Ultrasonic Glossary

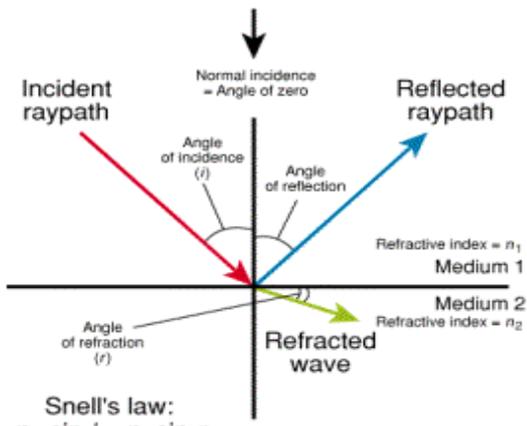|	
Accuracy	Is the maximum error between expected and actual position following a move. It can be linear or axial, and it includes the effects of backlash and hysteresis.
Acoustic Impedance (Z)	The product of velocity of sound in a material and density of the material. It is changes in acoustic impedance that reflect and refract ultrasonic energy. The metric unit is "kilograms per second per square meter."
Amplitude	Is the vertical height of the indication on an A-Scan display measured from the lowest to the highest point on the indication.
Attenuation	Loss of ultrasonic intensity as it passes through a material.
A-Scan	A method of data presentation on a display screen utilizing a horizontal base line, which indicates elapsed time reading from left to right. A vertical deflection in the base line indicates reflected signal amplitude.
Backlash	Is the amount of play (lost motion) between a set of moveable parts.
B-Scan	An ultrasonic presentation of a cross-sectional view or image of the material under test.
Back Reflection	Indication of the echo from the far boundary of the material under test.
Band-Pass	Frequencies within the acceptable limits of a filter. The term is commonly used as an adjective, as in "band-pass filter," to denote a filter that passes a range of frequencies unaltered while rejecting frequencies outside the range.
C-Scan	An ultrasonic data presentation, which provides a plain view image of the area selected by a data gate set in the A-Scan. The image can be a representation of the amplitude variations or the depth relationship of the indications detected by the data gate.
Calibration	The process of comparing an instrument or system with a standard to determine accuracy or produce a scale.
Certification	With respect to NDT personnel and AWS D1.1, certification is a "written statement of qualification" from the employer of the NDT technician. The employer's written practice will document the requirements for acquiring the certification.
Compressional Wave	Those waves in which the particle motion of the atoms of the material is essentially in the same direction as the wave propagation. Also known as longitudinal wave.
Couplant	Any material, usually a liquid or semi-liquid, used between the face of the transducer and the test surface to permit or improve transmission of the ultrasonic vibration from the transducer to the material under test.
Cycle	One complete set of recurrent values of a periodic quantity comprises a cycle. In other words, any one set of variations starting at one condition and returning once to the same condition is a cycle.
Damping Control	A control, which varies the duration of the ring of the transducer.
Data Gate	An electronic or software means of selecting a segment of the time range for monitoring or further processing.
dB (Decibel)	The fundamental unit of sound intensity. A logarithmic function of the ratio of the obtained amplitude to the reference amplitude.

Dynamic Range	The ratio of maximum to minimum size of reflection area that can be adequately distinguished on the A-Scan display at a constant gain control.
Echo	Indication of reflected energy.
Fast Fourier Transform	An iterative computer algorithm to perform the Fourier transform of digitized waveforms rapidly. A set of mathematical formulas used to convert a time function to a function in the frequency domain (Fourier analysis) and back (Fourier synthesis). The function is expressed as a convergent trigonometric series, similar to that first formulated by French mathematician Jean-Baptiste-Joseph, Baron Fourier (1768 to 1830). The Fourier transform is used extensively in signal processing to design filters and remove coherent noise. Many filtering operations are performed in the frequency domain.
Focused Beam	Converging energy of the sound beam at a specific distance.
Frequency	The number of cycles per second of a wave (i.e. sound wave), measured in cycles per second, or hertz.
Full Screen Height	The highest point on an A-Scan display used for evaluation and recording purposes, designated as 100%.
Gain Control	A control, which varies the amplification of the ultrasonic system. Also considered the sensitivity control. Units are in decibels.
Hertz (Hz)	A unit of frequency equivalent to the "cycle-per-second" (cps). One Hertz (1 Hz) equals 1 cps.
Interface	The boundary between two materials, which are in contact with each other.
Kilohertz (KHz)	A unit of frequency equivalent to one thousand "cycles-per-second" (cps). One Kilohertz (1 KHz) equals 1,000 cps.
Longitudinal Wave	(Also known as a compression wave or "straight beam") Wave propagation in which the particles of the medium in which a wave is traveling are disturbed or move in the same direction as the sound energy, e.g., sound moves left to right, particles move left to right. The wave is composed of compressions, where the particles are closer together than normal, and rarefactions, where the particles are farther apart than normal.
Megahertz (MHz)	A unit of frequency equivalent to one million "cycles-per-second" (cps). One Megahertz (1 MHz) equals 1,000,000 cps.
Modulus of Elasticity (Young's Modulus)	A measure of the stiffness of a material, the MOE is the ratio of stress to strain in the elastic region of strain. It is measured in the same units as stress, that is, psi in English units or megapascals in the metric system. Steel has a modulus of elasticity of approximately 29,000,000 psi or approximately 200,000 megapascals.
Piezo-Electric Ceramic	A material made of crystalline substance, which creates charges of electricity by the application of pressure and vice versa.
Piezoelectric	Having to do with systems driven by the effect of certain crystals, such as lead-zirconate-titanate, and other materials, which expand and contract in an alternating (charged) electrical field.
Probe	A sensing element used in non-destructive testing and measuring. Also known as transducer.
Pulse-Echo	A technique in which an ultrasonic transducer, in transmit mode, emits a high-frequency acoustic pulse towards the sample wall, where it is reflected back to the same transducer operating in receive mode. The measurement consists of the amplitude of the received signal, the time between emission and reception, and sometimes the full waveform received.

Reflection	The phenomenon by which a wave strikes a boundary and changes the direction of its propagation.
Refraction	The change in the direction of propagation of a sound wave resulting fro the passage of that wave from one medium to another medium having different acoustic properties. The change in velocity is accomplished by change in angular direction of propagation.
Repeatability	Is a measure of how close a positioning system can return to a given starting point. To eliminate the effects of backlash and hysteresis, the actuator must approach the target position from the same direction, at the same speed and deceleration rate, and under the same load conditions.
Resolution	The ability to clearly distinguish signals obtained from two reflective surfaces with a minimum difference in either depth, or spatially.
Resonant Frequency	The frequency at which a piezo-electric ceramic will vibrate most efficiently i.e. will produce the highest output with the least amount of voltage applied.
Ringing	Analogous to the ringing of a bell, it is the rise and decay time before and after the transducer reaches maximum amplitude. Expressed as the mechanical Q of the transducer, which is the number of cycles it takes to get up to 90% of maximum amplitude, or down to 10% above zero amplitude.
Scanning	The moving of the transducer along a test surface to obtain complete testing of the entire volume of the material being tested.
Sensitivity	The measure of the ability of the ultrasonic equipment to detect discontinuities.
Snell's Law	The mathematical description of refraction, or the physical change in the direction of a wave front as it travels from one medium to another with a change in velocity and partial conversion and reflection of a P-wave to an S-wave at the interface of the two media. Snell's law, one of two laws describing refraction, was formulated in the context of light waves, but is applicable to ultrasonic waves. It is named for Willebrord Snell (1580 to 1626), a Dutch mathematician. Snell's law can be written as: $$n_1 \sin \iota = n_2 \sin r,$$ where n_1 = refractive index of first medium n_2 = refractive index of second medium $\sin \iota$ = sine of the incident angle $\sin r$ = sine of the angle of refraction.

Shear Wave (Also known as transverse wave or "angle beam")	Wave propagation in which the particles of the medium in which a wave is traveling are disturbed or move in a direction perpendicular (or "normal) to the direction of travel of the sound energy, e.g., sound moves left to right, particles move up and down or in and out.
"Time-of-Flight"	Technique for calculating the distance to a target by using the timing of the return echo from target utilizing the speed of sound in the medium between the two reference points.
Through Transmission Testing	A test procedure in which the ultrasonic vibrations are emitted by one transducer and received by another at the opposite surface of the material being tested.
Transducer	In ultrasonic testing, a device containing a piezo-electric material used for introducing vibrations into the material to be tested and receiving the vibrations reflecting from the material. The active element of the transducer is defined as the effective transmitting area.
Ultrasonic	Having to do with frequencies of sound above normal human hearing, generally accepted to be at 20KHz and above. Ultrasonic non-destructive testing is typically done in the frequency range of 1 MHz and above.
Velocity (V)	The speed at which the sound wave travels through the test material.
Water Path	The distance from the transducer to the test surface in immersion testing.
Waveform	The shape of a wave, typically shown as a graph of amplitude (or other quantity of interest) versus time.
Wavelength (?)	For a longitudinal wave, the distance from the start of one compression or rarefaction to the start of the next compression or rarefaction. For a shear wave, the distance between successive peaks in the perpendicular motion of the particles of the medium. Wavelength is defined as $?=V/f$. V = Material Velocity, f = Transducer Frequency.
Wave Train	A succession of ultrasonic waves arising from the same source, having the same characteristics, and propagating along the same path.
Written Practice	With respect to NDT, this is a document that providers of NDT services use to establish the procedures for the control and administration of NDT personnel training, examination and certification.