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DIDATIC METHODOLOGY TO CALIBRATE AN ULTRASOUND PHASED ARRAY SYSTEM

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ABSTRACT

Non-destructive testing (NDT) is an extensive field that plays a vital role in determining the functioning of systems and components. This work describes a didactic methodology to calibrate the OmniScan MX2 equipment manufactured by Olympus which is based phase in phased array ultrasound technology. In this study was used an ultrasonic transducer (SA10-N55S 5L16) composed by sixteen linear array elements. For the standard calibration, the angular beam had 36.1º, the frequency had 5MHz and the pattern block was the AW5083 manufactured in 6061 aluminum alloy.

Keywords: Ultrasound, phased array, nondestructive test, angular transducer, calibration.

INTRODUCTION

Non-destructive testing is widely used in industry, mainly in the evaluation of parts and mechanical structures for the identification of defects, corrosion, faults or imperfections in welds, being one of the most technique to control the quality of products [1].

Currently, ultrasonic inspections have been increasingly required due to the need for non-destructive control of new materials processed by new manufacturing processes and can be used in various industries such as foundry, automotive, naval, nuclear, oil, textile, aerospace, chemical, power generation, among others [2]. NDTs are techniques used to inspect products, different materials and equipment in their manufacturing, maintenance and final finishing stages, ensuring the integrity and reliability of a product. NDTs also allow for better control of the manufacturing process, lowering production costs while maintaining uniform quality, and ultimately ensuring end-customer satisfaction. In this way, these types of tests influence and support reliability studies and therefore all aspects of the life of a product in any industry.

RESULTS AND CONCLUSIONS

The non-destructive test by ultrasound investigates the health of the materials without altering their characteristics [3], providing information about the defect content, the material characteristics and the degradation control of components or equipment, integrating one of the main tools of quality control and security of goods and services.

In most industries, the calibration of measurement equipment is extremely important because it is through them that it is possible to maintain the quality and control of the products, besides keeping the measurements always accurate. For each type of equipment there is a specific calibration for the purpose for which it is intended and the parameters involved in the process.

In the Phased Array ultrasound equipment, three types of calibration were required: the calibration of velocity, wedge delay and sensitivity. As the ultrasonic propagation velocity is different for each type of material, a specific standard block is required to calibrate the equipment, where all dimensions and reflectors are known (radii, hole depth, thickness) to the specifications of the associated standard, allowing you to adjust the reflection echoes so that they remain in defined positions on the device screen, corresponding to the sound path in the standard block.

The calibration of the OmniScan MX2 was carried out with a standard block made of the same material as the plates to be inspected, i.e aluminum, which is a type IIW-2 block and its dimensions and characteristics were established according to AFNOR standard EN 12223. In order to facilitate the transmission of sound energy between the transducer and the standard block, glycerin was used as the coupling agent. To perform the speed calibration, it was necessary to place the probe in the standard block and detect on the screen the two rays in the block, one with a 50 mm radius and a 100 mm radius, so that the peaks corresponding to each radius were maximized, where the transducer fully captures the reflected echo. In the calibration of the wedge delay, the 50 mm radius was used as a reference, and the sensitivity calibration took into account the 15 mm deep hole. In these two calibrations, the probe was carefully moved so that the signal captured by the focal laws was constructed graphically in the most linear way possible. With the calibrations carried out it will be possible to obtain a correct positioning and dimensioning of the discontinuities, as well as the compensation of losses by attenuation and divergence of the acoustic beam.

Figure 1 shows the detail of the standard block used for the ultrasound equipment calibration for a 6061 aluminum alloy.

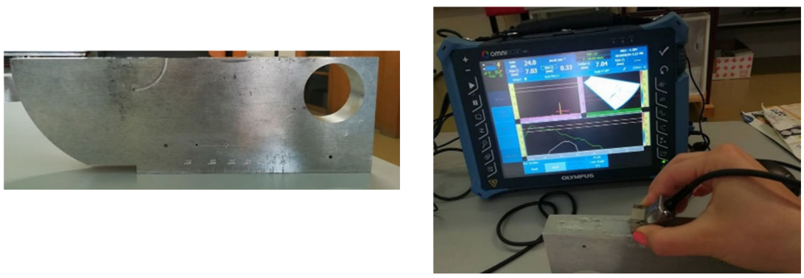

Fig. 1 - Standard block on the left and example of the equipment calibration procedure on the right.

REFERENCES

[1]- Baldev Raj, T. Jayakumar and M. Thavasimuthu, Practical Non-destructive Testing, Woodhead Publishing, 2002.

[2]-M. Moles, et al., Review of Ultrasonic Phased Arrays for Pressure Vessel and Pipeline Weld Inspections, Journal of Pressure Vessel Technology, Vol 127 Nº 3, p. 351-356, 2005.

[3]-V. Janapati, et al., Damage detection sensitivity characterization of acousto-ultrasound-based structural health monitoring techniques, Structural Health Monitoring, Vol 15 Nº 2, 2016.