Overview

This standard identifies the competencies you need to carry out penetrant flaw detection tests on ferrous and non-ferrous castings produced from sand or ceramic moulds, dies or investment shells, in accordance with approved procedures/techniques. The castings inspected 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.

You will be required to prepare the castings for the penetrant flaw detection activities and to check that the equipment complies with the specification requirements, is safe to use and is 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 you will 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 castings to show where there are any indications of 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 penetrant flaw detection 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 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 on its flaw detecting capabilities. Your knowledge will include an appreciation of 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 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.
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. identify and confirm the inspection checks to be made and acceptance criteria to be used
3. carry out the inspections, using appropriate equipment and techniques
4. identify any casting defects/flaws or variations from product specification
5. record the results of the inspections in the appropriate format
6. deal promptly and effectively with problems within your control and report those that cannot be solved
7. ensure that work records are completed, stored securely and available to others, as per organisational requirements
8. 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 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)
8. the 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 casting; breaking any discontinuities/flaws in the castings; and how to develop indications of the discontinuities/flaws so that they show up clearly)
10. the different types of penetrants that are used (including colour and fluorescent intensity), methods of applying them and contact time required to be effective
11. the various types of penetrant removers (solvents, water soluble and oil soluble emulsifiers)
12. the various types of developers that are used (dry powder, powder in aqueous and non-aqueous carriers, developers in solution); contact times required for effective development
13. the type of lighting that is required for the defects/flaws to show up clearly
14. the preparations that need to be carried out on the casting test area (degreasing); the effect of finish, contaminants and testing
temperature on the test results achieved
15. the importance of ensuring parts to be tested are clean and potential impact on testing activities if they are not clean
16. how to carry out the testing activities, including selecting tools, equipment and techniques for testing in daylight and in the dark, the application of the penetrant, removal of excess penetrant, contact time, drying of casting, application of developer, conditions for viewing developed indications (ambient light or ultra violet (UV)) and cleaning of the castings on completion of the testing activities
17. the types of defect/flaws or discontinuities that are detectable using penetrant flaw detection methods (sub-surface connected blowholes/shrinkage, inclusions, cracks, hot tears, cold shut, mis-runs, scab, oxide fold and mould-metal reactions)
18. how to recognise the defects/flaws from the developed indications, and identify false indication of effects and their cause
19. the level of defects/flaws that are acceptable in the castings, the influence of the defects/flaws on the service/performance of the casting
20. the system of quality control within the company and who is responsible for it
21. the extent of your own responsibility and whom you should report to if you have problems that you cannot resolve
22. how to access, use and maintain information to comply with organisational requirements and legislation
1. Inspect castings using penetrant flaw detection techniques, carrying out all of the following activities:
   1. obtain the required penetrant flaw detection equipment and materials, and check they are in a safe and usable condition
   2. adhere to health and safety regulations, systems and procedures to realise a safe system of work
   3. comply with job instructions/techniques, NDT testing inspection specifications
   4. follow the defined testing procedures/techniques leave the work area in a safe condition on completion of the activities

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

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

4. Obtain the appropriate penetrant flaw detection dispensers, to include both of the following, and check that they are fully operational:
   1. penetrant dispenser
   2. developer dispenser

5. Carry out the specified tests, in accordance with instructions and procedures, to include all of the following:
   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 for (ambient light or ultra violet (UV))
   5. recording conclusions of observations
   6. restoring and cleaning the casting on completion of the test

6. Identify five of the following casting surface defects/flaws:
   1. inclusions
   2. cold shuts
3. oxide folds
4. cracks
5. mis-runs
6. mould metal reactions
7. hot tears
8. scabs
9. sub-surface connected blowholes/shrinkages
10. other defects/flaws (specify)

7. Follow the correct procedures to deal with castings in all of the following categories:
   1. castings which meet the specification
   2. castings with identified defects/flaws
   3. castings requiring further investigation
   4. castings requiring other inspection methods

8. Complete the inspection, carrying out all of the following activities:
   1. marking up defective castings with all relevant information
   2. recording all the required details of the inspection in the appropriate format
   3. handing over the castings and inspection details to the appropriate people
Inspecting castings using penetrant flaw detection techniques

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