

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



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Supported by lead employer

Rolls-Royce



Overview

This unit identifies the competencies required to carry out the dimensional and visual inspection of engineering components in accordance with approved procedures. The scope includes checks prior to, during and post production, along with in-service checks.

The apprentice will be required to select the appropriate inspection equipment, based on the features to be checked and the accuracy to be measured. Part of the requirement will involve checking that the appropriate equipment is within current test dates, that the equipment has been maintained in a safe state and, where necessary, setting up and calibrating the equipment ready for the inspection operations to be performed. Additionally, if required, he/she will check that the materials specified conform to the relevant codes/standards and specifications. The different product types, manufacturing status and whether the component is in-service will all impact on the type of inspection required. Inspections during manufacture ensure that the manufacturing activities are proceeding according to the requirements and good practice. The apprentice will visually inspect the components against the acceptance criteria, which could be during or post manufacture or while in-service, checking that dimensions, distortion, damage or flaws are either within or out of specified tolerances. They will mark areas where non-compliance exists and record the results of the inspection using the approved reports. The repair procedure for defects (if possible) has to be understood, along with an understanding of defect types and their detrimental effect on the component.

The apprentice's responsibilities will require them to comply with organisational policy and agreed codes/standards/procedures for the inspection activities. 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 own actions and for the quality and accuracy of the work they carry out.

The apprentice's underpinning knowledge will demonstrate a good understanding of the importance of the work and will provide an informed approach to applying visual inspection procedures to components. They will understand the inspection process and its application and will know about the equipment and inspection techniques in adequate depth to provide a sound basis for carrying out the activities to the required specification. They will appreciate the need to have the correct materials and consumables for the task and to work to the agreed codes and standards, reporting the results in a clear and concise way. Additionally, they will understand the need for suitable lighting conditions, along with the requirement to demonstrate that they have adequate uncorrected or corrected vision in accordance with national standards and colour vision acceptable to the employing company, allowing them to competently perform the inspection.

Performance Criteria

The apprentice must be able to:

- P1 Work safely at all times, complying with health & safety and other relevant regulations and guidelines, including site-specific rules
- P2 Follow the correct specification for the product or equipment being inspected, using adequate lighting
- P3 Use the correct equipment to carry out the inspection in a competent way, with acceptable near-distance acuity and colour vision
- 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 their 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 visually inspecting (such as specific legislation or regulations governing the activities or work area, safe working practices and procedures to be adopted, general workshop safety practice, risk assessment procedures and relevant requirements of HASAWA, COSHH and Work Equipment Regulations)
- K2 The personal protective clothing and equipment that should be worn (such as leather gloves, eye protection (corrected if required), ear protection, safety harness, etc)
- K3 The hazards associated with visual inspection (such as working at height, safety in enclosed/confined spaces, handling fabricated structures, slips, trips and falls) and how they can be minimised. The need for adequate lighting
- K4 How and where to obtain the required drawings and related specifications, and how to check that they are current and complete
- K5 How to extract information from engineering drawings and related specifications (to include symbols (including welding symbols and nomenclature) and conventions to appropriate BS, EN or ISO standards) in relation to the work undertaken
- K6 How to interpret first and third angle drawings, understand imperial and metric systems of measurement, use work-piece reference points and systems of tolerancing
- K7 The types and features of components
- K8 The appropriate use of British, European and international standards at the correct issue in determining if components are fit for purpose
- K9 General principles of quality assurance systems and procedures
- K10 The cleanliness and physical condition of the test area
- K11 The visual and dimensional inspection methods and techniques that are used for the inspection
- K12 The equipment that is used to carry out the various inspection checks (such as rules and tapes, borescope, optical aids (such as magnifying glass and mirror), CCTV viewing system, lighting, recording equipment such as pens, paper, camera, etc)
- K13 Prior to fabrication, as an example, items that need to be checked (such as set-up, raw material condition, condition of consumables, equipment settings, etc)
- K14 During fabrication, as an example, the features of the component to be checked (such as linearity of profile, dimensional tolerances, distortion, shrinkage, visual appearance, etc)
- K15 For post fabrication, final documents, weld profiles, distortion, post-manufacture surface dressing and protection
- K16 Acceptance criteria to be used and the influence of defects on the service performance of the components (including risks and consequences of failure)
- K17 The need to carry out the checks and to record the results using the appropriate documentation
- K18 The procedure to be followed when inspected products are out of specification, as well as repair procedures
- K19 The importance of completing inspection documentation, what needs to be recorded and where records are kept
- K20 The extent of their own responsibility and to whom they should report if there are problems that they cannot resolve.

Scope/range related to performance criteria

The apprentice must be able to:

1. Carry out **all** of the following activities during the inspection process:
 - Observe all of the required safety procedures for the work area/activity
 - Obtain and use the correct issue of drawings, job instructions and procedure specifications
 - Obtain and check the condition and calibration dates of tools, measuring instruments and equipment used
 - Follow specified or appropriate inspection procedures
 - Identify and record out-of-specification features in the appropriate format
 - Identify and mark areas where non-compliance with specification or defect indications are found
 - Leave the work area in a safe and tidy condition on completion of the activities.
2. Ensure that they have the required inspection equipment and that it is in good working order; checks should be carried out as appropriate to the operation/features on **six** of the following:
 - CCTV viewing system
 - Depth gauge
 - Borescope
 - Means of marking defective areas
 - Shadow graphs
 - Profile gauges
 - Micrometers
 - Verniers
 - Surface table (of a suitable size for the largest measurement)
 - V-blocks
 - Block-mounted pointers/sensors
 - Squares, rules and protractors
 - External calipers
 - Dial-reading bore gauge
 - Hand magnifiers (×2, ×5)
 - Lupes with metric scales no greater than ×7
 - Mirrors – various sizes up to 50 mm diameter with fixed and articulating heads
 - Light sources – penlights, flashlights, bespoke sources to power intrascope and fibrescope
 - Indirect viewer – either fibrescope or endoscope with forward and side viewing lenses
 - Photometer
 - Welding gauges
 - Surface protective systems
 - Thickness meters
 - Binocular inspection.

3. Carry out specified inspection checks, to include some of the following, as appropriate:
 - Lighting measurements
 - Luminance
 - Lighting levels
 - Lighting techniques
 - Contrast cleanliness
 - Colour
 - Condition
 - Shape
 - Size
 - Temperature
 - Texture
 - Type
 - Surface finish
 - Surface preparation.
4. Carry out the inspection of **two** of the following types of component:
 - Weld
 - Cast
 - Wrought
 - Forging
 - Part machined
 - Fully machined.
5. Carry out specified inspection during fabrication/manufacture to check the following:
 - Availability of inspection requirements
 - Material compliance, including any consumables
 - Relevant fit-up compliance.
6. Carry out the final inspection checks, including the following:
 - Overall dimensional tolerances
 - Visual appearance
 - Extent of distortion, shrinkage, misalignment or other type
 - Evidence of damage (requiring repair/re-work)
 - Defect indications
 - Extent of excess material, or lack of material.
7. Carry out the inspection checks to **one** or more of the following:
 - Approved construction/fabrication/manufacturing drawings
 - Client specifications/detail drawings
 - Applicable national and international standards
 - Welding/manufacturing procedure specification (as appropriate).

8. Complete the inspection documentation, to include **one** from the following:
- Inspection report
 - Job card
 - Customer-specific documentation
 - Concession report.

