

ULTRASONIC TESTING - PHASED ARRAY

PA

Qualification training according to the ISO 9712

PROCESS	SYSTEM	METHOD	LEVEL / TECHNIQUE	SECTOR	CODE	VALID FROM	PREPARED BY
NDT	ISO 9712	UT	PA	MS, w	-	1 / 2023	ŽBÁNEK

INTRODUCTION

Purpose of Ultrasonic Testing Phased Array technique (UT-PA, sometimes also referenced as PAUT) is detection of mainly internal and back-wall (root side) defects in industrial parts and components using advanced UT technique.

UT-PA qualified personnel has to have knowledge of its **physics principles of conventional UT**, be familiar with overall **requirements of most widely codes and standards of Phased Array technique**, be able to expand them to new applications and be **able to perform and document testing**.

Training is suitable for currently certified conventional UT2 and UT3 personnel. It focuses on **gaining knowledge and essential skills** to be further strengthened when collecting experience. Duration and content of the training **depends on the product or industrial sector selected** (e.g. welding, casting, multisector applications etc.).

Training are designed to prepare participants for all examination parts to the technique – **specific** (use of standards and codes), and **practical** (performance of the method) acc. to EN ISO 9712 in the ATG CERT Examination Center.

RECOMMENDED PUBLICATIONS

ATG publications

- UT – Ultrasonic Testing, Level 1, 2 (ATG handbook)
- UT-PA – Ultrasonic Testing Phased Array (ATG handbook)
- UT – Collections of formulas (published by ATG)

Other publications

- Personnel Training Publications: Ultrasonic Testing (UT) Programmed Instruction Series (ASNT handbook)
- Level III Study Guide: Ultrasonic Testing Method (UT) (ASNT handbook)
- Relevant Discontinuities – Ultrasonic Testing (UT) (ASNT handbook)
- Nondestructive Testing Handbook, Third Edition: Volume 7, Ultrasonic Testing (ASNT handbook)

SYLLABUS COVERAGE

Training provides theoretical and practical training to understand Ultrasonic Testing Phased Array (UT-PA) technique principles, be familiar with various types of equipment, accessories, and other aids, and handling of tested parts and components to perform safely Ultrasonic Phased Array Testing, report and evaluate results of the testing.

TRAINING DURATION

	SECTOR	LEVEL I	LEVEL II	LEVEL III
MS	Multisector	N/A	5 d (40 h)	N/A
w	Welds	N/A	5 d (40 h)	N/A

BODY OF KNOWLEDGE – GENERAL PART

	SUBJECT	LEVEL I	LEVEL II	LEVEL III
1	Introduction			
1.1	A brief history of the Phased Array technique	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
1.2	Types of devices currently available	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
1.3	What is Phased Array	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
1.4	How Phased Array systems work	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
1.5	Advantages compared to conventional ultrasound	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2	Probes			
2.1	Conventional probes construction	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2.2	Composite transducers	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2.3	What is meant by Array (matrix)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2.4	Phased Array probe design	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2.5	Characteristics of Phased Array probes	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2.6	Phased Array wedges	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2.7	Wave forming	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2.8	Sequence of beam transmitting (focal law)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2.9	Beam/scan shaping	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2.10	Beam control	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2.11	Grating and side lobes	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2.12	Phased array probes focusing	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2.13	Summary of Phased Array probe parameter selection	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
3	Imaging			
3.1	A-Scan	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
3.2	Simple B-Scan	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
3.3	Classic C-Scan	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
3.4	Phased Array C-Scan	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
3.5	Complex B-Scan	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
3.6	Combined view	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
3.7	S-Scan	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
3.8	Influence of adjustable scan parameters on display	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
3.9	Resolution - lateral, angular and depth	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
4	Devices			
4.1	Block diagram of the phased array device	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
4.2	Specifics of conventional ultrasonic devices	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
4.3	Specifics of Phased Array Instruments	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
4.4	Other instrument settings affecting the test result	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

SUBJECT		LEVEL I	LEVEL II	LEVEL III
5	Devices Settings			
5.1	Linear scan settings	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
5.2	Straight linear scan	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
5.3	Angular linear scan	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
5.4	Section scan settings	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
5.5	Indication localization	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
6	Calibration			
6.1	Calibration procedure	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
6.2	Setting / verifying the phased array properties of a beam	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
7	Evaluation of Indications			
8	Standard Applications			
8.1	Requirements	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
8.2	Welds	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
8.3	Forgings/castings	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
8.4	Composite inspection	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
8.5	Corrosion	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
9	Special Applications			
9.1	Testing of stainless steels by DLA technique	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
9.2	TOFD technique using Phased array probes	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
9.3	Full matrix capture/total focusing method (FMC/TFM)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

BODY OF KNOWLEDGE – SPECIFIC PART

The content of specific part is modified according to product sector which is covered by training. Multisector includes standards from all sectors.

STANDARD		LEVEL I	LEVEL II	LEVEL III
1	General Methodology			
ISO 13588	Non-destructive testing of welds - Ultrasonic testing - Use of automated phased array technology	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
ISO 19285	Non-destructive testing of welds — Phased array ultrasonic testing (PAUT) — Acceptance levels	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
ASME BPVC V - ARTICLE 4	Ultrasonic Examination methods for welds - Mandatory Appendix V: phased array e-scan and s-scan linear scanning examination techniques	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
ASME BPVC V - ARTICLE 4	Ultrasonic Examination methods for welds - Mandatory appendix VII: ultrasonic examination requirements for workmanship-based acceptance criteria	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
ASME BPVC V - ARTICLE 4	Ultrasonic Examination methods for welds - Mandatory Appendix VIII: ultrasonic examination requirements for fracture mechanics based acceptance criteria	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
ASTM E 164	Standard Practice for Contact Ultrasonic Testing of Weldments	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
ASTM E 2700	Standard Practice for Contact Ultrasonic Testing of Welds Using Phased Arrays	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

STANDARD		LEVEL I	LEVEL II	LEVEL III
E2491-08	Historical Standard: ASTM E2491-08 Standard Guide for Evaluating Performance Characteristics of Phased-Array Ultrasonic Testing Instruments and Systems	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

BODY OF KNOWLEDGE – PRACTICAL PART

In the practical part of the training the trainees practice working with instructions and procedures as well as knowledge gained from the standards discussed in the specific part. Training an specimens are representative for given product sectors.

SUBJECT		LEVEL I	LEVEL II	LEVEL III
1	General			
1.1	Using of ultrasonic devices	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
1.2	Calibration of ultrasonic devices	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
1.3	Defect detection and interpretation	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
1.4	Checking of ultrasonic system	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
1.5	Verification of probe parameters	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2	Testing According To Instructions			
2.1	Welds	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2.2	Forgings	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2.3	Castings	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

BODY OF KNOWLEDGE – DOCUMENTATION

In the practical part of the training the trainees practice dealing with process documentation from reporting results to reports, drafting instructions and procedures.

SUBJECT		LEVEL I	LEVEL II	LEVEL III
1	Test Report			
1.1	Purpose	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
1.2	Tested part	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
1.3	Testing conditions	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
1.4	Reporting findings	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
1.5	Evaluation	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2	Written Instruction			
2.1	Validity range	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2.2	Personnel requirements	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2.3	Inspection range and area of interest	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2.4	Equipment and accessories	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2.5	Testing parameters and their verification	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2.6	Evaluation, acceptance criteria	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2.7	Reporting	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2.8	Post-testing activity	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>