chocolate effect. In gas, adiabatic compressibility is directly related to the pressure through the thermal capacity ratio (adiabatic index), while the pressure and density are inversely proportional to temperature and molecular weight, thus making the properties completely independent of temperature and molecular structure Important (Thermal Report Capacity can be determined by temperature and molecular structure, but simple molecular weight is not enough to determine it). Propaga Sounds fast in low molecular weight as the helium that does more heavy gases like xenon. For monoatomic gases, the sound speed is about 75% of the average speed that atoms move in that gas. For a given ideal gas the molecular composition is fixed, and therefore the speed speed depends only on its temperature. At constant temperature, the gas pressure has no effect on the speed of the sound, as the density increases, and since the pressure and density (also proportional to pressure) have equal but opposite effects on the speed of sound, and the two contributions Delete exactly out. Similarly, compression waves in solids depend on both the compressibility and densityÂ ¢ equally in liquidsÂ ¢ except in gas the density contributions of the compressibility in such a way that a part of each factors attribute, leaving only a temperature dependence, molecular weight, and report of thermal capacity that can be derived regardless of temperature and molecular composition (see below derivations). So, for a single given gas (assuming that the molecular weight does not change) and for a small temperature range (so the thermal capacity is relatively constant), the speed speed becomes addicted only the gas temperature. In the non-ideal gas behavior, for which the Van der Waals gas equation would be used, proportional is not exact, and there is a slight dependence on the speed speed from the gas pressure. Humidity has a small but measurable effect on sound speed (making it increase of about 0.1% Â ¢ 0.6%), due to oxygen and nitrogen air molecules are replaced by more light water molecules. This is a simple mixing effect. Altitude variation and implications for atmospheric acoustics density and decrease in pressure evenly with altitude, but the temperature (red) does not. The speed of the sound (blue) only depends on the complicated temperature variation at altitude and can be calculated by it because isolated effects of density and pressure on the speed Sound cancel each other. The speed of the sound increases with the height in two regions of the stratosphere and thermosphere, due to heating effects in these regions. In the earth's atmosphere, the main main factor The speed of sound is the temperature. For a given ideal gas with constant heat capacity and composition, the speed of sound depends exclusively on the temperature; See details below. In this case ideal, the effects of the reduction of the density and the decrease in the pressure of the altitude are canceled each other, save for the residual effect of temperature. As the temperature (and therefore the speed of the sound) decreases with a growing altitude up to 11 km, the sound is aimed upwards, away from the listeners on the ground, creating an acoustic shadow to a certain distance from the source. [9] The decrease in sound speed with height is indicated as a negative sound speed gradient. However, there are variations in this trend greater than 11 km. In particular, in the upper stratosphere of about 20 km, the sound speed increases with height, due to an increase in temperature from the heating inside the ozone layer. This produces a positive speed of the sound gradient in this region. Another positive gradient region takes place at very high altitudes, in the thermosphere rightly appointed upper than 90 km. Practical formula for the approximation of the dry air speed in dry air based on the thermal capacity ratio (in green) against truncated taylor expansion (in red). The approximate speed of the sound in dry air (moisture 0%), in meters per second, at temperatures near 0 Â ° C, can be calculated by CAIR = (331.3 + 0.606 Â ¢