

Overview

This standard identifies the competencies you need to carry out ultrasonic testing activities on castings, using manual, semi-automatic or fully automatic equipment, in accordance with approved procedures/techniques. The castings will have been produced from sand or ceramic moulds, dies or investment shells and will be circular, square or irregular in shape and will have projections and internal cavities. The profiles will also be curved and tapered. The testing will generally take place after the castings have received a provisional visual examination and have been fettled. The use of both contact and non-contact ultrasonic flaw detector equipment is covered in this standard.

You will be required to check that the ultrasonic test equipment complies with the specification requirements, is safe to use, fit for purpose and has been correctly calibrated. You will prepare the castings for testing, identifying the test area for future reference and will check the material of the casting for features which might interfere with the ultrasonic tests. You will set up and adjust the equipment, carry out the specified tests using the correct procedures/techniques, according to the non-destructive testing (NDT) instructions and requirements, and observe and record the test indications.

You will be expected to draw conclusions about the type of defect/flaw, its location and size. You will complete the tests by preparing/completing a NDT test report containing the required test information and data, along with your interpretation of the test indications. You will be expected to mark up the castings to show where there are any indications of defects/flaws. The completed inspection report, along with the castings, will be passed to the appropriate person, in accordance with procedures.

Your responsibilities will require you to comply with organisational policy and procedures for the ultrasonic testing activities undertaken and to report any problems with the equipment in use that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You will be expected to work with a minimum of supervision, taking personal responsibility for your actions and for the quality and accuracy of the work that you carry out.

Your underpinning knowledge will provide a good understanding of your work and will provide an informed approach to the inspection of castings using ultrasonic flaw

detection/testing techniques. You will have a working knowledge of the principles of ultrasonic testing using the pulse-echo system and will understand the functions and characteristics of the flaw detector, its performance requirements and the different types of probes available.

You will have a detailed knowledge of testing practice, including the equipment calibration requirements, defect/flaw measurement techniques, equipment performance checks and routine care of the equipment. Your knowledge will include an appreciation of potential hazards and safe working practice and you will understand the risks posed by casting defects/flaws and the consequences of component failure. The importance of compiling accurate and legible reports will also be a key issue in complying with this standard.

You will understand the safety precautions required when carrying out the ultrasonic testing activities and when using the associated tools and equipment. You will be required to demonstrate safe working practices throughout and will understand the responsibility you owe to yourself and others in the workplace.

Performance criteria

You must be able to:

1. work safely at all times, complying with health and safety legislation, regulations, directives and other relevant guidelines
2. follow the correct specification/technique for the product or equipment being inspected
3. identify and confirm the inspection checks to be made and acceptance criteria to be used
4. carry out the inspections, using appropriate equipment and techniques
5. identify any casting defects/flaws or variations from specification
6. record the results of the inspections in the appropriate format
7. deal promptly and effectively with problems within your control and report those that cannot be solved
8. ensure that work records are completed, stored securely and available to others, as per organisational requirements
9. leave the work area in a safe condition on completion of the activities, as per organisational and legal requirements

Knowledge and understanding

You need to know and understand:

1. the specific safety precautions to be taken whilst carrying out the activities (including any specific legislation, regulations or codes of practice relating to the activities, equipment or materials)
2. the health and safety requirements of the work area and the activities, and the responsibility these requirements place on you
3. the hazards associated with the activities, and how to minimise them and reduce risks
4. the personal protective equipment and clothing (PPE) to be worn during the activities
5. how to obtain the job instructions/techniques and NDT testing specifications and how to interpret the information
6. why it is important to test castings using non-destructive testing methods
7. why castings need to be tested by a range of different non-destructive testing methods (magnetic particle, penetrant flaw detection, ultrasonic and radiography) and uses of different types of tests
8. the basic principles of ultrasonic flaw detection testing (including sound transmission and reflection; the echo principle; ultrasound; pulse echo system; defects as reflectors and transmission time as a measuring system)
9. the basic components of the ultrasonic flaw detection equipment (such as use of pulse generators; transducers to transmit and receive ultrasound; the receiver to recognise echo signals; the amplifier and signal display panel)
10. the generation of ultrasonic waves (to include types of transducer; pulse length; frequency and bandwidth and the coupling of the transducer to the casting)
11. the different types of ultrasonic waves (to include compression, shear and surface; velocity of ultrasonic waves versus the materials from which the castings are constructed; frequency and wavelength, and the relationship between the parameters)
12. the reflection and transmission of the ultrasonic waves (perpendicular incidence at reflectors; acoustic impedance; reflected and transmitted energy; critical angles and factors affecting angles of reflection; refraction of ultrasonic waves; calculations; echo signal amplitude and the definition of 'decibel')
13. the ultrasonic beam (to include beam diameter and spread; intensity versus the

radius; near field and far field; the influence of frequency, velocity and transducer size)

14. factors which will affect the selection of suitable probes (type, frequency, size, angle and product to be tested, the influence of expected defects on the probe selection)

15. how the properties of the castings will affect the way the test equipment performs (flat, curved, smooth or rough surface conditions and the size of the object) and any heat treatment or repairs to the castings)

16. how to setup and calibrate the ultrasonic flaw detection equipment using specified calibration blocks (setting range appropriate to castings being inspected; the effect of different sound velocities in calibration block and material of castings being inspected; the effect of casting shape and surface finish on range, sensitivity and signal-to-noise ratio)

17. how to carry out the ultrasonic testing activities (role of the couplant, the use of single and tandem probes; scanning pattern required to detect expected defects; the use of reference marks related to hidden features, essential to probe positioning)

18. how to interpret the various signals from the equipment (in terms of defect/flaw identification, defect/flaw sizing and the effect of probe manipulation)

19. the types of casting defect/flaw that are detectable using ultrasonic testing methods (gas blowholes, pinhole porosity, shrinkage porosity, entrapped air/gas holes, inclusions, cold shuts, mis-runs, metal-mould reactions and run-outs)

20. the level of defects/flaws that are acceptable in the castings; influence of the defects on the service/performance of the casting

21. the system of quality control within the company and who is responsible for it

22. care and control of the equipment (to include checking condition of insulation, all electrical cables and connections, equipment operating controls and displays, mechanical functions and probes)

23. the extent of your own responsibility and whom you should report to if you have problems that you cannot resolve

24. how to access, use and maintain information to comply with organisational requirements and legislation

Scope/range related to performance criteria

1.

Inspect castings using ultrasonic testing techniques, carrying out all of the following activities:

- 1.1 obtain the required ultrasonic testing equipment and ensure that it is in a safe and usable condition
- 1.2 adhere to health and safety regulations, systems and procedures to realise a safe system of work
- 1.3 comply with job instructions/techniques, NDT testing inspection specifications, follow the defined testing procedures and apply safe working practices and procedures at all times
- 1.4 leave the work area in a safe condition on completion of the activities

2.

Ensure correct type of equipment, as required by the NDT instructions/techniques, is available, to include all of the following:

- 2.1 the flaw detector
- 2.2 calibration blocks
- 2.3 specified probes
- 2.4 couplant (as appropriate)

3.

Carry out ultrasonic testing activities, using one of the following types of equipment:

- 3.1 manual
- 3.2 semi-automatic
- 3.3 fully automatic

4.

Prepare the castings for testing, to include all of the following:

- 4.1 identifying and marking the test areas
- 4.2 checking that the test areas are correctly prepared for testing
- 4.3 checking for key reference (datum) markings indicating the location of casting features
- 4.4 marking the scanning limits on the surface of the test areas
- 4.5 checking, when appropriate, the castings for internal features which may interfere with the wave propagation and flaw detection

5.

Carry out the specified tests, using all of the following:

- 5.1 the specified type of scan
- 5.2 the appropriate scanning procedure and technique
- 5.3 the specified probes (correct type, size and frequency)
- 5.4 the correct defect/flaw size measurement technique

6.

Inspecting castings using ultrasonic testing techniques

Identify five of the following internal defects/flaws:

- 6.1 gas blowholes
- 6.2 entrapped air/gas holes
- 6.3 mis-runs
- 6.4 run-outs
- 6.5 pinhole porosity
- 6.6 inclusions
- 6.7 metal-mould reactions
- 6.8 shrinkage porosity
- 6.9 cold shuts
- 6.10 other defect/ flaw (specify)

7.

Record the test indications and conclusions, including all of the following:

- 7.1 defect/ flaw type
- 7.2 defect/ flaw location
- 7.3 defect/ flaw size
- 7.4 test area identification

8.

Follow the correct procedures to deal with castings in all of the following categories:

- 8.1 castings which meet the specification
- 8.2 castings with identified defects/flaws
- 8.3 castings requiring further investigation
- 8.4 castings requiring other inspection methods

9.

Complete an NDT report, to include recording all of the following:

- 9.1 casting identification
- 9.2 geometry, thickness, surface condition of identified test areas where defect indications were found
- 9.3 test information (specified flaw detector, probe data, scan type and procedure, size measurement technique, sensitivity and other parameters relevant to the test)
- 9.4 test indications and interpretation
- 9.5 comparison of defect/ flaw data with acceptance criteria
- 9.6 conclusions and recommendations
- 9.7 personal data

10.

Complete the inspection activities, to include carrying out all of the following activities:

- 10.1 marking up defective castings with all relevant information
- 10.2 recording all the required details of the inspection in the appropriate format
- 10.3 handing over the castings and inspection details to the appropriate people

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