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Non-destructive testing — Ultrasonic testing — Vocabulary

Essais non destructif — Contrôle par ultrasons — Vocabulaire

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Foreword

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ISO 5577 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 138, *Non-destructive testing*, in collaboration with ISO Technical Committee TC 135, *Non-destructive testing*, Subcommittee SC 3, *Ultrasonic testing*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 5577:2000), which has been technically revised with changes to terms and definitions and structure.

Non-destructive testing — Ultrasonic testing — Vocabulary

1 Scope

This document defines the terms used in ultrasonic non-destructive testing and forms a common basis for standards and general use. This document does not cover terms used in ultrasonic testing with phased arrays.

NOTE Terms for phased array ultrasonic testing are defined in EN 16018.

2 Normative references

There are no normative references in this document.

3 Terms related to frequencies, waves and pulses

For the purposes of this document, the terms and definitions given in this clause and those given in Clauses 4, 5 and 6 for sound, test equipment and ultrasonic testing apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1 Frequencies

3.1.1
frequency
number of cycles per second

Note 1 to entry: Expressed in Hertz (Hz).

3.1.2
nominal frequency
probe frequency
frequency (3.1.1) of the *probe* (5.2.1) as stated by the manufacturer

3.1.3
test frequency
effective ultrasonic frequency of a system used to test a material or object

3.1.4
frequency spectrum
distribution of *amplitude* (3.2.2) in relation to *frequency* (3.1.1)

Note 1 to entry: See Figure 1.

3.1.5
centre frequency
arithmetic mean of the cut-off frequencies

Note 1 to entry: See Figure 1.

3.1.6
peak frequency
frequency (3.1.1) at which the maximum amplitude is observed

Note 1 to entry: See Figure 1.

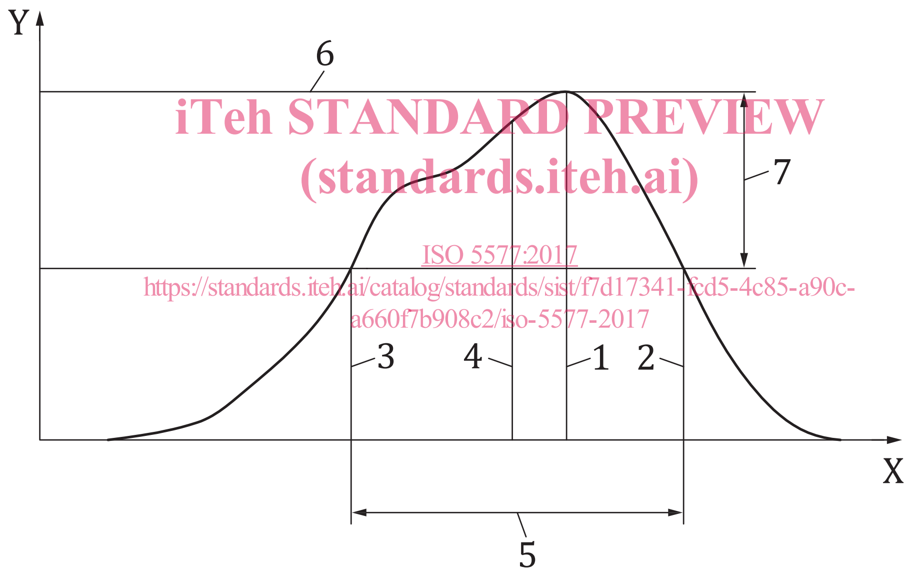
3.1.7
cut-off frequency
frequency (3.1.1) at which the *amplitude* (3.2.2) of transmitted signal has dropped by a specified amount from the amplitude at *peak frequency* (3.1.6), for example, by 3 dB

Note 1 to entry: See Figure 1.

3.1.8
bandwidth
width of the *frequency spectrum* (3.1.4) between the upper and lower cut-off frequency

Note 1 to entry: See Figure 1.

3.1.9
relative bandwidth
ratio of the *bandwidth* (3.1.8) to the *centre frequency* (3.1.5), in per cent



Key

X frequency
Y amplitude
1 peak frequency
2 upper cut-off frequency
3 lower cut-off frequency
4 centre frequency
5 bandwidth at specified amplitude drop
6 peak amplitude
7 specified amplitude drop

Figure 1 — Terms related to frequency and bandwidth

3.2 Waves and pulses

3.2.1
ultrasonic wave
any acoustic wave having a *frequency* (3.1.1) higher than the audible range of the human ear, generally taken as higher than 20 kHz

3.2.2
amplitude
absolute or relative measure of a sound wave's magnitude

3.2.3
phase
momentary condition of a vibration expressed as an arc measurement or an angle

3.2.4
wavelength
distance between consecutive corresponding points of the same *phase* (3.2.3)

Note 1 to entry: See Figure 2.

3.2.5
wavefront
continuous surface joining all the most forward points of a wave that have the same *phase* (3.2.3)

3.2.6
time-of-flight
TOF
time it takes an ultrasonic pulse to travel from the transmitter probe through the test object to the receiver probe

3.2.7
pulse
electrical or ultrasonic signal of short duration

3.2.8
pulse amplitude
maximum amplitude of a *pulse* (3.2.7) (peak-to-peak)

Note 1 to entry: For rectified pulses (A-scan), baseline-to-peak.

3.2.9
pulse rise time
time taken for a *pulse amplitude* (3.2.8) to change between two defined levels

3.2.10
pulse duration
time interval between the leading and trailing edges of a *pulse* (3.2.7) measured at a defined level below the peak amplitude

3.2.11
pulse shape
diagramatic representation of the *amplitude* (3.2.2) of a *pulse* (3.2.7) as a function of time

3.2.12
pulse envelope
contour of a *pulse shape* (3.2.11) including all the peaks in terms of *amplitude* (3.2.2) and time

3.2.13
pulse energy
total energy within a *pulse* (3.2.7)

3.2.14
pulse reverberation
undesirable vibration at the beginning and end of a *pulse* (3.2.7) above a defined level

3.2.15
broad-band pulse
pulse (3.2.7) in which the *relative bandwidth* (3.1.9) is ≥65 %

3.2.16
medium-band pulse
pulse (3.2.7) in which the *relative bandwidth* (3.1.9) is >35 % and <65 %

3.2.17
narrow-band pulse
pulse (3.2.7) in which the *relative bandwidth* (3.1.9) is ≤35 %

3.2.18
pulse repetition frequency
PRF
number of *pulses* (3.2.7) generated per second, expressed in Hertz (Hz)

3.3 Types of waves

3.3.1
longitudinal wave
compressional wave
wave in which the direction of displacement of particles is in the same direction as the propagation of the wave

Note 1 to entry: See Figure 2 a).

3.3.2
transverse wave
shear wave
wave in which the direction of displacement of particles is perpendicular to the direction of the propagation of the wave

Note 1 to entry: See Figure 2 b).

3.3.3
surface wave
Rayleigh wave
wave which propagates on the surface of a material with an effective penetration depth of less than one *wavelength* (3.2.4)

3.3.4
creeping wave
wave generated at the first *critical angle* (4.4.11) of incidence and propagated along the surface as a *longitudinal wave* (3.3.1)

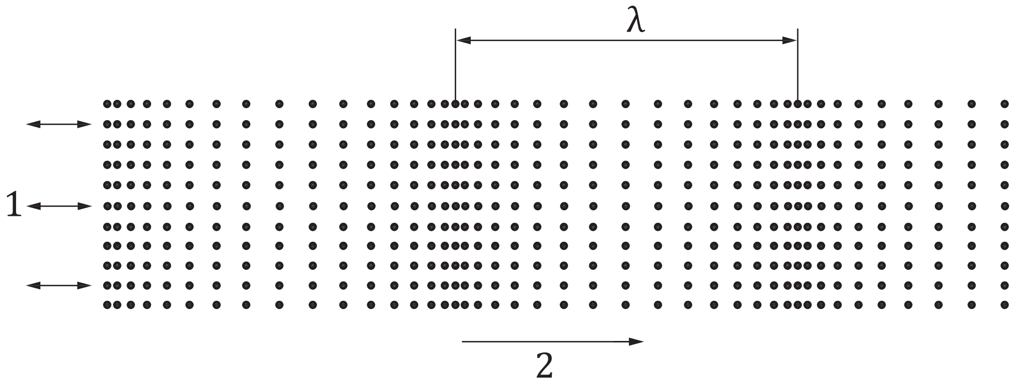
Note 1 to entry: It is not influenced by the test object's surface conditions, nor does the beam follow undulations on the surface.

3.3.5
plate wave
Lamb wave
wave which propagates within the whole thickness of a plate and which can only be generated at particular values of angle of incidence, *frequency* (3.1.1) and plate thickness

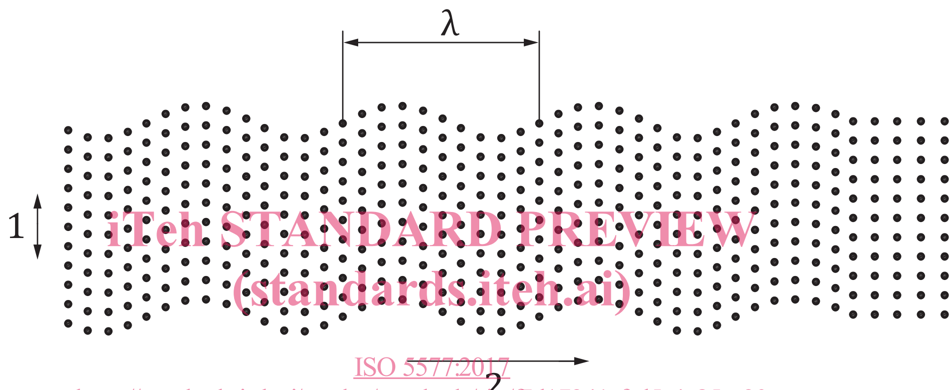
3.3.6
plane wave
wave with a planar wave front

3.3.7
cylindrical wave
wave with a cylindrical wave front

3.3.8
spherical wave
wave with a spherical wave front



a) Longitudinal wave; compressional wave



b) Transverse wave; shear wave

Key

1 direction of oscillation

2 direction of propagation

λ wavelength

Figure 2 — Types of waves

4 Terms related to sound

4.1 Sound generation and reception

4.1.1
transducer
active element of a *probe* (5.2.1) which converts electrical energy into sound energy and vice versa

4.1.2
piezo-electric transducer
transducer (4.1.1) made from piezo-electric material

4.1.3
composite transducer
plate consisting of piezo-electric ceramic rods embedded in a polymer matrix

4.1.4
electro-magnetic acoustic transducer
EMAT
transducer (4.1.1) which uses magnetostriction or Lorentz force to generate ultrasound in paramagnetic materials

4.1.5
focusing transducer
piezo-electric transducer (4.1.2) having at least one curved surface, used for focusing the sound beam (4.2.2)

4.2 Sound propagation

4.2.1
sound field
three-dimensional pressure distribution produced by transmitted sound energy

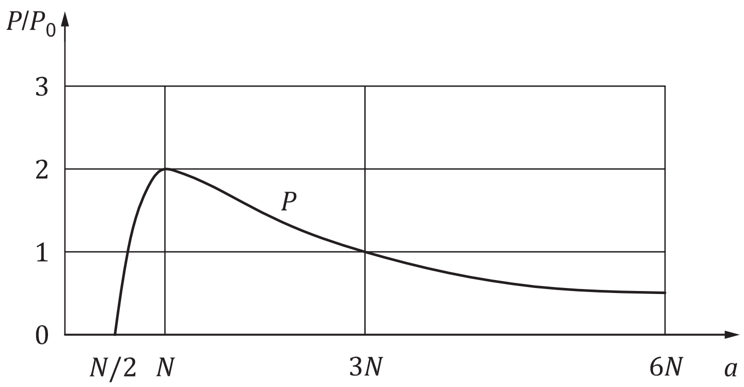
4.2.2
sound beam
ultrasonic beam
part of the *sound field* (4.2.1) within which the major part of the ultrasonic energy is transmitted

4.2.3
beam axis
line through the points of maximum sound pressure at different distances

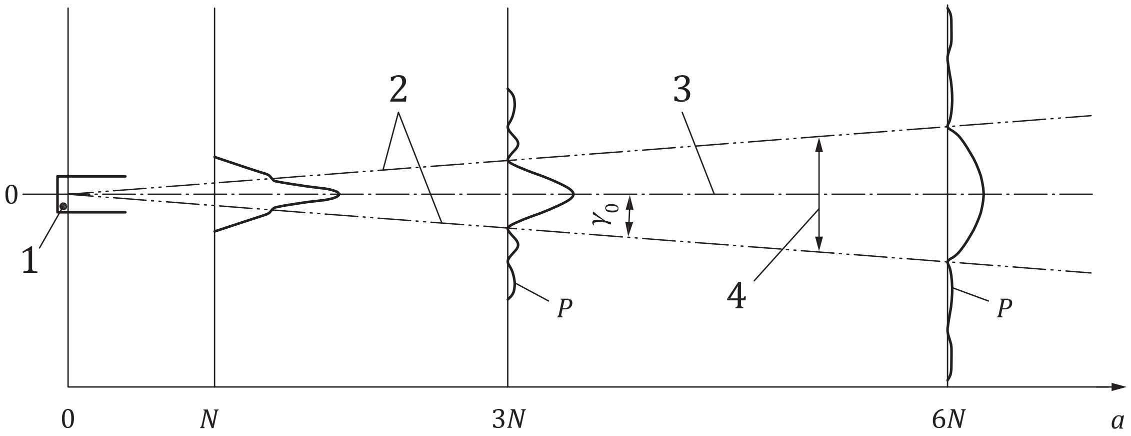
Note 1 to entry: See Figures 3 b), 8, 9, 10 and 11.

4.2.4
beam profile
curve which shows the signal amplitude along the *beam axis* (4.2.3) or perpendicular to the beam axis at a defined distance from the *probe* (5.2.1)

Note 1 to entry: See Figure 3.



a) Profile along the beam axis



b) Profiles perpendicular to the beam axis

Key

1	transducer	γ_0	angle of divergence (drop to zero)
2	beam boundary	a	distance
3	beam axis	N	near-field length
4	beam width at a given distance	P	sound pressure

Figure 3 — Beam profiles

4.2.5
beam boundary

boundary of the ultrasonic beam where the sound pressure has fallen to a given fraction of the value on the *beam axis* (4.2.3), measured at the same distance from the *probe* (5.2.1)

Note 1 to entry: See Figures 3 b), 8, 9 and 11.

4.2.6
beam width

dimension of the beam perpendicular to the *beam axis* (4.2.3) measured between the beam boundaries at a defined distance from the *probe* (5.2.1)

Note 1 to entry: See Figure 3 b).

4.2.7
angle of divergence

angle within the *far-field* (4.2.11) between the *beam axis* (4.2.3) and the *beam boundary* (4.2.5)

Note 1 to entry: See Figures 3 b), 8 and 11.

4.2.8
near-field

Fresnel zone

zone of the *sound beam* (4.2.2) where sound pressure does not change monotonically with distance because of interference

Note 1 to entry: See Figure 8.

4.2.9
near-field point

position on the *beam axis* (4.2.3) where the sound pressure reaches a final maximum

4.2.10
near-field length
distance between the *transducer* (4.1.1) and the *near-field point* (4.2.9)

Note 1 to entry: See Figure 3.

4.2.11
far-field
zone of the *sound beam* (4.2.2) that extends beyond the *near-field point* (4.2.9)

Note 1 to entry: See Figures 8 and 11.

4.2.12
focal point
focus
point where the sound pressure on the *beam axis* (4.2.3) is at its maximum

4.2.13
focal distance
focal length
distance from the *probe* (5.2.1) to the *focal point* (4.2.12)

Note 1 to entry: See Figures 8 and 11.

4.2.14
focal zone
focal range
zone in *sound beam* (4.2.2) of a *probe* (5.2.1) in which the sound pressure remains above a defined level related to its maximum

4.2.15
length of the focal zone
distance along the *beam axis* (4.2.3) from the start to the end of the *focal zone* (4.2.14)

4.2.16
width of the focal zone
dimension of the *focal zone* (4.2.14) at *focal distance* (4.2.13) perpendicular to the *beam axis* (4.2.3)

4.2.17
acoustical properties
characteristic parameters of a material which control the propagation of sound in the material

4.2.18
acoustically anisotropic material
material which has differing sound velocities in differing directions of propagation

4.2.19
sound velocity
velocity of propagation
phase velocity (4.2.20) or *group velocity* (4.2.21) of a sound wave in a material in the direction of propagation

Note 1 to entry: In a non-dispersive material, there is no difference between phase and group velocity.

Note 2 to entry: In an anisotropic material, the velocities may depend on the direction of propagation.

4.2.20
phase velocity
velocity of propagation(4.2.19) of a wave front

4.2.21
group velocity
velocity of propagation (4.2.19) of the acoustic energy

4.3 Loss of sound pressure

4.3.1
attenuation
sound attenuation
decrease of sound pressure when a wave travels through a material, arising from *absorption* (4.3.4) and *scattering* (4.3.3)

4.3.2
attenuation coefficient
coefficient used to express *attenuation* (4.3.1) per unit of distance travelled, dependent on material properties, *wavelength* (3.2.4) and wave type

Note 1 to entry: The attenuation coefficient is usually expressed in dB/m.

4.3.3
scattering
random reflections caused by grain structure and/or by small *reflectors* (6.4.1) in the beam path

4.3.4
absorption
part of the *attenuation* (4.3.1) resulting from transformation of ultrasonic energy into other types of energy, for example, thermal energy

4.4 Sound waves at interfaces

4.4.1
interface
boundary between two materials, in acoustic contact, having different acoustic properties

Note 1 to entry: See Figure 4.