



AFRICAN NDT CENTRE
COURSE CURRICULUM
ULTRASONIC TESTING LEVEL 1, 2 and 3

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Contents	Level 1	Level 2	Level 3
1.0 Introduction, Terminology History of NDT	1.0 Task of non-destructive testing - Personnel	1.0 Review of level 1 knowledge	1.0 Terminology and definitions of UT Overview of standards: ISO, CEN and national (general, and products)
	1.1 History of NDT	1.1 Terminology and Definitions of UT	
	1.2 Terminology of NDT (EN 1330-1 & -2)		
	1.4 Terminology of UT (EN 1330-4)		
2.0 Physical principles of method and associated knowledge	2.0 Relevant standards: EN 583-1 to EN 583-6 EN 14127	2.0 Physical definitions and typical parameters	2.0 As level 2 + Isotropic and anisotropic materials Phenomena of guided propagation Velocity measurement and Dispersion Relation between velocity and elastic properties of materials
	2.1 Review of mathematical basics Physical definitions and typical parameters Sinusoidal movement, amplitude, period, frequency, wavelength, propagation velocity	2.1 Same as level 1 + - acoustic impedance, factors of reflection and transmission (normal beam only) - beam propagation	



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<p>2.2 Various types of wave modes</p> <p>Longitudinal waves</p> <p>Transverse waves</p> <p>Concepts of surface waves or Rayleigh waves and of plate waves or Lamb waves</p>	<p>2.2 Various types of wave modes</p> <p>Same as level 1 +</p> <p>- extended knowledge of surface waves or Rayleigh waves and of plate waves or Lamb waves</p> <p>- creeping waves</p>	
<p>2.3 Reflection and refraction</p> <p>Normal incidence, transmission and Reflection</p> <p>Incidence oblique</p> <p>Snell's law</p> <p>Critical angles, mode conversion</p>	<p>2.3 Reflection and refraction</p> <p>Same as level 1 + acoustic pressure</p>	
<p>2.4 Transmission and reception of ultrasonic waves</p> <p>Piezo-electric effect</p> <p>Ferro-electricity or electrostriction</p>	<p>2.4 Transmission and reception of ultrasonic waves</p> <p>Same as level 1</p>	
<p>2.5 Magnetostriction</p>	<p>2.5 Magnetostriction</p>	
<p>2.6 Transducer characteristics</p> <p>Material, dimensions, piezo-electric Constants</p>	<p>2.6 Transducer characteristics</p> <p>Same as level 1 (deeper knowledge)</p>	



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	<p>2.7 Characteristics of the beam of a circular transducer</p> <p>Influence of transducer frequency and Diameter</p> <p>Near field (Fresnel zone) Far field (Fraunhofer zone) Beam divergence</p>	<p>2.7 Characteristics of the beam of a circular transducer</p> <p>Same as level 1 +</p> <ul style="list-style-type: none"> - characteristics of the beam of a rectangular transducer - beam profiling - beam divergence factor 	
<p>3.0</p> <p>Products knowledge and related capability of the method and derived techniques</p>	<p>3.0 Various defects related to the manufacturing processes and service induced defects related to the defined sectors</p> <p>Implementation of the testing techniques according to products and to expected discontinuities</p> <p>Influence of geometry and structure (spurious echoes, sound attenuation)</p>	<p>3.0 Same as level 1 +</p> <ul style="list-style-type: none"> -Tandem (zones) -Selection of transducers for required resolution and reduction of noise (type, frequency, size) -immersion - TOFD - phased arrays <p>Influence of the main parameters</p>	<p>3.0 Same as level 2+</p> <p>Choice of techniques (contact, immersion, transmission, resonance, ...)</p> <ul style="list-style-type: none"> -EMAT -Multiple probe arrays <p>A comprehensive understanding and knowledge of the manufacturing processes and associated metallurgy & flaw types etc...</p> <p>A comprehensive understanding and knowledge of the cause and formation of in-service defects including associated metallurgy & flaw types etc...</p>



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<p>4.0 Equipment</p>	<p>4.0 Various probes (normal, angle, dual) Instruments (analogical and digital) Pulse generation</p> <p>Reception and amplification (percentage and dB)</p> <p>Range setting A- scan presentation B- and C-scan presentation</p> <p>Additional functions: Couplant</p>	<p>4.0 Same as level 1 +</p> <ul style="list-style-type: none"> - detailed knowledge of the different functions of UT test equipment - automatic and semi automatic systems - B- and C-scan presentation (deeper knowledge) - couplant (deeper knowledge) <p>Calibration reference and transfer blocks</p>	<p>4.0 Same as level 2 +</p> <p>Systems (manual/semi-automatic, automatic,): speed, incrementation, repeatability, ...</p> <p>Analog flaw detectors (different circuits) Digital flaw detectors (Comparison with analog flaw detectors, Sampling-rate)</p> <p>Special equipment including thickness measurement Probes</p> <ul style="list-style-type: none"> - Dynamic range - Probes for immersion: focused, spherical, cylindrical, Fermat surface; - Measurement of pulse length practical measurement of the near field <p>Shoe (delay, curvature, ...); Connecting cables (sealing, insulation and flexibility); Blocks: representativity</p>
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<p>5.0 Information prior to testing</p>	<p>5.0 Written instruction (prepared by a level 2 or 3)</p> <p>Objectives Requirements</p>	<p>5.0 Same as level 1 (deeper knowledge)+</p> <ul style="list-style-type: none"> - contents and requirements of instructions, procedures and standards - Preparation of written instructions... 	<p>5.0 As level 2 +.</p> <p>Selection of technical parameters:</p> <ul style="list-style-type: none"> - Products: geometry, surface - quality, accessibility, environment, - UT indication/ discontinuity/ defect: type, origin, shape, dimension, orientation, tilt/skew, ... - properties of the equipment: <p>Preparation of written specifications</p>
<p>6.0 Testing</p>	<p>6.0 Verification of combined equipment according to EN 12668-3</p> <hr/> <p>6.1 Standardized calibration blocks ref : EN 12223 & EN 27963</p> <hr/> <p>6.2 Contact technique (straight and angle beam)</p> <p>Reflection Transmission</p> <hr/> <p>6.3 Immersion techniques (straight and angle beam)</p> <p>Reflection</p>	<p>6.0 Same as level 1 (deeper knowledge) +</p> <ul style="list-style-type: none"> - reference reflectors (laws of distance and size) - DGS-method - DAC-curves - distance/amplitude-correction - transfer correction (surface and attenuation) - sizing techniques, principles and limitations - scanning 	<p>6.0 Same as level 2 +</p> <p>Control and assessment of procedures and instructions for their efficiency</p>



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	<p>Transmission</p> <hr/> <p>6.4 Setting of range and sensitivity</p> <p>Reference reflectors Transfer correction</p> <hr/> <p>6.5 Ultrasonic thickness measurement</p> <p>Equipment Techniques</p>		
<p>7.0 Evaluation And Reporting</p>	<p>7.0 Detecting, locating (trigonometrical rules) and sizing techniques</p> <p>Recording and evaluation level Acceptance levels Test reports System of coordinate Measurement (probe, reflector) Calculated values</p>	<p>7.0 Same as level 1 (deeper knowledge)+</p> <ul style="list-style-type: none"> - characterization (planar / non planar according to EN 1713 for welds) - Interpretation and evaluation of indications 	<p>7.0 Use of complementary NDT methods;</p> <p>Interpretation of relevant standards and codes Evaluation (conventional approach, validated method) Distinction defect/artefact Acceptance criteria; Level of significant variation; Storage and recording process</p>
<p>8.0 Assessment</p>	<p>NOT APPLICABLE</p>	<p>8.0 Evaluation and confirmation of test Reports</p> <p>Application of the acceptance criteria according to standards, codes and</p>	<p>Detailed knowledge of how to classify & assess observations, analyse the results and compare them to codes, standards and design specifications etc....</p>



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		procedures	<p>How to develop codes, standards and design specifications etc.... into clear acceptance criteria to be written into procedures and instructions</p> <p>Also how to find information /assistance to investigate observations not covered by codes and standards & develop acceptance criteria. The training of levels 1 & 2 for these acceptance criteria.</p>
9.0 Quality aspects	<p>9.0 Personnel qualification (according to EN ISO 9712)</p> <p>Equipment verification</p>	<p>9.0 Personnel qualification (according to EN ISO 9712)</p> <p>Equipment verification Written instructions Traceability of documents</p>	<p>9.0 Personnel qualification and responsibility (according to EN ISO 9712)</p> <p>Equipment verification Format of working procedures Traceability of documents Other NDT qualification and certification systems A review of applicable NDT application and product standards</p>
10.0 Developments	(Not applicable)	10.0 General information	Newest developments for industrial and scientific applications of UT: e.g. tomography holography, acoustic microscopy, ...