This glossay is a conglomerate of several people's opinions.

As of today, these definitions have not been published by any organization, though they have been submitted to ASME and to IIW.

Proposed Phased Array Glossary

1. **Angle Corrected Gain**: also called ACG. This is compensation for the variation in signal amplitudes received from a constant soundpath during S-scan calibration. The compensation is typically performed electronically at multiple depths. Note that there are technical limits to ACG, i.e. beyond a certain angular range, compensation is not possible.
2. **Beam steering**: the ability of a phased array system to electronically sweep the beam through a range of incident angles without probe movement.
3. **Dead elements:** elements in an array that are no longer active. Dead elements may influence the construction of the ultrasonic beam.
4. **Depth focusing**: focusing over a larger range than conventional transducers by electronically adjusting the beam.
5. **Electronic scan**: Also termed an E-scan, swept index point, or electronic raster scanning. Note: in some industries, an E-scan is referred to as a “linear scan”. The same focal law is multiplexed across a group of active elements; E-scans are performed at a constant angle and along the phased array probe length. E-scans are equivalent to a conventional ultrasonic probe performing a raster scan. For angle beam scans, the Focal Law typically compensates for the change in wedge thickness.
6. **Focal Law**: Strictly, a mathematical formula used for firing the phased array instrument. More generally, a file containing the entire set of hardware and software parameters for phased array operation, which defines the elements to be fired, time delays, voltages, for both the transmitter and receiver functions.
7. **Linear scan**: Also called a one-line scan in some industries. A single pass mechanical scan parallel to the weld or region to be inspected.
8. **Multiple group**: Also called multi-group. Firing and displaying multiple scan patterns during a single scan, e.g. combinations of S-scans, E-scans, TOFD using different parameter sets or exit positions, and possibly with more than one array.
9. **Phased array**: The phased array technique is a process wherein UT data is generated by constructive phasal interference formed by multiple elements controlled by accurate time delayed pulses. The arrays can perform beam sweeping through an angular range (S-scans), beam scanning at fixed angle (E-scans), beam focusing, lateral scanning and a variety of other scans depending on the array and programming. Each element consists of an individually wired transducer, with appropriate pulsers, multiplexers, A/D converters, and the elements are acoustically isolated from each other. The phased array system is computer-controlled, with software typically user-friendly such that the operator can simply program in the required inspection parameters. Usually, a wedge is used to optimize inspection angles and minimize wear. Phased arrays are particularly useful for regions with limited access, rapid inspection of components such as welds, imaging and storing data, and sizing cracks by tip diffraction.
10. **Probe types**:
    a. **Annular array probes**: Phased array probes that have the transducers configured as a set of concentric rings. Annular array probes allow the beam

to be focused to different depths along an axis. The surface area of the rings is in most cases constant, which implies a different width for each ring.

   b. **Circular array probes:** elements on a cylinder, for tube inspection from the inside without mirror.
   c. **Convex array probe:** A curved array probe designed typically for inspection from the inside of tubes.
   d. **Concave array probe:** A curved array probe designed typically for inspection from the outside of tubes.
   e. **Daisy array probe:** Daisy array probes are effectively a linear array curved into a circle such that the ultrasound is emitted along the axis of the circle/cylinder. This type of array can be used with a mirror to inspect from the inside of tubes.
   f. **Linear array probes**: Probes made using a set of elements juxtaposed and aligned along a linear axis. They enable a beam to be rastered, focused, swept and steered along a single azimuthal plane (active axis) only.
   g. **Matrix array probes**: These probes have an active area divided in two dimensions using different elements. Matrix array probes are typically in a checkerboard format, though other designs are used. These probes allow ultrasonic beam steering etc. in multiple planes.
   h. **Sectorial array probe:** an annular array probe in which the annular rings are subdivided into multiple elements.
   i. **Sparse matrix array:** A matrix array containing less than 100% elements such that effective gaps occur between elements. Sparse arrays are typically used in larger arrays where instrumentation and array costs are significant.
   j. **TRL PA:** Transmitter-Receiver Longitudinal wave Phased Array probe. A dual array probe generating longitudinal waves primarily used for austenitic metal inspections.

11. **Refracted Steering Angle:** Deviation relative to the natural refracted angle.
12. **Sectorial scan**: Also termed an S-scan, swept angle scan, or azimuthal scan. This may refer to either the beam movement or the data display. As a data display, it is a 2D view of all A-scans from a specific set of elements corrected for delay and refracted angle. When used to refer to the beam movement, it refers to the set of focal laws that sweeps through a defined range of angles using the same set of elements.
13. **Terminology for Array Probes**:
   a. **Grating Lobe**: Undesirable lobes of ultrasonic energy caused by the regular, periodic spacing of array elements.
   b. **Active Aperture**: The size of the group of active acoustic elements.
   c. **Axial Resolution**: The ability to distinguish closely spaced reflectors that lie in a plane perpendicular to the ultrasonic beam's direction of propagation.
   d. **Cross-Coupling:** Also called "cross-talk". An undesirable condition where array elements are activated, electrically or acoustically, by adjacent elements.
   e. **Element Width:** In a rectangular element, the acoustic element's short dimension.
   f. **Element Length:** In a rectangular element, the acoustic element's long dimension. See Passive Aperture.

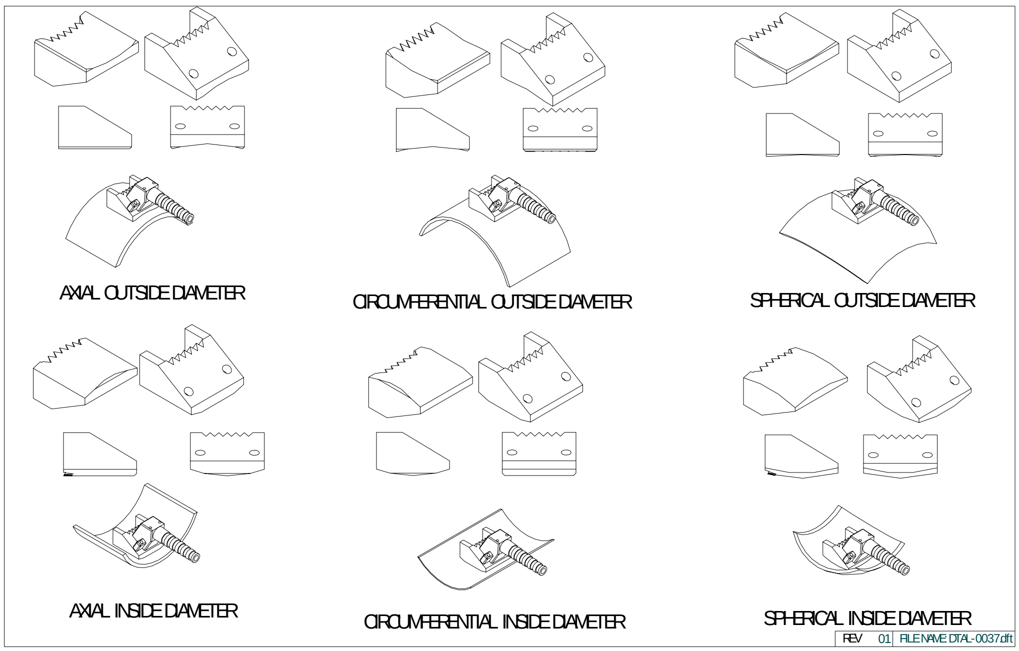
g. **Element Pitch:** The distance between the centers of two adjacent array elements.
h. **Elevation**: The same as Passive Aperture.
i. **Elevation focus:** focusing a transducer in the passive direction by either applying a lens or by shaping the ceramic
j. **Lateral Resolution**: The ability to distinguish closely spaced reflectors that lie in a plane parallel to the ultrasonic beam's direction of propagation.
k. **Passive Aperture**: The dimension of an array element's length.
l. **Saw cut:** Also called "kerf". The space between adjacent elements
m. **Virtual Probe**: A group of individual array elements, pulsed simultaneously or at phasing intervals to generate a larger acoustic aperture.

12. Skew: the ability of the phased array probe to deliberately skew the beam away from the main axis. This capability requires a matrix array or 2D array.

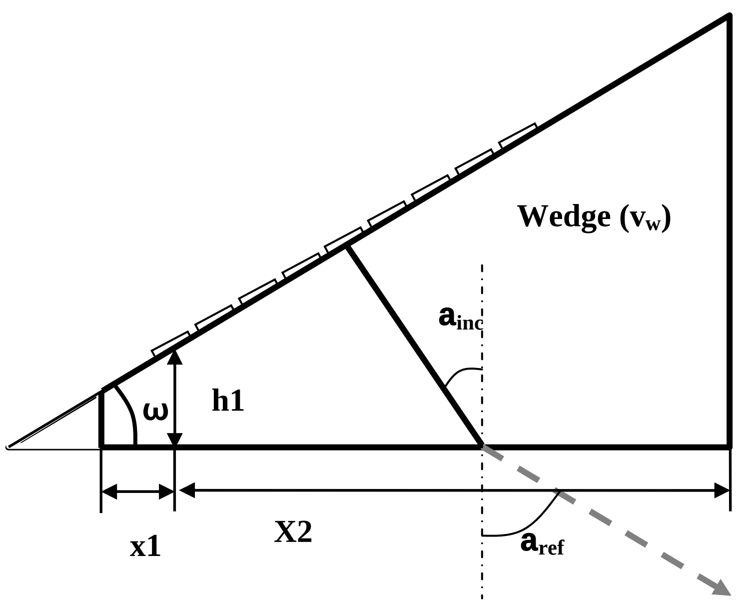
14. **Wedge Parameters for Phased Array Probes:**

a. **Coupling:** method for keeping the wedge to test material interface wet or coupled. Also called **irrigation**.
b. **Contoured wedges:** These are wedges machined to match the contour of the component, for example, curved to match a pipe circumference.
c. **Wedges can be contoured in more than one dimension.** (See pictures for examples)
d. **Dual Array Wedge:** Wedge made to accommodate two phased array crystals. These are generally used in a pitch-catch application. They also normally have a barrier dividing the wedge in half**.**
e. **Height of first element:** The linear dimension from the contact face of the wedge vertically to the centre of the first element. (See picture below.)
f. **Lateral array wedge:** array wedge used with the array mounted 90 degrees to the normal array wedge mounting. The resulting beam is fixed in the incident plane while it is steered as to skew the beam
g. **Natural refracted angle;** the (unsteered) angle of the refracted beam into a given material
h. **Normal array wedge:** array wedge used with array mounted so that when the array is steered, the resulting beam is steered to vary the incident angle
i. **Refracted Steering Angle:** The refracted angle (+/-) excursions the wedge is designed to produce in the test material beyond the nominal refracted angle produced from the wedge angle
j. **Roof angle:** in a complex angle wedge, the roof angle is the minor angle, while incident angle is the major angle (see picture)
k. **Squint Angle:** rotation of the phased array transducer on the wedge (see picture
l. **Wedge Angle:** The incident angle of a wedge as referenced to the normal longitudinal axis.
m. **Wedge Velocity:** The longitudinal wave speed of the wedge material.
n. **(x_1):** Distance from back end of wedge to projected centre of first element: (See picture below.)

o. **(x_2):** Distance from projected centre of first element to 'diffuser' or the thick end of the wedge. The diffuser is usually serrated to diffuse unwanted internal echoes.



Schematic of various wedge types



Schematic of wedge and dimensions

Miscellaneous

1. **Code**: Legal document specifying key requirements of inspection, e.g. coverage, angles, calibration etc.
2. **Loop Gain Sensitivity:** the normalised relative efficiency of the transmitting and receiving capabilities of a piezoelectric material;

$$S\ (dB) = 20 \log V_x / V_0$$

where V_x is the amplitude of the received signal in volts, and where V_0 is the amplitude of transducer excitation in volts.

3. **Procedure**: Written document that defines how the technique will be carried out in practice, which defines all the critical parameters that need to be reported.
4. **Standard**: A standard is a written document assembled by recognized experts, with the purpose of recommending actions to achieve certain objectives. A standard is usually enforced or given authority by an organization or agency. When a set of standards is incorporated into law, and thereby enforceable legally, it is considered a code.
5. **Technique**: The details of how the inspection will be performed, or a specific way of utilizing an NDT method.
6. **Technology**: Generic concepts and related electronics that make equipment work.

Depth Focusing: is one of several focusing options available to phased array probes. Focusing may be at a specific plane, such as (True) Depth, Projection (vertical plane) or some other Focal Plane focus. The other option is to focus at a fixed sound path. In all cases, the ability to focus is a function of the near zone of the beam and can only occur for sound paths less than the near field of the unfocused aperture.

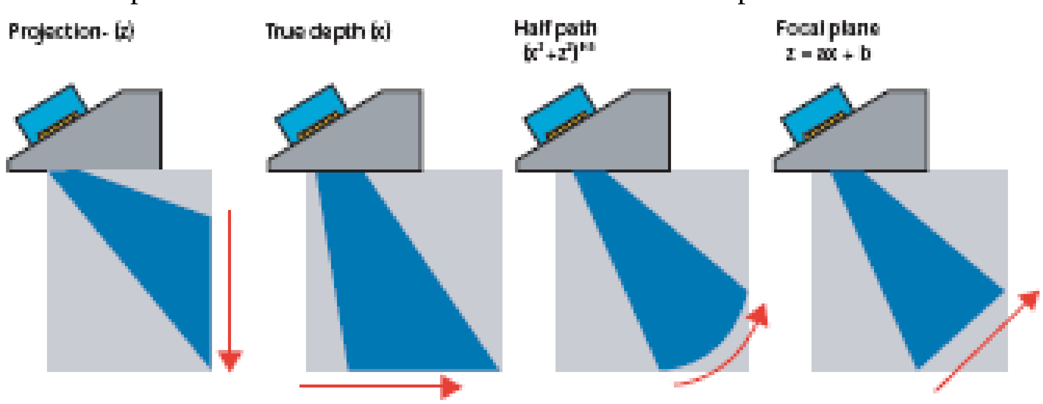


Figure 3-28 Type of focusing for linear phased array probe.

Dynamic Depth Focusing:

Dynamic depth focusing (DDF) is a programmable, real-time array response on reception by modifying the delay line, the gain, and the excitation of each element as a function of time (see Figure 3-33). DDF replaces multiple focal laws for the same focal range by the convolution of the emitted beam with separate "focused beams" at the receiving stage. In other words, DDF dynamically changes the focal distance as the signal returns to the phased array probe. DDF significantly increases the depth-of-field and SNR.

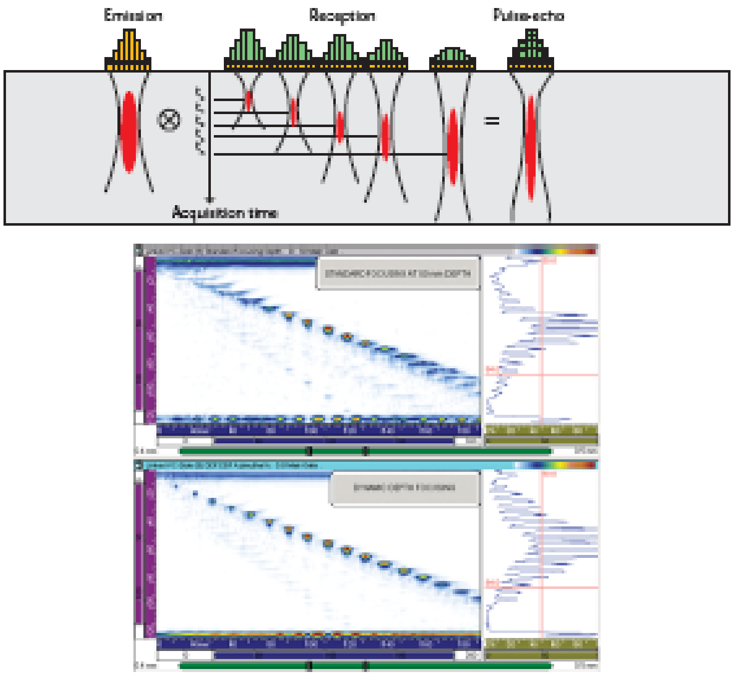


Figure 3-33 Dynamic depth focusing (DDF): (a) principle-resulting beam by convolution; (b) comparison between standard phased array focusing and DDF on the depth-of-field. Note the detection of two SDH in the near-surface zone by DDF and missed by standard phased array focusing.