Non-Destructive Testing (NDT) Engineering Technician – **Assessment Plan**

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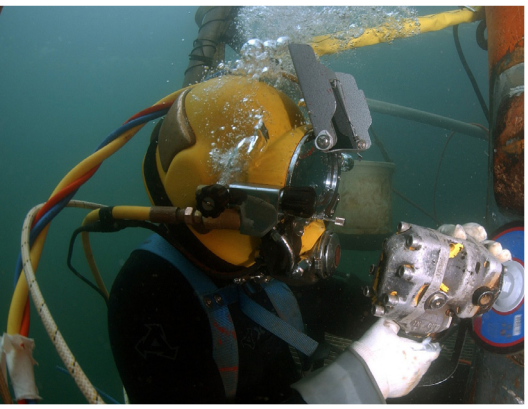




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Development Group

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Quarterly checks on progress.

Key:
- Lead Provider Assessment
- Employer Assessment
- End-point Assessment

Gateway

Employer's Final Review

Determine that the NDT Level 2 qualifications have been completed.

Determine that the knowledge requirements stipulated in the standard have been met.

Determine that the skill requirements stipulated in the standard have been met.

Determine that the behaviour requirements stipulated in the standard have been met.

End-Point Assessment
(Carried out by independent assessment organisation)

Review of Evidence and Achievements

Carry out a review of all evidence and achievements, including mapping the outcomes to the requirements of the apprenticeship standard. Review course attendance, end-of-course tests, examination results, log book of on-the-job training, CPD, awards, certificates and employer's reports and assessments.

Product Showcase – Presentation of NDT Project

The apprentice will give a comprehensive presentation of the NDT project. The presentation will establish that the project, which has been designed to encompass as many requirements of the apprenticeship standard as possible, has been completed and that the requisite knowledge and skills have been achieved.

Synoptic Assessment Interview

Carry out a synoptic interview to ensure that the apprentice has achieved those aspects of the apprenticeship standard that were not covered by the project presentation. This will include non-project technical requirements, behaviours and health & safety. The interview will also cover Engineering Council EngTech requirements, such as engineering knowledge, personal responsibility, communication skills and personal commitment.

Overview of the Independent Assessment Organisation's Activities

Independent Assessment Organisation's Decision

The independent assessment organisation will have had no involvement in the development of the apprentice.

Based on the documentation review, the project showcase presentation and the synoptic assessment interview, the independent assessment organisation will make a decision as to whether the apprentice has achieved the required levels of knowledge, skills and behaviour and any other requirements specified in the standard and, if so, whether to award a 'Pass' or a 'Distinction'.

Synoptic Assessment Interview

The end-point assessment will be conducted by the independent assessment organisation and will include a synoptic assessment interview. The interview panel will include two Engineering Council registrants knowledgeable in NDT and appointed by the independent assessment organisation. The interview will cover knowledge, skills and behaviours specified in the standard, will address any shortfalls in the project showcase presentation and portfolio of evidence and will take into account the Engineering Council UK-SPEC requirements for Engineering Technician (EngTech) registration.

Project Showcase – Presentation of NDT Project

The project showcase will be presented by the apprentice to the independent assessment organisation. The presentation will establish that the NDT project, which has been designed to encompass as many knowledge and skills requirements of the apprenticeship standard as possible, has been completed and the requisite knowledge and skills have been achieved.

Documentation Review

The independent assessment organisation will review the portfolio of evidence provided by the employer, the lead provider and apprentice and make their own assessment against a formal checklist. At this stage, the independent assessment organisation may request additional information and/or evidence. The portfolio of evidence will include certificates of competence, letters of approval, training attendance certificates, log book of on-the-job training (experience), employer reports, the EngTech competency matching form and the apprentice's project report. If the independent assessment organisation is satisfied with the overall evidence, it will arrange the project showcase presentation and the synoptic end-point interview.

Gateway to the End-Point Assessment

Notes

Reference numbers identified in red in this document [Ref:] relate to the requirements expressed in the Non-Destructive Testing (NDT) Engineering Technician standard. Details of other references are listed in Section I.

Other documents that will be of interest to the apprentice, employer, lead provider and independent assessment organisation can be found on the British Institute of NDT's website (www.bindt.org). These include the Engineering Technician Standard [**Ref: 4**], Apprentice's Guidance Document [**Ref: 6**], On-Programme Competency Development [**Ref: 7**] and Employer's Units of Competence [**Ref: 8**].

Section A – Overview of the Apprenticeship

At the beginning of the apprenticeship, it is recommended that the employer and the apprentice develop a schedule (quality plan), in the form of a GANTT chart, to demonstrate how the desired outcomes will be achieved throughout the apprenticeship.

In order for the apprenticeship to be completed in accordance with the approved apprenticeship standard and for the apprentice to be successful in achieving a minimum of a 'Pass', the apprentice, the employer and the lead providers need to follow a structured process, as suggested below.

A1 Recommended On-Programme Assessment

The apprentice will embark on a foundation stage of the apprenticeship, which will last for the first six months. The apprentice is expected to gain a basic understanding of the knowledge, skills and behaviour requirements and will cover NDT methods, product technology, health & safety and behaviours. Apprentices will not be allowed to progress to the development stage until they have completed the foundation stage. The development stage will commence at six months and will continue until the end of the apprenticeship. The requirements are to gain the knowledge, skills and behaviours specified in the standard [Ref: 3.0]. In particular, to obtain the appropriate knowledge and skills to pass examinations for three NDT Level 2 methods, including at least one complex method. The employer will undertake quarterly reviews with the apprentice to match progress against the requirements of the standard, assessment plan and other documentation. At the end of the development stage, the employer will collate all the evidence, including the log book, the portfolio of evidence, the EngTech competency matching form, the project report, certificates, results and quarterly appraisals. The employer will then carry out an assessment of all the accumulated evidence with the apprentice to determine that the on-programme outcomes of the apprenticeship have been achieved.

A2 Independent Assessment Organisation's End-Point Assessment

The independent assessment organisation will have had no involvement in the development of the apprentice.

The end-point assessment will be carried out by the independent assessment organisation and will include:

- A thorough review of the portfolio of evidence, including the log book of experience, results, end-of-course tests, certificates, EngTech competency matching form and the employer's reports produced during the apprenticeship. The portfolio of evidence will be tested during the synoptic interview.
- A project showcase presentation by the apprentice on the NDT project, to establish what elements of the apprenticeship standard have been completed and what requisite knowledge and skills have been achieved.
- A synoptic end-point interview with the apprentice to ensure that the apprentice has achieved those aspects of the apprenticeship standard that were not covered by the project showcase presentation. These could include non-project technical requirements, behaviours, health & safety and Engineering Council UK-SPEC EngTech registration requirements [**Ref: 3**], such as engineering knowledge, personal responsibility, communication skills and personal commitment. The interview will also include testing the portfolio of evidence.

The interview panel will comprise two Engineering Council registrants, trained as interviewers and knowledgeable in NDT and the apprenticeship process.

After the interview, the independent assessment organisation will make a decision as to whether the apprentice has successfully completed the apprenticeship (and is therefore 'EngTech ready') and, if so, whether to award a 'Pass' or a 'Distinction'.

Section B – End-Point Assessment

B1 Assessment ('What')

The end-point assessment will consider the knowledge, skills and behaviours that have been achieved during the apprenticeship. The assessors will carry out a gap analysis of the outcomes against the requirements of the standard and include appropriate questions in the interview.

A summary of the knowledge, skills and behaviours that will be assessed is listed below.

B1.1 Knowledge

The apprentice will undertake training, both in a classroom environment and on-site, including NDT Level 2 training in three methods, comprising at least one complex method (mandatory) and a choice of any two other methods (Appendix 1). A list of the methods is summarised below:

- Ultrasonic testing – complex. [Ref: 3.1c]
- Radiographic testing – complex. [Ref: 3.1c]
- Eddy current testing – complex. [Ref: 3.1c]
- Infrared thermography testing – complex. [Ref: 3.1c]
- Magnetic particle testing. [Ref: 3.1c]
- Penetrant testing. [Ref: 3.1c]
- Visual testing. [Ref: 3.1c]

In addition to the NDT methods, it is a requirement that the apprentice obtains knowledge of:

- Engineering and scientific principles, including relevant mathematics, numerical and data analysis. [Ref: 3.1d]
- Industry-specific product technology, including material types, defect types, defect mechanisms, growth rates, industry-specific NDT applications and R&D opportunities. [Ref: 3.1i]
- How to use the results of engineering NDT analysis for the purpose of developing solutions to well-defined engineering problems, including materials, equipment, tools, processes and products relating to NDT. [Ref: 3.1j]
- Health & safety and company general requirements, permits to work, inductions, specific NDT applications, confidentiality, risk assessments, safety passport, working at heights and in confined spaces, chemical handling, radiation safety, restricted zones (gas, nuclear and site radiography, etc) and other requirements where applicable. [Ref:3.1l]
- The use of codes, standards procedures and techniques. [Ref: 3.1g]
- Limitations of methods and techniques. [Ref: 3.1h]
- Quality assurance, audit and surveillance. [Ref: 3.1g]
- General engineering. [Ref: 3.1j]
- NDT project management. [Ref: 3.1m]
- Human factors and behaviours. [Ref: 3.3]
- Understanding the consequences of failure. [Ref: 3.1n]

B1.2 Skills

The apprentice will be able to use their knowledge in order to develop skills and to demonstrate their proficiency by passing the appropriate NDT Level 2 examination, resulting in the award of a certificate or letter of approval. The apprentice could also demonstrate the acquisition of skills by passing end-of-course tests or examinations where appropriate.

In order to demonstrate that skills have been acquired in accordance with national and international standards, the apprentice must:

- Pass three NDT Level 2 method examinations. [Ref: 3.2c]
- Undergo supervised practice of the NDT methods they intend to study during their apprenticeship. [Ref: 3.2b]
- Manage a project through to completion*. [Ref: 3.2n]

*The apprentice will be given a project to undertake and report on, which will demonstrate some of the knowledge and skills he/she has learnt during the apprenticeship. An example of a project is as follows:

Project Proposal

This is a start-to-finish project that requires the apprentice to carry out some research, determine the inspection methodology, prepare NDT technique sheets, carry out the inspection and report the findings.

Given a weld configuration, casting, forging or other material, determine what steps are needed to fully inspect the component.

Aspects to consider

- What type of NDT procedure and technique sheets need to be created?
- What inspection authority is mandating the inspection?
- What national or international codes have to be complied with?
- What equipment is required?
- What defects are being sought?
- What material(s) is the component made of?
- Does the specification require surface inspection, volumetric inspection or both?
- What methods would you select to undertake the inspection?
- Are there any limitations of the test?
- Are there any special NDT processes required, such as techniques, consumables or probes?
- What are the reporting requirements?

The project will be assessed on:

- Preparation;
- Planning;
- Project tasks and continuous review; and
- Project completion.

As part of the skills set, it is required that the apprentice will also:

- Pass the end-of-course test/examination for the common methods appreciation of NDT course and, if appropriate, pass the end-of-course Level 1 examination for the complex method(s).
- Gain an appreciation of the NDT equipment that will be used during the apprenticeship by developing practical skills. [Ref: 3.2b]
- Pass end-of-course tests or examinations associated with product technology, health & safety and other selected modules. [Ref: 3.2b]
- Pass end-of-course tests or examinations for general engineering. [Ref: 3.2d]
- Apply appropriate solutions to well-defined engineering problems using the chosen NDT methods. [Ref: 3.2k]
- Select appropriate methods and techniques and understand their limitations. [Ref: 3.2e]

- Implement quality control and quality assurance of NDT systems and performance. [Ref: 3.2h]
- Supervise and project manage areas of work and be able to audit other people's work and reports for compliance and accuracy. [Ref: 3.2f and 3.2n]
- Interpret engineering/CAD drawings, particularly those related to weld/component configuration and produce and submit clear and precise NDT reports and instructions. [Ref: 3.2k and 3.2m]

B1.3 Behaviours

Exhibiting good behaviour is essential for the NDT Engineering Technician to work responsibly in the workplace. In order to assist the end-point assessment, the employer will carry out regular appraisals of the behaviours and prepare reports for the independent assessment organisation's end-point assessment. As part of the end-point assessment, the apprentice will be measured against the following criteria:

- Behaviour – develop an understanding of behaviours. [Ref: 3.3]
- Human factors – understand the impact of human factors, especially with respect to NDT. [Ref: 3.3]
- Teamwork – work effectively in a team and be trusted by others. [Ref: 3.3b]
- Courage – be willing to stand in the minority and be respected and understood when doing so. [Ref: 3.3c]
- Delivery – consistently see things through to timely completion. [Ref: 3.3d]
- Leadership – provide direction, implement plans and motivate people. [Ref: 3.3a]
- Influence – have a positive impact in multiple contexts without relying on others, and be assertive. [Ref: 3.3f]
- Compassion – have empathy for the predicaments of others, particularly junior staff. [Ref: 3.3g]
- Ethics – to act with maturity, honesty, integrity and responsibility. [Ref: 3.3h]
- Clear focus – avoid distractions and be a good communicator. [Ref: 3.3i]
- Environmental awareness – undertake safe working practices for self, others and the environment. [Ref: 3.3j]
- Personal responsibility – take responsibility as an individual and as a team member. [Ref: 3.3k]
- UK-SPEC behaviours:
  - Exhibit ethical conduct in engineering. [Ref: 3.3h]
  - Promote sustainable development.
  - Be aware of legal requirements governing engineering, including personnel, health & safety, intellectual property rights, product safety and liability issues.
  - Be aware of risk issues.

B1.4 Experience (On-the-Job Training) [Ref: 3.2b]

It is important to understand what is meant by experience in terms of acquiring NDT certification. Experience is mandatory and is defined in the national and international standards as 'supervised practice' – in reality it is on-the-job training. The person carrying out the supervision needs to be suitably experienced and qualified in the application of the NDT method(s) undertaken. The end-point assessment will review the extent of experience gained for each NDT method during the apprenticeship. For the purpose of this apprenticeship, experience may include:

- Carrying out the method(s) under supervision
- Working closely with a suitably experienced inspector who is inspecting a weld, component or material, etc
- Working within a team carrying out the method(s)
- Fast-tracked training at a training centre
- Supervised practice at a training school
- Calibrating equipment
- Checking the parameters of equipment, such as probe angles, beam spread or magnetic flux, etc
- Carrying out any other activities of the method identified in the syllabus.

If the apprentice is attempting more than one method at the same time, *ie* within the apprenticeship, it is recognised that there are some common themes, such as product technology, that run through all methods and therefore there are allowances (a reduction of time) in experience for this.

The minimum duration of experience for NDT Level 2 for a single method is given in the following Table:

Table 1. Minimum duration of experience (on-the-job training)

NDT method	Experience (months)*	Experience (hours)**
Ultrasonic testing (UT)	12	2080
Radiographic testing (RT)	12	2080
Eddy current testing (ET)	12	2080
Thermography testing (TT)	12	2080
Visual testing (VT)	4	694
Magnetic particle testing (MT)	4	694
Penetrant testing (PT)	4	694

*Work experience in months is based on a nominal 40 hours/week or the legal week of work. When an individual is working in excess of 40 hours per week, he/she may be credited with experience based on the total hours, but he/she shall be required to produce evidence of this experience.

**Hours in the Table are based on a nominal 40 hours/week but could vary if the working week is different from 40 hours.

Although the excess working hours will shorten the length of time required to achieve the necessary NDT experience, it does not in any way affect the length of the apprenticeship because of other knowledge, skills and behaviours requirements identified in the standard. The apprenticeship duration remains at typically three years.

According to the standards, reductions may be applicable if two or more methods are being carried out at the same time.

B2 Assessment ('How')

The end-point assessment will be carried out by the independent assessment organisation and will include a portfolio assessment, a project showcase presentation and a synoptic interview with the apprentice.

The independent assessment organisation will carry out a portfolio assessment of all the gathered evidence (from the employer, lead provider and apprentice) and make its own assessment against a formal checklist (Appendix 2). At this stage, the independent assessment organisation may request additional information and/or evidence. If the independent assessment organisation is not satisfied with the overall evidence, it will either fail the apprentice (because the apprentice has fallen well below the required standard) or invite the employer to allow more time (to be specified) for the apprentice to reach the required standard. If the employer declines the offer of more time, the apprentice has failed; if the employer agrees to more time, then the apprentice will be reassessed at the end of the specified time period.

The interview panel will include two Engineering Council registrants from the independent assessment organisation. The interview questions will cover the Engineering Council UK-SPEC requirements of Engineering Technician (EngTech) registration.

B3 Assessment ('Who')

Because non-destructive testing is considered to be a highly-specialised engineering profession and is inextricably linked to international standards, UKAS accreditation, Engineering Council registration and certification, it is considered that the independent assessment organisation assessors should have extensive knowledge of NDT.

The independent assessment organisation will constitute an assessment panel, which will include two Engineering Council registrants who are approved professional review interviewers. The independent assessment organisation assessment panel will not include anyone involved in an active apprenticeship from the same company or one of its subsidiaries.

The apprentice's skills, knowledge and behaviours will be assessed at the end-point assessment by the independent assessment organisation; however, the independent assessment organisation will rely on the employer's assessment of outcomes that are best assessed in the workplace, such as behaviours and human factors.

B4 Quality Assurance

We are considering employer-led approaches for quality assurance and governance and are working through the options with BIS. At the moment, assessment organisations that wish to deliver against the standard will need to be on the SFA register of assessment organisations.

Section C – Weighting and Grading

The apprentice will be scored against the knowledge, skills and behaviours gained within the apprenticeship, as well as the document review, the project showcase presentation and the synoptic interview.

Table 2. Minimum scores required and maximum scores achievable for the apprenticeship

	Knowledge and skill sets	Sub totals		Totals %	
		Minimum	Maximum	Minimum	Maximum
Project showcase presentation	Core knowledge and skills – NDT	25.2%	36%	42%	60%
	Other knowledge and skills, including health & safety	10.5%	15%		
	Behaviours and human factors	6.3%	9%		
Synoptic end-point interview	Core knowledge and skills – NDT	10.5%	15%	17.5%	25%
	Other knowledge and skills, including health & safety	3.5%	5%		
	Behaviours and human factors	3.5%	5%		
Documentation and evidence	Core knowledge and skills – NDT	6.3%	9%	10.5%	15%
	Other knowledge and skills, including health & safety	2.1%	3%		
	Behaviours and human factors	2.1%	3%		
Totals		**70%**	**100%**	**70%**	**100%**

C1 Weighting

Table 2 above shows the minimum scores required and the maximum scores achievable for the apprenticeship and demonstrates how weighting has been applied. Although the Table above displays minimum requirements for 'Other knowledge and skills, including health & safety' and 'Behaviours and human factors', the minimum scores are based on composite grading, which means that the high-level category requires a minimum average score, whereas individual components within the category could be a lesser percentage.

For example, in the project showcase presentation 'Behaviours and human factors' you require 6.3%, but in the individual components, such as 'Influence' or 'Teamwork', you could score less than 6.3% provided that you scored higher in other components to bring the average score back up to 6.3%.

The sections for 'Core knowledge and skills' are treated differently, in as much as you are required to achieve a minimum score in each module of each NDT method qualification (see C2 Grading on the following page).

C2 Grading

During the competency development and achievement of NDT certification, the apprentice is required to achieve a minimum of 70% in each module of all three NDT methods. If the apprentice does not achieve 70% in each module of all three NDT methods, he/she will not be allowed through the gateway to the end-point assessment and if retraining does not rectify the shortcomings, then the apprentice will fail the apprenticeship.

During the end-point assessment the apprentice is required to achieve:

- a minimum of 70% for core knowledge and skills of NDT methods;
- a minimum of 70% composite grading for other knowledge and skills, including health & safety;
- a minimum of 70% composite grading for knowledge of behaviours and human factors.

NOTE: Composite grading in this context means an average across the category.

If the apprentice achieves the above minimums he/she will have passed the apprenticeship.

There are two levels of pass: 'Pass' and 'Distinction'. If the apprentice satisfies the above criteria and achieves 70% or over but less than 80%, they will receive a 'Pass' designation; if the apprentice satisfies the above criteria and achieves 80% or over, they will receive a 'Distinction' designation.

Section D – Implementation/Delivery

The NDT Engineering Technician Apprenticeship standard, assessment plan and funding cap have now been approved. Employers and providers are encouraged to promote and deliver the apprenticeship in accordance with the NDT Engineering Technician standard.

During and at the end of the apprenticeship, the employer and independent assessment organisation will carry out an internal audit to ensure the accuracy and consistency of implementation and delivery.

Section E – Ensuring Independence and Impartiality of Assessment

Independence and impartiality are achieved through the final end-point assessment being undertaken by an independent assessment organisation listed on the 'Register of Apprentice Assessment Organisations' using the Bravo Solution portal. The independent assessor will make a holistic assessment of each apprentice's work, including the grade to be awarded, on the basis of evidence supplied through the 'portfolio of evidence', project showcase presentation and the interview. The portfolio of evidence will include the log book, test results, examination results, certificates, EngTech competency matching form, the apprentice's project and the employer's reports obtained during the apprenticeship. Organisations delivering the independent assessor service will need to include two Engineering Council registrants, knowledgeable in NDT.

Section F – Affordability

There were two factors affecting the promotion of apprenticeships in the non-destructive testing sector. One was the lack of opportunity, particularly with in-service inspections, and the other was self-funding of the engineering technician, particularly for SMEs.

The costs and practicality of assessment have been key considerations in the development of this apprenticeship, not least because of the number of smaller businesses who would find it extremely difficult, if not impossible, to develop and run an apprenticeship scheme without assistance from government, an independent assessment organisation and the professional body.

Cost-effectiveness has been increased by enhancing learning opportunities, development of online learning modules, combining the requirements of the apprenticeship with the requirements of professional registration, assistance with training costs and carrying out the project showcase presentation and the synoptic interview on the same day.

The cost of the end-point assessment as a percentage of the training costs is approximately 10% to 12%.

Section G – Manageability/Feasibility

The use of the approved standard [**Ref: 4**], approved Assessment Plan [**Ref: 5**], Apprentice's Guidance Document [**Ref: 6**], On-Programme Competency Development [**Ref: 7**] and Employer's Units of Competence [**Ref: 8**] ensures that assessments will be conducted consistently whilst maintaining incentives for those organisations to be innovative and cost-effective. It will also ensure that there is capacity to meet immediate and future demands. It is also anticipated that the turnaround of assessments will not unduly delay the award of the apprenticeship to successful candidates.

Section H – Professional Body Recognition

Professional registration is the process whereby an individual is admitted to the Engineering Council's register as an Engineering Technician, Incorporated Engineer or Chartered Engineer, based on the individual demonstration, via a peer review process by a licenced professional engineering institute, that he/she has met the professional standards of commitment and competence.

Section I – References

Ref: 1 BS EN ISO 9712:2012 – Non-destructive testing – Qualification and certification of NDT personnel

Ref: 2 BS EN 4179 – Aerospace series – Qualification and approval of personnel for non-destructive testing

Ref: 3 UK-SPEC – The UK Standard for Professional Engineering Competence

Ref: 4 Non-Destructive Testing (NDT) Engineering Technician Standard

Ref: 5 Non-Destructive Testing (NDT) Engineering Technician Apprenticeship Assessment Plan

Ref: 6 Apprentice's Guidance Document (located on the British Institute of NDT website at www.bindt.org)

Ref: 7 On-Programme Competency Development (located on the British Institute of NDT website at www.bindt.org)

Ref: 8 Employer's Units of Competence

Section J – Glossary

Apart from the acronyms mentioned in this document, other acronyms have been added to provide the reader with useful information they may come across when reading other NDT documentation.

AQB	Authorised qualifying body
ATO	Approved training organisation
BINDT	British Institute of Non-Destructive Testing
CAD	Computer-aided design
CCNSG	Client/Contractor National Safety Group
CEng	Engineering Council, Chartered Engineer registration grade
CPD	Continuing professional development
CSD	BINDT Certification Services Division
ECITB	Engineering Construction Industry Training Board
EngTech	Engineering Council, Engineering Technician registration grade
EngTech-ready	This describes the situation whereby the apprentice has fulfilled all of the requirements for EngTech registration, including passing the professional review interview
GANTT	An illustration of a project schedule that was devised by Henry Gantt in 1910
IEng	Engineering Council, Incorporated Engineer registration grade
IOSH	Institute of Occupational Safety and Health
NDT	Non-destructive testing
PEI	Professional engineering institute

SFA	Skills Funding Agency
UKAS	United Kingdom Accreditation Service
UK-SPEC	The UK Standard for Professional Engineering Competence

Appendix 1

Description of NDT Methods

The apprentice will undertake safety-critical and complex training, both in a classroom environment and on-site, which will include NDT Level 2 training in a minimum of three methods and which will comprise at least one complex method (mandatory) and a choice of any two other methods. Each method is described briefly below:

- **Visual testing:** Visual inspection, with or without optical aids, is the original method of NDT. Many defects are surface-breaking and can be detected by careful direct visual inspection. Optical aids include low-power magnifiers, microscopes, telescopes and also specialised devices such as borescopes, endoscopes and other fibre-optic devices for the inspection of restricted-access areas. These devices can also be used with television camera systems. Much of the success of visual inspection depends on the surface condition and the lighting arrangements. Surface preparation such as cleaning and etching is often used. [Ref: 3.1b]
- **Ultrasonic testing:** Ultrasonic methods of NDT use beams of mechanical waves (vibrations) of short wavelength and high frequency, transmitted from a small probe and detected by the same or other probes. Such mechanical waves can travel large distances in fine-grain metal, in the form of a divergent wave with progressive attenuation. The frequency is in the range from 0.1 to 20 MHz and the wavelength is in the range from 1 to 10 mm. The velocity depends on the material and is in the range from 1000-6000 m/s. The technique detects internal, hidden discontinuities that may be deep below the surface. Transducers and coupling wedges are available to generate waves of several types, including longitudinal, shear and surface waves. Applications range from thickness measurements of thin steel plate to internal testing of large turbine rotors. [Ref: 3.1b]
- **Radiographic testing:** Radiography uses X-rays or gamma rays to produce an image of an object on film. The image is usually natural size. X-rays and gamma rays are very short wavelength electromagnetic radiation that can pass through solid material, being partly absorbed during transmission. Thus, if an X-ray source is placed on one side of a specimen and a photographic film on the other side, an image is obtained on the film of the thickness variations in the specimen, whether these are surface or internal. This is a well-established technique that gives a permanent record and is widely used to detect internal flaws in weldments and castings and to check for misconstructions in assemblies. The source of radiation is either an X-ray tube or a pellet of radioactive material emitting gamma radiation. [Ref: 3.1b]
- **Eddy current testing:** In eddy current testing, a coil carrying an AC current is placed close to the specimen surface or around the specimen. The current in the coil generates circulating eddy currents in the specimen close to the surface and these in turn affect the current in the coil by mutual induction. Flaws and material variations in the specimen affect the strength of the eddy currents. The presence of flaws and so on is therefore measured by electrical changes in the exciting coil. Both voltage and phase changes can be measured, but some simpler instruments measure only the voltage changes. The strength of the eddy currents produced depends on the electrical conductivity of the specimen, the magnetic permeability (for a ferromagnetic specimen), the stand-off distance between the specimen and coil, the AC frequency used in the exciting coil and the dimensions of the coil and specimen. [Ref: 3.1b]
- **Magnetic particle testing:** This method is used for the detection of surface and near-surface flaws in ferromagnetic materials and is primarily used for crack detection. The specimen is magnetised either locally or overall and, if the material is sound, the magnetic flux is predominantly inside the material. If, however, there is a surface-breaking flaw, the magnetic field is distorted, causing local magnetic flux leakage around the flaw. This leakage flux is displayed by covering the surface with very fine iron particles, applied either dry or suspended in a liquid. The particles accumulate at the regions of flux leakage, producing a build-up that can be seen visually, even when the crack opening is very narrow. Thus, a crack is indicated as a line of iron powder particles on the surface. [Ref: 3.1b]

- **Penetrant testing:** This is a simple, low-cost method of detecting surface-breaking flaws such as cracks, laps, porosity, etc. To be detected, the flaw must reach the surface to be tested. Penetrant testing is one step up from visual inspection and offers many advantages, such as speed, large-area coverage and cheapness. It is usually a six-stage process:
  - surface cleaning (degreasing, etc)
  - application of a penetrant liquid (dipping, spray, brush)
  - removal of excess penetrant (solvent, water)
  - application of developer
  - inspection of the test surface (visual, television camera)
  - post-inspection cleaning (anti-corrosion solutions).

  [Ref: 3.1b]
- **Infrared thermography testing:** Thermography is a technique of obtaining an image of the heat distribution over the surface of an object. The usual method is to use a special television camera with an infrared sensitive detector and a lens that transmits infrared radiation. Such cameras can operate at normal video rates. Temperature variations in the subject are then displayed as shades of grey or can be converted into a pseudo-colour image. Temperature variations as small as 0.1°C can be detected. The two main fields of application are:
  - to look at the heat distribution in hot specimens, such as furnace walls, insulated structures, electronic circuits, etc, in a steady-state – generally known as passive thermography;
  - to provide a pulsed source of heat on one side of a specimen and examine the other side for non-uniformities in infrared emission that would correspond to internal inhomogeneities or large flaws – generally known as active thermography. [Ref: 3.1b]

Appendix 2

Independent Assessment Organisation's Assessment Checklist

Chair of Independent Assessment Organisation:			
Module for review	**Yes**	**No**	**Assessment Comments**
Was the apprentice issued with a start-up pack?			
Was the quality plan submitted to the independent assessment organisation?			
In the first three months, did the apprentice register as an Affiliate Member of the professional body?			
In the first three months, did the apprentice initiate a CPD record online?			
Have the apprenticeship manager's three monthly reports been received?			
Did the apprenticeship manager ensure that the foundation section was achieved before embarking on the development section?			
Has the completed log book been submitted?			
Has the completed portfolio of evidence been submitted?			
Has the apprentice's project been submitted?			
Has the EngTech competency matching form been received?			

Scoring	Minimum totals for a 'Pass'	Minimum totals for a 'Distinction'	Percentage of Apprenticeship	Actual
NDT Project				
Core knowledge and skills	70%	80%	60%	
Other knowledge and skills, including health & safety	70%	80%		
Behaviours and human factors	70%	80%		
End-Point Assessment				
Core knowledge and skills	70%	80%	25%	
Other knowledge and skills, including health & safety	70%	80%		
Behaviours and human factors	70%	80%		
Documentation and Evidence				
Core knowledge and skills	70%	80%	15%	
Other knowledge and skills, including health & safety	70%	80%		
Behaviours and human factors	70%	80%		
Minimum totals to pass the apprenticeship	**70% (Pass)**	**80% (Distinction)**		

Synoptic End-Point Interview

(Scores derived from notes taken during interview)

Candidate's name:		**Candidate reference:**	
Place of interview:		**Date and time:**	
Independent assessors			
Observer/moderator			

		Very strong 3	Practise standard 2	Adequate awareness 1	Little or no evidence 0	Row score	Block mean score
A	1. Review and select appropriate techniques, procedures and methods to undertake tasks						
	2. Use appropriate scientific, technical or engineering principles						
B	1. Identify problems and apply appropriate methods to identify causes and achieve satisfactory solutions						
	2. Identify, organise and use resources effectively to complete tasks, with consideration for cost, quality, safety, security and environmental impact						
C	1. Work reliably and effectively without close supervision, to the appropriate codes of practice						
	2. Accept responsibility for work of self or others						
	3. Accept, allocate and supervise technical and other tasks						
D	1. Use oral, written and electronic methods for the communication in English of technical and other information						
	2. Work effectively with colleagues, clients, suppliers or the public and be aware of the needs and concerns of others, especially where related to diversity and equality						
E	1. Comply with the Code of Conduct of your institution						
	2. Manage and apply safe systems of work						
	3. Undertake engineering work in a way that contributes to sustainable development						
	4. Carry out and record CPD necessary to maintain and enhance competence in own area of practice						
	5. Exercise responsibilities in an ethical manner						
	Total score						

Reporting Considerations for Synoptic End-Point Interview

1. You should consider passing the candidate if the following conditions are met:
   - The total score is not less than 24; and
   - The block mean score in any block is not less than 1.5; and
   - There is not more than one zero across the whole form; and (where applicable)
   - Any special requirements of the apprenticeship have been satisfied.
2. Where these conditions are not met by a small margin but the interviewers wish to recommend a pass, they may argue a case for dispensation from normal guidelines. This must not be out of misplaced kindness but because there is evidence that cannot properly be accounted for on the form. Give the reasons below:
3. Where the guidelines are not met and there is no exceptional case to be made under paragraph 2, the candidate is not yet ready to pass his or her apprenticeship; it may be possible to re-test the evidence against the criteria at a later date, provided both the candidate and employer agree to that course of action and the timescales.

Notes

Issued by the British Institute of Non-Destructive Testing
Midsummer House, Riverside Way, Bedford Road, Northampton NN1 5NX, United Kingdom
Tel: +44 (0)1604 438300 | Fax: +44 (0)1604 438301 | Email: apprenticeships@bindt.org