Overview

This standard identifies the competences you need to carry out penetrant flaw detection tests on ferrous and non-ferrous engineering products, materials or structures, in accordance with approved procedures/techniques. You will be required to prepare the products for the penetrant flaw detection activities, and to check that the equipment complies with the specification requirements, is safe to use and fit for purpose. You must ensure that the ambient conditions are satisfactory for the tests to proceed, and you will carry out the specified tests using the correct procedures (according to the non-destructive testing (NDT) instructions and requirements) and observe and record the test indications. 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 products to show where there are indications of flaws. The completed inspection report 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 penetrant flaw detection testing activities undertaken, and to report any problems with the activities or 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 show a good understanding of your work, and will provide an informed approach to the inspection of engineering products by using penetrant flaw detection testing techniques. You will have a working knowledge of the principles of penetrant flaw detection techniques, and will understand the role of penetrant fluids, developers and ultraviolet light imaging. You will have a detailed knowledge of testing practice and will understand why this method has significant limitations in its flaw detecting capabilities. Your knowledge will include an appreciation of hazards and safe working practice, and you will understand the risks posed by material defects/flaws and the consequences of component failure. The importance of compiling accurate and legible reports will also be a key issue in completing this standard.

You will understand the safety precautions required when carrying out
the penetrant flaw detection 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.

Glossary of Terms:
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
Performance criteria

You must be able to:

1. work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines
2. follow the correct specification/technique for the product or equipment being inspected
3. use the correct equipment to carry out the inspection
4. identify and confirm the inspection checks to be made and acceptance criteria to be used
5. carry out all required inspections as specified
6. identify any defects or variations from the specification
7. record the results of the inspection in the appropriate format
8. deal promptly and effectively with problems within your control and report those that cannot be solved
Knowledge and understanding

You need to know and understand:

1. the specific safety precautions to be taken when carrying out penetrant flaw detection activities on engineering products, materials or structures
2. the hazards associated with carrying out the penetrant flaw detection activities (such as using inflammable materials, toxic and volatile material, use of aerosol containers and safety in the use of sprays and powders), and how they can be minimised
3. the type(s) of personal protective equipment (PPE) to be used, and how to obtain it
4. the COSHH regulations relating to materials used during the penetrant flaw detection process
5. how to obtain the necessary job instructions/techniques, testing specifications, and how to interpret their information
6. the reasons why some components, materials or structures require to be tested using non-destructive testing methods
7. why it is sometimes necessary to use a range of different non-destructive testing methods (such as magnetic particle, penetrant flaw detection, ultrasonic and radiography)
8. the various types of penetrant flaw detection equipment used (to include portable kits and fixed installations; containers and dispensers for penetrants, removers and developers)
9. the basic concepts of penetrant flaw detection testing (including the type and characteristics of penetrant liquids; how the liquids are absorbed by capillary flow into the surface of the product, breaking any discontinuities/flaws in the products)
10. how to develop indications of the discontinuities/flaws so that they show up clearly
11. the different types of penetrants that are used (including colour and fluorescent intensity, methods of applying them and contact time required to be effective)
12. the various types of penetrant removers (such as solvents, water-soluble and oil-soluble emulsifiers)
13. the various types of developers that are used (such as dry powder, powder in aqueous and non-aqueous carriers, developers in solution), and the contact times required for effective development
14. the type of lighting that is required for the defects/flaws to show up
clearly
15. the preparations to be carried out on the test area (such as degreasing); the effect of finish, contaminants and testing temperature on the test results achieved
16. how to carry out the testing activities (including the application of the penetrant, removal of excess penetrant, contact time, drying of products, application of developer, conditions for viewing developed indications (such as ambient light or ultraviolet (UV) light), and cleaning of the products on completion of the testing activities
17. the types of defect/flaws that are detectable using penetrant flaw detection methods
18. how to recognise the defects/flaws from the developed indications, and how to identify false indication of effects and their cause
19. the level of defects/flaws that are acceptable in the products; influence of the defects on the service/performance of the products
20. the system of quality control within the company, and who is responsible for it
21. why it is critical that records of penetrant flaw detection on the products, materials or structures are accurate, comprehensive and maintained legibly
22. the person that you need to pass the inspection records to
23. the extent of your own responsibility, and whom you should report to if you have problems that you cannot resolve
SEMETS322
Inspecting engineering products by penetrant flaw detection techniques

Scope/range related to performance criteria

1. Carry out all of the following during the penetrant flaw detection activities:
   1. obtain the required penetrant flaw detection equipment and materials, and check that they are in a safe and usable condition
   2. use appropriate personal protective equipment
   3. comply with job instructions/techniques, NDT testing inspection specifications, relevant COSHH sheets and risk assessment documentation
   4. check that penetrant flaw detection dispensers are fully operational
   5. follow the defined testing procedures/techniques, and apply safe working practices and procedures at all times
   6. leave the work area in a safe condition on completion of the activities

2. Check and confirm that all of the following ambient testing conditions are satisfactory:
   1. temperature
   2. humidity
   3. freedom from pollutants

3. Prepare the products, materials or structures for testing, to include carrying out all of the following:
   1. identifying and marking the test areas
   2. removing any contaminants from the test area (such as degreasing)
   3. preparing the surface of the test area to the specified finish (such as grinding or polishing)

4. Use both of the following penetrant flaw detection dispensers:
   1. penetrant
   2. developer

5. Carry out all of the following, in accordance with instructions and procedures:
   1. applying penetrant to the area under inspection
   2. washing and drying the test area
   3. applying a developer (where appropriate)
   4. observing defect indications under correct lighting conditions
5. recording conclusions of observations
6. restoring and cleaning the product on completion of the test

6. Carry out penetrant flaw detection on one of the following:
   1. welded joints
   2. castings
   3. wrought products/materials (such as forged, rolled, extruded)
   4. cold formed products/materials (such as by bending, pressing, rolling)
   5. heat treated components
   6. structures (such as airframes, lifting beams, pressure vessels)
   7. other specific products

7. Identify all of the following:
   1. defect/flaw type
   2. dimensional size of the defect/flaw
   3. location of the defect/flaw

8. Follow the correct procedure to deal with components, materials or structures which fall into three of the following categories:
   1. components, materials or structures which meet the specification
   2. components, materials or structures with identified defects/flaws
   3. components, materials or structures requiring further investigation
   4. components, materials or structures requiring other inspection methods

9. Complete a NDT report, to include recording all of the following:
   1. product identification
   2. material of construction
   3. geometry, thickness and surface condition where defect indications were found
   4. ambient testing conditions
   5. defects identified
   6. comparison of flaw data with acceptance criteria
7. conclusions and recommendations
8. personal data

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