Employer's Unit of Competence –
Sector-specific product technology

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Overview

Before undertaking any form of NDT inspection, it is essential that inspection personnel are fully conversant with the engineering working practices, manufacturing processes, operating environments and flaws/defects that they are likely to encounter within the industrial sector in which they are employed and the potential for those flaws to compromise the integrity, reliability or longevity of a component or material. This knowledge can be collectively described as sector-specific product technology (SSPT).

This unit identifies the key areas of sector-specific background engineering knowledge that the apprentice is required to acquire in order for them to effectively apply the most appropriate NDT inspection method(s)/technique(s) to full advantage, maximising the inspection process in detecting, identifying, sizing and recording applicable discontinuities that may compromise the integrity of the item under test. In addition, by having a thorough understanding of SSPT, the apprentice will have a contextual appreciation of engineering practice and how it applies to their environment, enhancing their forensic evaluation competency in NDT applications.

It is not the intention of this unit to be prescriptive in the exact contents of the SSPT syllabus, but rather to define knowledge modules that an employer may wish to incorporate as part of the unique training programme that meets the employer's business profile. For example, if an employer's business is solely concerned with the manufacture and inspection of cast steel automotive components, then there is no reason why the apprentice should have a detailed knowledge of welding processes.

In following an SSPT programme as part of the apprenticeship scheme, the apprentice will also gain experience and competency in researching additional complementary information from a wide range of sources and develop a network for information exchange to augment their knowledge.

In conjunction with developing NDT technical competence, the apprentice, through an increasing awareness of SSPT, will be expected to design NDT inspection techniques to be capable of detecting discontinuities that may affect the integrity of an item/plant component requiring inspection.

In conjunction with developing NDT technical competence, the apprentice will be expected to base inspection assessments upon appropriate SSPT knowledge to draw conclusions about the type of anomalies present and to consider their relevance to the classification and rejection/acceptance criteria given by the appropriate specification.

Through SSPT awareness, the apprentice will be capable of preparing/completing NDT test reports, which may contain information to include appropriate relevant details relating to the manufacturing of the item/plant component's and/or in-service history details.

The apprentice's knowledge will include an appreciation of hazards and safe working practices relevant to their SSPT environment and they will understand the risks posed by working within these types of environment. Their responsibilities will require them to comply with organisational policy and procedures for the inspection 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 SSPT knowledge will demonstrate a good understanding of their work and will provide an informed approach to the inspection of engineering products, materials or structures using NDT methods and techniques.

Performance Criteria

The apprentice must be able to:

P1 Work safely at all times, complying with health & safety and other relevant regulations, directives and guidelines

P2 Understand sector-specific terminology, manufacturing processes and plant/component/item identification systems

P3 Recognise sector-specific operating processes and operational parameters

P4 Recognise the sector-specific discontinuities/flaws/defects and degradation mechanisms likely to be encountered when undertaking inspection activities

P5 Apply SSPT in assessing inspection requirements and select the most appropriate method/technique to inspect an item based upon material type, operational constraints and the discontinuities likely to be encountered

P6 Deal promptly and effectively with problems within their control and report those that cannot be solved.

Knowledge and Understanding

The apprentice must know and understand SSPT within their employer's business activities, including:

K1 The specific safety precautions associated with sector-specific industries. They will understand the importance of safe working practices at their place of work as well as the relationship between safety and quality, *ie* that a structured inspection mitigates the risk of a latent safety event. Understand how human performance and human factors affect safety culture

K2 The hazards associated with plant process safety within sector-specific industries

K3 The type(s) of personal protective equipment (PPE) to be used and how to obtain it within sector-specific industries

K4 Sector-specific overview – have an understanding of their employer's business, where it is positioned within an industrial sector and its context; specific terminology, product line and/or process/operational plant type

K5 Materials science – have a clear understanding of the chemical, physical, mechanical and processing properties of materials and how the service and operational environments will dictate material choices to be used in an industrial sector. Where appropriate, have an understanding of stress/strain load systems, mechanical destructive testing techniques and finite element analysis, metallographic examination techniques, metallic structure deformation, strengthening, hardening and annealing processes. Oxidisation and corrosion of materials

K6 Manufacturing processes: casting – have a clear understanding of casting technology, including accepted terminology, standards and abbreviations, process and plant equipment. Pouring and feeding castings, solidification and shrinkage. Foundry casting processes: sand, die, investment, centrifugal and continuous. Understanding of the formation of casting flaws

K7 Manufacturing processes: millwork and forging – have a clear understanding of millwork technology, including accepted terminology, standards, abbreviations and processes (hot rolling, cold finishing, extrusion, tube and pipe making). Also to include forging processes, *ie* open die, closed die, drop forged, press forged and the progressive application of pressure forging. Understanding of the formation of forging flaws

K8 Manufacturing processes: machining – have a clear understanding of machining technology, including accepted terminology, standards and abbreviations and processes, *ie* milling, turning, drilling, grinding, abrasion, EDM and sawing. Understanding of the formation of machining flaws

K9 Manufacturing processes: fabrication – have a clear understanding of fabrication technology, including accepted terminology, standards and abbreviations and processes, *ie* thermal cutting processes, shearing, forming, bending and rolling. Assembly and erection, bolting and riveting

K10 Manufacturing processes: welding – have a clear understanding of welding technology, including accepted terminology, standards, abbreviations and processes, *ie* SMAW, GSAW, TIG and SAW. Awareness of the weldability of material, consumable selection, joining dissimilar materials and post-weld heat treatment. Familiarisation of weld procedure and welder approval process. Understanding of the formation of welding flaws formed during the manufacturing process and those resulting from ongoing exposure to in-service conditions

K11 Manufacturing processes: miscellaneous – have a clear understanding of technologies associated with plastics, non-metallic and composite materials, to include forming processes (moulding, casting and extrusion) and joining processes (resins, adhesive bonding and hot air welding). Understanding of the formation of flaws associated with plastic, non-metallic and composite materials

K12 Operational environments and degradation mechanisms – have a clear understanding of how a component's service life will be affected by its operational environment. Factors such as temperature, load, time, cyclic loading, corrosive, sour or erosive conditions may accelerate and reduce the expected service life of the component. Understanding of service degradation mechanisms such as fatigue, creep and environmentally-assisted degradation may require inspection strategies to be developed that were not originally considered at the time of manufacture

K13 Defect morphology – have a clear understanding of the level of defects/flaws that are acceptable in a component or structure, to include the influence of the defect/flaws on the service/performance of the product, component materials or structures. Awareness of how defect morphology, position and orientation may affect detectability by NDT methods and the need to apply careful selection of an appropriate NDT method/technique to allow detection and characterisation

K14 Surface finishes and protective systems – have a clear understanding of the effect that surface finishes and protective systems have on the ability to apply NDT methods and the likelihood to detect relevant indications

K15 Information management processes – have a clear understanding of the employer's systems for the recording of engineering activities. To include the reporting of inspections undertaken, the referral process and the mechanisms and control measures that manage the repair, rectification, replacement or return to service of unacceptable products/plant components

K16 Quality management system – have a clear understanding of the employer's quality assurance, quality control and inspection and test plan practices that underwrite the NDT activities through an auditable and transparent process. Recognise that they are an integral part of the QMS and have a responsibility to positively contribute to its successful implementation

K17 The extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

Skills

The apprentice must be able to:

S1 Seek, explore and research for complementary information from a wide range of available sources and develop a network for information exchange to augment their engineering information knowledge base

S2 Utilise SSPT knowledge and apply it in the design, choice and application of NDT methods and techniques to be capable of detecting discontinuities that may affect the integrity of engineering products, materials, structures or plant components requiring inspection

S3 Sentence the inspected item based on an appreciation of the risks posed by material/structure defects/flaws, the related potential consequences of component failure within the operating environment and by applying precise flaw severity assessments that can be unambiguously matched against the specified rejection/acceptance criteria

S4 Prepare and complete NDT test reports, which may contain information relating to the manufacture of SSPT items/plant components and/or in-service history details

S5 Identify risks, hazards and safe working practices relevant to their SSPT environment

S6 Comply with organisational policy and procedures for the inspection activities undertaken and report any problems with the activities or equipment in use that they cannot personally resolve, or are outside their permitted authority, to the relevant people

S7 Work with minimal supervision, taking personal responsibility for their actions and for the quality and accuracy of the work they carry out. Their underpinning SSPT knowledge will demonstrate a good understanding of their work and will provide an informed approach to the inspection of engineering products, materials or structures using NDT methods and techniques.