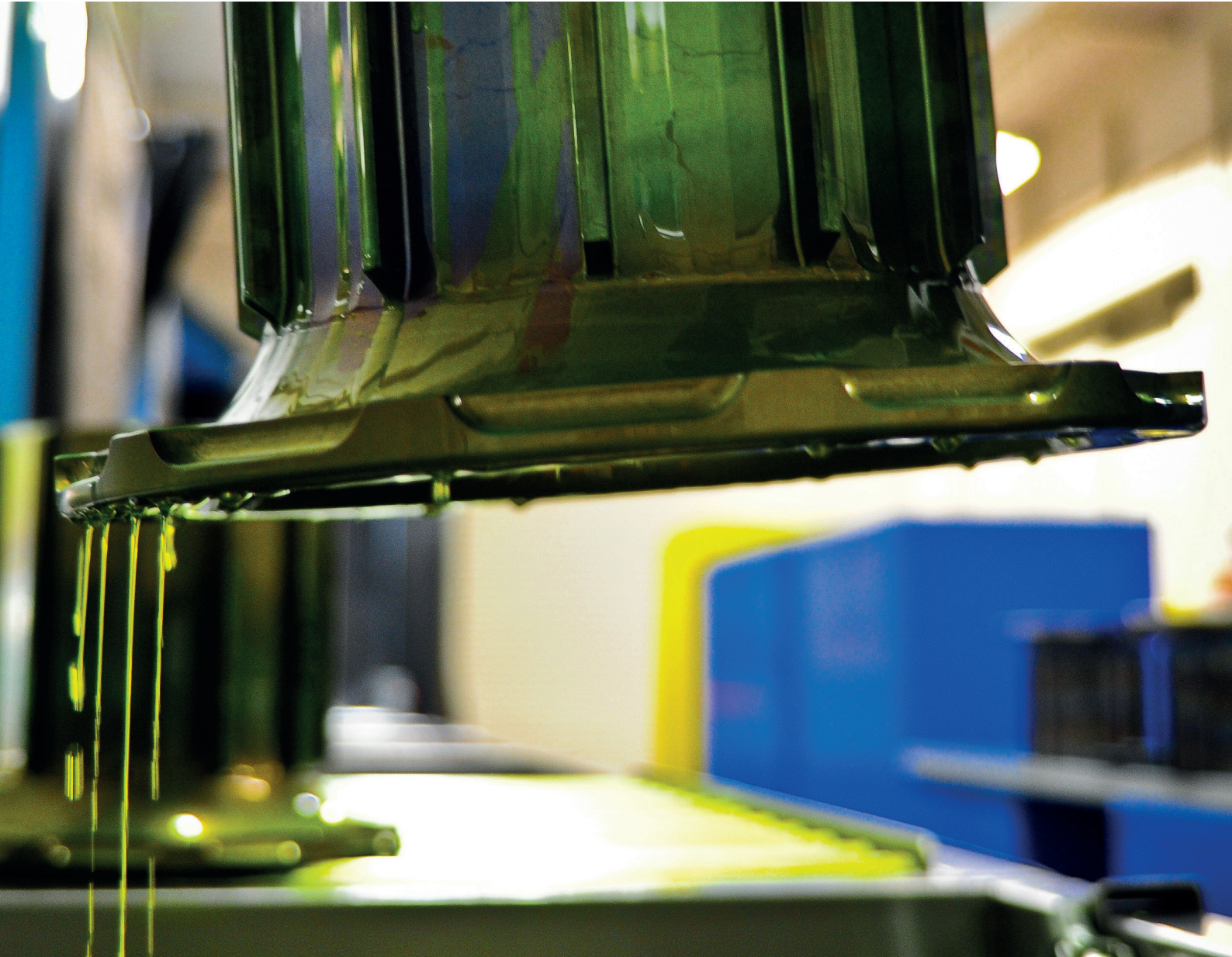


Employer's Unit of Competence – **Penetrant testing of materials, products and plant**

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THE BRITISH INSTITUTE OF
NON-DESTRUCTIVE TESTING



Overview

This unit identifies the competencies required to carry out penetrant flaw detection tests on ferrous and non-ferrous engineering products, materials or structures in accordance with approved procedures.

The apprentice will be required to prepare the products for penetrant flaw detection activities and to check that the equipment complies with the specification requirements, is safe to use and fit for purpose. They must ensure that the ambient conditions are satisfactory for the tests to proceed. They 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. They will complete the tests by preparing/completing an NDT test report containing the required test information and data, along with their interpretation of the test indications. They 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.

The apprentice's responsibilities will require them to comply with organisational policy and procedures for the penetrant flaw detection testing activities undertaken. Any problems with the activities or equipment in use that they cannot personally resolve, or are outside their permitted authority, will be reported to the relevant people. They will be expected to work with minimal supervision, taking personal responsibility for their actions and for the quality and accuracy of the work they carry out.

The apprentice's underpinning knowledge will demonstrate a good understanding of their work and will provide an informed approach to the inspection of engineering products by using penetrant flaw detection testing techniques. They 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. They will have detailed knowledge of testing practices and will understand why this method has significant limitations in its flaw detecting capabilities. Their knowledge will include an appreciation of hazards and safe working practices and they will understand the risks posed by material defects and the consequences of failure. The importance of compiling accurate and legible reports will also be a key issue in completing this unit.

The apprentice will understand the safety precautions required when carrying out the penetrant flaw detection activities and when using the associated tools and equipment. They will be required to demonstrate safe working practices throughout and will understand the responsibility they owe to themselves and others in the workplace.

Performance Criteria

The apprentice must be able to:

- P1 Work safely at all times, complying with health & safety and other relevant regulations and guidelines
- P2 Follow the correct specification for the product or equipment being inspected
- P3 Use the correct equipment to carry out the inspection
- P4 Identify and confirm the inspection checks to be made and acceptance criteria to be used
- P5 Carry out all required inspections as specified
- P6 Identify any defects or variations from the specification
- P7 Record the results of the inspection in the appropriate format
- P8 Deal promptly and effectively with problems within your control and report those that cannot be solved.

Knowledge and Understanding

The apprentice needs to know and understand:

- K1 The specific safety precautions to be taken when carrying out penetrant flaw detection activities on engineering products, materials or structures
- K2 The hazards associated with carrying out the penetrant flaw detection activities (such as using inflammable, potentially toxic and volatile materials, the use of aerosol containers and safety in the use of sprays and powders) and how they can be minimised
- K3 The type(s) of personal protective equipment (PPE) to be used and how to obtain it
- K4 The COSHH regulations relating to materials used during the penetrant flaw detection process
- K5 How to obtain the necessary job instructions and testing specifications and how to interpret this information
- K6 The reasons why some components, materials or structures need to be inspected using non-destructive testing methods
- K7 Why it is sometimes necessary to use a range of different non-destructive testing methods (such as magnetic particle inspection, penetrant flaw detection, ultrasonics and radiography)
- K8 The various types of penetrant flaw detection equipment used (to include portable kits and fixed installations as well as containers and dispensers for penetrants, removers and developers)
- K9 The basic concepts of penetrant flaw detection testing (including the type and characteristics of penetrant liquids and how the liquids are absorbed by capillary flow into the surface of the product, breaking any discontinuities/flaws in the products)
- K10 How to develop indications of the discontinuities/flaws so that they show up clearly
- K11 The different types of penetrants that are used (including colour and fluorescent intensity, the methods of applying them and the contact time required to be effective)
- K12 The various types of penetrant removers (such as solvents and water-soluble and oil-soluble emulsifiers)
- K13 The various types of developers that are used (such as dry powder, powder in aqueous and non-aqueous carriers and developers in solution) and the contact times required for effective development
- K14 The type of lighting that is required for the defects to show up clearly
- K15 The preparations to be carried out on the test area (such as degreasing) and the effect of finish, contaminants and testing temperature on the test results achieved
- K16 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
- K17 The types of defect that are detectable using penetrant flaw detection methods
- K18 How to recognise the defects from the developed indications and how to identify the false indication of effects and their cause
- K19 The level of defects that are acceptable in the products and the influence of the defects on the service/performance of the products
- K20 The system of quality control within the company and who is responsible for it
- K21 Why it is critical that records of penetrant flaw detection on the products, materials or structures are accurate, comprehensive and maintained legibly
- K22 The person that the inspection records need to be passed to
- K23 The extent of their own responsibility and to whom they should report if there are problems that they cannot resolve.

Skills

Scope/range related to performance criteria

The apprentice must be able to:

1. Carry out **all** of the following during the penetrant flaw detection activities:
 - Obtain the required penetrant flaw detection equipment and materials and check that they are in a safe and usable condition
 - Use appropriate personal protective equipment
 - Comply with job instructions, NDT testing inspection specifications, relevant COSHH sheets and risk assessment documentation
 - Check that penetrant flaw detection dispensers are fully operational
 - Follow the defined testing procedures and apply safe working practices and procedures at all times
 - 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:
 - Temperature
 - Humidity
 - Freedom from contaminants.
3. Prepare the products, materials or structures for testing, to include carrying out **all** of the following:
 - Identifying and marking the test areas
 - Removing any contaminants from the test area (such as degreasing and coating removal)
 - Preparing the surface of the test area to the specified finish (such as grinding, etching or machining).
4. Use of the following penetrant flaw detection dispensers where applicable:
 - Penetrant
 - Emulsifiers
 - Developer.
5. Carry out **all** of the following, in accordance with instructions and procedures:
 - Cleaning and drying the test area
 - Applying penetrant to the area under inspection
 - Correct removal of the penetrant after the required time
 - Applying a developer (where appropriate)
 - Observing defect indications under correct lighting conditions (ambient light or ultraviolet (UV) light)
 - Recording conclusions of observations
 - Restoring and cleaning the product on completion of the test.
6. Carry out penetrant flaw detection on **one** of the following:
 - Welded joints
 - Castings

- Wrought products/materials (such as forged, rolled or extruded)
 - Cold-formed products/materials (formed, for example, by bending, pressing or rolling)
 - Heat-treated components
 - Structures (such as airframes, lifting beams or pressure vessels)
 - Other specific products.
7. Identify **all** of the following:
- Defect type
 - Dimensional size of the defect
 - Location of the defect.
8. Follow the correct procedure to deal with components, materials or structures that fall into **three** of the following categories:
- Components, materials or structures that meet the specification
 - Components, materials or structures with identified defects
 - Components, materials or structures requiring further investigation
 - Components, materials or structures requiring other inspection methods.
9. Complete an NDT report, to include recording **all** of the following:
- Product identification
 - Equipment/consumables used
 - Material
 - Surface condition
 - Ambient testing conditions
 - Defects identified
 - Comparison of flaw data with acceptance criteria
 - Conclusions and/or recommendations
 - Personal data.
10. Complete the inspection activities, to include carrying out **all** of the following:
- Marking up defective components, materials or structures with all relevant information
 - Recording all the required details of the inspection in the appropriate format
 - Handing over the inspection details to the appropriate people.

