SEMETS325

Inspecting engineering products by ultrasonic testing

Overview

This standard identifies the competences you need to carry out ultrasonic testing activities on engineering products, materials or structures in accordance with approved procedures. This can apply to contact, non-contact, manual, semi-automatic or fully automatic ultrasonic flaw detector equipment.

You will be required to check equipment, prepare products for testing, identify test areas, check product materials, set up and adjust the equipment, carry out tests, observe and record test indications, draw conclusions, prepare/complete NDT test reports and mark up products, materials, or structures to indicate defects/flaws. Your responsibilities will require you to comply with organisational policy and procedures and to report any problems with activities or equipment that you cannot resolve, or which are outside your permitted authority. You will take personal responsibility for your actions and for the quality and accuracy of the work that you carry out.

You will have a good understanding of your work, and will provide an informed approach to the inspection of engineering products by using Ultrasonics testing techniques. You will have adequate uncorrected or corrected vision in accordance with national standards to allow you to competently perform inspections. You will have an appreciation of hazards, safe working practice and safety precautions, have correct vision at all times and you will understand the risks posed by material defects/flaws and the consequences of component failure and how to carry out ultrasonic detection activities and use associated tools and equipment safely.

This standard is for anyone who inspects engineering products using ultrasonic testing techniques.

Performance criteria

You must be able to:

1. work safely at all times, complying with health and safety legislation and other relevant regulations, directives and guidelines **identify, confirm and carry out specified inspection checks against agreed acceptance criteria.
2. identify, confirm and carry out specified inspection checks against agreed acceptance criteria.
3. prepare testing equipment and materials, checking they comply with specification requirements, are safe to use and fit for purpose.
4. prepare ambient conditions, ensuring they are satisfactory for tests to proceed
5. calibrate and carry out performance checks on ultrasonic testing equipment at appropriate times.
6. identify test areas and use appropriate reference marks to take account of features of product material that might interfere with tests.
7. position probes to produce effective test results and operate ultrasonic testing equipment in line with manufacturer's instructions and organisational procedures.
8. carry out all required inspection checks as specified and identify any defects or variations.
9. analyse test indications and identify any defects/flaws or variations from specification.
10. mark up products or equipment to show where there are indications of flaws.
11. record accurately the results of the inspections in the appropriate format and in line with legislative and organisational requirements and pass to designated people.
12. deal with problems within your control in line with organisational procedures without delay, reporting problems outside your control to designated people.

Knowledge and understanding

You need to know and understand:

1. relevant health and safety and other regulations, directives, national standards and guidelines and your responsibilities to yourself and others including those relating to quality control,
2. hazards associated with ultrasonic flaw detection activities including electrical contact and moving mechanical parts
3. safe working practice and specific safety precautions to minimise hazards when carrying out ultrasonic flaw detection activities and using associated tools and equipment on engineering products, materials or structures including the type(s) of personal protective equipment (PPE) to be used, and how to obtain it
4. how to obtain and interpret job instructions/techniques, testing specifications.
5. how to interpret and evaluate test results to identify defects or variations from specification
6. the reasons why it is sometimes necessary to test products using non-destructive testing methods and why products may need to be tested by a range of different non-destructive testing methods including magnetic particle, penetrant flaw detection, ultrasonic and radiography
7. the types of defect/flaws that are detectable using ultrasonic testing methods and how to interpret the various signals from the equipment, in terms of defect/flaw identification, defect/flaw sizing and the effect of probe manipulation
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 functions and characteristics of ultrasonic flaw detecting equipment, its performance requirements and the different types of probes available and its basic components including the 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 including types of transducer; pulse length; frequency and bandwidth and the coupling of the transducer to the product
11. the different types of ultrasonic waves including compression, shear and surface; velocity of ultrasonic waves versus materials from which the components, materials or structures are constructed; frequency and wavelength and the

relationship between the parameters
12. the reflection and transmission of ultrasonic waves including 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 including beam diameter and spread; intensity versus radius; near field and far field; the influence of frequency, velocity and transducer size
14. factors which will affect the selection of suitable probes including type, frequency, size, angle, product to be tested, whether product surface conditions are flat, curved, smooth or rough or have any previous heat treatment or repairs
15. how to set up and calibrate ultrasonic flaw detection equipment, using specified calibration blocks, setting range appropriate to products being inspected; the effect of different sound velocities in calibration block and material of the products being inspected; the effect of product shape and surface finish on range, sensitivity and signal-to-noise ratio
16. how to carry out the ultrasonic testing activities including the 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
17. acceptable levels of defects/flaws in products and the influence of defects on product, material or structure service/performance
18. care and control of the equipment including checking the condition of insulation, all electrical cables and connections, equipment operating controls and displays, mechanical functions and probes
19. the importance of accurate NDT test reports, the data and information required, organisational formats and how to prepare and complete them
20. the extent of your own responsibility and problems within your control and whom you should report to and when, including who to pass inspection records to and to whom to report unresolved problems with activities, equipment and test results and who is responsible for quality control

Scope/range

1. Carry out all of the following during the ultrasonic testing activities:
    1.1 obtain the required ultrasonic testing equipment and materials, and check that they are in a safe and usable condition
    1.2 use appropriate personal protective equipment
    1.3 comply with job instructions/techniques, NDT testing inspection specifications, risk assessments and other relevant safety standards
    1.4 follow the defined testing procedures/techniques, and apply safe working practices and procedures at all times
    1.5 leave the work area in a safe condition on completion of the activities
2. Obtain the correct type of equipment, as required by the NDT instructions/techniques, to include all of the following:
    2.1 the flaw detector (such as analogue or digital)
    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 products, materials or structures, equipment for testing, to include carrying out all of the following:
    4.1 identifying and marking the test areas
    4.2 removing any contaminants from the test area (such as cleaning or degreasing)
    4.3 preparing the surface of the test area to the specified finish (such as grinding or polishing)
    4.4 marking the scanning limits on the surface of the test areas
    4.5 checking, when appropriate, the products 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 flaw size measurement technique
6. Carry out ultrasonic testing on one of the following:
    6.1 welded joints
    6.2 castings
    6.3 wrought products/materials (such as forged, rolled, extruded)
    6.4 cold formed products (such as by bending, pressing, rolling)
    6.5 heat treated components

6.6 structures (such as airframes, lifting beams, pressure vessels)
6.7 other specific products

7. Record the test indications and conclusions including all of the following:
7.1 defect/flaw type
7.2 defect/flaw size
7.3 defect/flaw location
7.4 test area identification

8. Follow the correct procedure for materials or structures which fall into all of the following categories:
8.1 components, materials or structures which meet the specification
8.2 components, materials or structures with identified defects/flaws
8.3 components, materials or structures requiring further investigation
8.4 components, materials or structures requiring other inspection methods

9. Complete the inspection activities, to include carrying out all of the following:
9.1 marking up defective components, materials or structures with all relevant information
9.2 recording all the required details of the inspection in the appropriate format
9.3 handing over the inspection details to the people

Glossary

Discontinuity – Any imperfection in the material / component / structure

Flaw – A significant discontinuity to be recorded but within specified limits and tolerances

Defect – A flaw outside specified limits and tolerances causing the material / component / structure to be non-compliant and rejected

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