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Qualification

Specification

EAL Level 3 Technical Occupational Entry in Mechanical Engineering Principles (Diploma)

Qualification Number: 610/3912/3

Version 1

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# About EAL

For over fifty years, EAL has been the specialist awarding organisation for engineering, manufacturing, building services and related sectors. Developed to the highest technical standards, our qualifications reflect ever-changing industry and regulatory needs. We support the providers of our qualifications with an unparalleled level of service to ensure that learners are well prepared to take the next step in their journeys, whether study, an apprenticeship or work.

Through industry partnerships with EAL Centres and training providers, decades of experience supporting our core sectors, and our role as part of the Enginuity Group, we have built unrivalled knowledge and understanding of employer skills needs. As a result, EAL’s skills solutions, including apprenticeship End-Point Assessment, External Quality Assurance and qualifications are respected and chosen by employers to deliver real lifelong career benefits for all our learners. That’s why in the last ten years, 1.2 million people across the UK have taken EAL qualifications.

## 1.1 Equal Opportunities and Diversity

EAL expects its Centres to enable learners to have equal access to training and assessment for qualifications in line with equalities legislation. Further details can be located in the EAL Equal Opportunities and Diversity Policy.

## 1.2 Customer Experience and Feedback

Customer Experience is a fundamental part of EAL’s commitment to you. EAL aims to ensure that all customers receive a high-quality efficient service. We are always interested in feedback and if you have any comments or feedback on our qualifications, products or services, please contact the Customer Experience team:

EAL Customer Experience

Tel: +44 (0)1923 652 400

Email: Customer.Experience@eal.org.uk

# Introduction to the Qualification

What is this qualification?

This qualification is for adults only (19+) and aligns to the knowledge, skills, and behaviours (KSBs) in the Engineering Fitter occupational standard (Apprenticeship Standard in England).

It **will not** make the student industry competent in mechanical engineering fitting work but facilitates progression into the occupation by providing potential employers with reliable evidence of a learner’s attainment against the Engineering Fitter Apprenticeship Standard.

It is intended to form part of an engaging course of learning for adult learners, and provide occupational entry, so that learners can progress with further learning and training by employment and completion of the apprenticeship standard including the relevant pathway.

Who is this qualification for?

Adults (19+) who wish to pursue a career in the mechanical engineering fitting sector but have not yet secured employment or an apprenticeship.

What does this qualification cover?

This qualification comprises of units which reflect the KSBs in the Engineering Fitter Apprenticeship Standard.

Please refer to Section 3: Qualification Structure for the units included in this qualification.

## 2.1 Support for this Qualification

This qualification:

* is regulated at Level 3
* is supported by employers from the engineering sector
* forms part of a recognised route to help adults into employment in the industry

## 2.2 Progression Opportunities

Learners who complete this qualification will be able to demonstrate to potential employers their commitment and achievement against the KSBs in the Engineering Fitter Apprenticeship Standard, thus enhancing employability prospects. This will also enable learners to progress to the recognised sector apprenticeship, and work toward becoming an industry recognised mechanical engineering fitter. Learners can further progress to undertake qualifications such as:

* EAL Level 3 Diploma in Advanced Manufacturing Engineering (Development Knowledge)

Further information can be obtained from the EAL Website or alternatively contact:

EAL Customer Experience

Tel: +44 (0)1923 652 400

Email: Customer.Experience@eal.org.uk

## 2.3 Qualification Support Materials

The following materials are available for these qualifications:

* **Assessor Pack**: which contains all relevant assessor guidance relating to the delivery and assessment and marking schemes for the holistically assessed practical and knowledge assessments
* **Learner Assessment Pack:** which contains the holistically assessed practical and knowledge assessments, assessment checklists and all associated guidance for learners
* **Holistic Knowledge Assessments:** which contains knowledge assessments that must be completed by the learner under appropriately controlled conditions
* **\*Practice Exam:** for the externally set and marked on-screen exam.

**\***The practice exams are available to schedule online as per externally set and marked exams.

All other materials can be accessed by EAL registered Centres from the EAL Website [www.eal.org.uk](http://www.eal.org.uk)

## 2.4 Achievement of the Qualification

This qualification is gained when all the necessary units have been achieved. The Centre will then be able to apply for the learner’s certificate.

# Qualification Structure

## 3.1 Rule of Combination

This qualification will be obtained by the learner once they have completed the **FOUR** mandatory core units and **THREE** mandatory occupational specialism units.

This qualification has **540** guided learning hours (GLH) and a Total Qualification Time (TQT) of **600** hours.

### **Mandatory core units**: **ALL** **must** be achieved.

|  |  |  |  |
| --- | --- | --- | --- |
| EAL Code | Unit Title | GLH | Ofqual Code |
| TOEC3/001 | Engineering and environmental health and safety in the workplace | 75 | M/651/0911 |
| TOEC3/002 | Engineering organisational efficiency and improvement  | 75 | R/651/0912 |
| TOEC3/003 | Essential mathematics and science for engineering and manufacturing | 60 | T/651/0913 |
| TOEC3/004 | The structure, properties and characteristics of common materials | 60 | Y/651/0914 |

### **Mandatory occupational specialism units**: **ALL must** be achieved.

|  |  |  |  |
| --- | --- | --- | --- |
| TOEMP3/001 | Mechanical principles of engineering systems | 75 | A/651/0915 |
| TOEMP3/002 | Apply manufacturing and assembly processes | 120 | D/651/0916 |
| TOEMP3/003 | Mechanical engineering inspection and quality control  | 75 | F/651/0917 |

# Centre and Qualification Approval

Centres wishing to run the qualifications will need to comply with the Qualification Specification and EAL’s Centre recognition criteria for these qualifications upon accreditation and launch. Centres must also put in place the appropriate physical and human resources and administration systems to effectively run the qualifications. Please refer to Section 5 for the requirements of Centre staff involved in the delivery of the qualifications.

**For existing EAL Centres to put the qualification on your Centre remit:**

* To add these qualifications to your Centre qualification remit, create and complete a qualification approval application form in Smarter Touch and submit to EAL

**For non EAL Centres to gain Centre approval to run the qualification:**

* Please contact the EAL Customer Experience Department, who will be delighted to hear from you:

EAL Customer Experience

Tel: +44 (0)1923 652 400

Email: Customer.Experience@eal.org.uk

# Profiles and Requirements

## 5.1 Staff Responsible for Registering and Certification of Learners

Centres are required to appoint a suitable member of staff who can take responsibility for registering learners onto qualifications, submitting entries for assessments to EAL, and taking receipt of external assessment procedures (if appropriate). They may also be responsible for applying to EAL for learner certificates. The role may be undertaken by the same person who undertakes quality assurance.

## 5.2 Teaching Staff

Tutors / trainers involved with the delivery of the units must demonstrate an understanding of the topics / technical content in this qualification. As a minimum they must have achieved a relevant technical qualification to at least Level 3 which covers the key topics in this qualification.

Teaching staff must have knowledge and understanding of:

* The qualification structure and content
* The learning outcomes and assessment criteria they are delivering

It is a recommendation that teaching staff will:

* Have a minimum of two years’ experience in teaching / training

 **or**

* Be working towards an appropriate teaching / training qualification

 **or**

* Hold an appropriate teaching / training qualification (e.g., Cert Ed or Learning and Development trainer units)

## 5.3 Learners

There are no formal academic entry requirements for the qualification; however, Centres should ensure that learners have the potential to achieve the qualification. Learners must have the minimum levels of literacy and numeracy to complete the learning outcomes and assessments.

Centres should make learners with particular requirements aware of the content of the qualification and they should be given every opportunity to successfully complete the qualification. EAL will consider any reasonable suggestions for, and from, those with disabilities that would help them to achieve the learning outcomes without compromising the standards required.

Age Restrictions

Learners **must** be at least 19 years old.

## 5.4 Assessors

The Centre must provide EAL with the names of any tutors, trainers or other individuals who will undertake internal assessment, so that these can be approved prior to them carrying out an assessment role.

Internal assessors must:

* Have knowledge and understanding of the assessment criteria they are assessing
* Have knowledge and understanding of the qualification structure, content and assessment components
* Understand the assessment process

It is a **recommendation** that assessor’s will**:**

* Have a minimum of two years’ experience in assessment (e.g. within an N/SVQ or teaching/training environment)

  **or**

* Be working towards an appropriate assessment qualification, such as the ‘Level 3 Award in Assessing Vocationally Related Achievement’

 **or**

* Hold an appropriate assessment qualification (as above)

Assessor continuing professional development

It is the responsibility of each assessor to identify and make use of opportunities for Continuing Professional Development (CPD), such as industry conferences, access to trade journals, and Professional Body / Trade Association events, at least on an annual basis to enhance and upgrade their professional development and technical knowledge.

It is imperative that records are kept of all such CPD opportunities / occasions and that they provide evidence of cascading such technical knowledge and industry intelligence to all relevant colleagues.

## 5.5 Markers: Technically Competent

Where Centre-based assessments are marked by a person who does not come into the assessor category, the marker must have auditable technical competence in the subject. As an example, for a scientific based assessment the person may have auditable competency in that subject area.

## 5.6 Internal Quality Assurers

This relates to staff undertaking internal verification / moderation of assessment. The Centre mustprovide EAL with the names of any tutors, trainers or other individuals who will undertake internal quality assurance, so that these can be approved prior to them carrying out this role.

The main focus of internal quality assurance for these qualifications are:

* The quality assurance of assessment procedures, including standardisation of assessment practice across different assessors within the Centre
* Internal standardisation of marking and moderation of learner grade awarded

Internal quality assurance staff **must**:

* Be familiar with the occupation(s) covered by the qualification
* Have knowledge and understanding of the qualification structure and content
* Understand the assessment process and the role of quality assurance

It is a recommendationthat the quality assurance staff will:

* Have experience in quality management / internal verification

 **or**

* Hold an appropriate qualification, such as the ‘Level 4 Award in the Internal Quality Assurance of Assessment Processes and Practice, or the ‘Level 4 Certificate in Leading the Internal Quality Assurance of Assessment Processes and Practice’

Continuing professional development of internal quality assurance staff

It is the responsibility of each internal quality assurance staff member to identify and make use of opportunities for CPD, such as industry conferences, access to trade journals, and SSC and Professional Body / Trade Association events, at least on an annual basis to enhance and upgrade their professional development and technical knowledge. It is imperative that records are kept of all such CPD opportunities/occasions and that they provide evidence of cascading such technical knowledge and industry intelligence to all relevant colleagues.

## 5.7 Staff Invigilating On-screen Exams

Members of staff with responsibility for invigilating on-screen exams must know, understand, and comply with the Procedures for Conducting the Exam Component within EAL Qualifications’ (EAF 1), which are published by EAL. These members of staff must also:

* Have experience in conducting and controlling exam sessions

 **or**

* Be supervised by an individual experienced in conducting and controlling exam sessions

Note: A tutor / trainer who has prepared the learners for the subject of the exam must not be the sole supervisor at any time during an exam for that subject(s).

# Assessment

The following table indicates the assessment components that are included in the qualification and for each component:

* Who is responsible for setting and marking the component
* How the component is quality assured

|  |  |  |  |
| --- | --- | --- | --- |
| **Assessment component** | **Set by** | **Marked by** | **Method of quality assurance** |
| **Internal** | **External** |
| On-screen exam1  | EAL | EAL | Exam invigilation | Verification and continuous monitoring via EQA visits |
| Centre marked holistic assessments2 | EAL | Centre | On-going standardisation within the Centre(Including moderation) | Verification and continuous monitoring via EQA visits |

1 Refer to Section 6.1 External Assessments (On-screen Exams).

2 Refer to Section 6.2 Internal Holistic Assessments (EAL Set and Centre Marked).

The learner must pass ALL assessments to achieve the qualification.

A breakdown showing the assessment requirements for each unit is shown below:

|  |  |  |  |
| --- | --- | --- | --- |
| **EAL Code** | **Unit Title** | **On-screen Exams** | **Centre Marked Holistic Assessments** |
| TOEC3/001 | Engineering and environmental health and safety in the workplace | Core Knowledge Exam 1 | No |
| TOEC3/002 | Engineering organisational efficiency and improvement |
| TOEC3/003 | Essential mathematics and science for engineering and manufacturing | Core Knowledge Exam 2 |
| TOEC3/004 | The structure, properties and characteristics of common materials |
| TOEMP3/001 | Mechanical principles of engineering systems | No | Holistic knowledge assessment  |
| TOEMP3/002 | Apply manufacturing and assembly processes | Holistic practical assessmentQuestioning component |
| TOEMP3/003 | Mechanical engineering inspection and quality control  |

## 6.1 External Assessments (On-screen Exams)

A specification for the exam, indicating the number of questions to be set for each learning outcome is provided in Appendix 1.

Key Points

* Arrangements must be made for learners to complete the external assessment between the 01st and the 30th of April
* The exam must be undertaken by the learner under controlled exam conditions, in accordance with EAL’s Procedures for Conducting the Exam Component within EAL Qualifications’ (EAF 1)
* The EAL co-ordinator within the Centre will assume responsibility for liaison and correspondence regarding the external assessment component
* Centres will be sampled, and spot checks will be carried out by EAL to ensure exams are delivered in accordance with EAL published procedures
* EAL will release exam results at the end of the third week in May.

Assessment objectives are used to set the level of thinking skills being assessed within the level 3 context, including knowledge, understanding and application of knowledge and understanding. Our approach to assessment objectives is designed to complement the purpose of the qualification and align with the occupational levels’ guidance provided by the regulator.

Each unit within the setting specification (Appendix 1) has a set number of questions. Across the questions, there is a question writing requirement to meet a defined coverage of each assessment objective so that the following assessment objective profile is met across the full range of assessment questions, as shown in the table below:

|  |  |
| --- | --- |
| **Assessment Objective**  | **MCQ Coverage**  |
| AO1 Knowledge of the principles, processes and procedures | 25% |
| AO 2 Understanding of the principles, processes and procedures | 50% |
| AO3 Application of understanding of the principles, processes and procedures | 25% |

Resitting external assessments (on-screen exams)

Learners who fail to achieve a pass will be permitted to resit the exam after feedback and appropriate tuition has taken place.

The learner will be allowed a maximum of two resit opportunities (three attempts in total). Learners who fail to achieve after three attempts will be required to re-register on the qualification.

The resits for externally set and marked exams will be subject to the current published charges.

Resit scheduling

Learners will be permitted to resit within the following arrangements:

Resit 1:

* EAL will open the window for the first resit scheduling opportunity during the last week of May
* Arrangements must be made for learners to complete the external assessment between 1st and the 14th of June.

Resit 2:

* EAL will open the window for the first resit scheduling opportunity during the last week of June
* Arrangements must be made for learners to complete the external assessment between 1st and the 14th of July.

Practice exams

In January of academic year 1 (following the launch of the qualification), EAL will make available an onscreen practice exam. This can be accessed via EAL’s Surpass Exam System. The practice exam is not part of the formal assessment arrangements and will therefore NOT count towards the qualification.

## 6.2 Internal Holistic Assessments (EAL Set and Centre Marked)

Internal holistic assessment both knowledge and practical are a form of controlled internal assessment marked by the Centre. General information regarding conducting controlled internal assessment can be found in the document ‘EAL Guidance for Controlled Internal Assessment marked by the Centre’ with specific guidance referenced from or contained within this qualification specification.

Internal holistic assessment includes practical and / or knowledge assessments. These assessments are set by EAL and marked by members of the delivery team at the Centre (see profiles of markers in Section 5). All assessment decisions are then subject to internal standardisation and external quality assurance.

Holistic assessments involve collecting and evaluating evidence that demonstrates achievement of the learning outcome / criteria. They are accompanied by marking criteria and other materials to ensure that the markers are consistent in their approach to assessment across learners.

Centres are responsible for ensuring that Centre marked assessments are suitably controlled to ensure that assessment decisions are valid and reliable, and that work submitted for assessment by learners is prepared and produced by them independently, without assistance from others, and free of plagiarism.

Specific Guidance - Controlled internal assessment marked by the Centre

Assessor packs

Assessor packs contain relevant information for Centre staff to use as reference/guidance. These documents must not be shared with the learner as they may contain confidential information for Centre staff only.

Learner assessment packs

Learner assessment packs contain instructions relating to the practical and knowledge assessment. Learners will require access to these documents when they are ready to be assessed. Assessors should issue the learner assessment packs to the learner, together with any Centre devised practical assessment task or tasks which have been developed based on the assessment specification provided by EAL. These documents must be controlled by the assessor and provided to the learner as and when required but not retained by the learner. All assessment documentation must be retained by the assessor and/ or internal quality assurer within the controlled environment, unless where otherwise specified. Centres must ensure that the assessment criteria information is only made available to a learner during the active part of the assessment.

Learners must be appropriately supervised when undertaking the practical and knowledge assessments. The level of supervision must be sufficient to safeguard the learners’ health and safety, and ensure the evidence generated is attributable to the learner.

Electronic systems and records

Interactive word-based versions of the learner assessment pack and knowledge assessments are available through on-line publications. Where an electronic system is used to administer the electronic versions of the learner assessment pack and /or knowledge assessment, the system used **must** operate with the necessary controls in the same manner as that described under ‘Learner assessment packs and knowledge assessment’ i.e., no assessment documentation should be left with the learners to have uncontrolled access etc. Any electronic system that is used **must** prevent the unauthorised sharing of assessment documentation by learners i.e., via email etc. Where electronic systems with the necessary controls are used, evidence such as learner reports and completed knowledge assessment answers may be uploaded or embedded within the system.

E-portfolio systems are generally NOT considered appropriate for delivering/administering internal assessments electronically. E-portfolio systems may be used to track learner attainment, record assessment outcomes and feedback. The following elements from the assessor and learner assessment packs may be replicated/uploaded to an e-portfolio system:

* Assessor pack: learning outcomes, assessment criteria, assessment specification to include the assessment criteria.
* Learner assessment pack: record of achievement for the knowledge assessment, assessment specification to include the assessment criteria, assessment checklist for the practical assessment and assessment feedback.

It is the responsibility of the internal quality assurer (IQA) for the qualification in advance to verifier the electronic system’s functionality and to agree the systems capabilities with regards to the control of qualification documentation before first use and to quality assure what has been uploaded/embedded is accurate and fit for purpose.

In relation to this qualification, evidence should generally not be uploaded to an e-portfolio system without the necessary controls but may reference to what the evidence is, and where this is located. Where electronic or e-portfolio systems are used, the system must be capable of capturing auditable electronic declarations of authenticity, learner and assessor sign off or the electronic equivalent.

About the holistic assessment

Learners are required to complete a holistic assessment for this qualification between the 01st of April and the 30th of June.

The holistic assessment will be set by EAL and comprise a work-related scenario.

The holistic assessment will be designed to cover a range of assessment criteria from several units that are relevant to the scenario and related tasks.

The holistic assessment will ensure that all relevant learning outcomes within the qualification have been appropriately covered.

The instructions provided with the holistic assessment will specify the time allowed to complete the tasks, the type of evidence that is expected, and other requirements, as appropriate.

Delivery of the holistic assessment will be subject to rigorous internal standardisation (including moderation).

Planning and conducting the Holistic Assessment

Scheduling the holistic assessment

Arrangements must be made for learners to complete the holistic assessment during the final term of their learning programme, or within the last third of the specified number of guided learning hours required to complete the qualification. Centres may determine the precise timing of the holistic assessment to suit local needs.

Time allowed

The time (number of hours) in which the holistic assessment must be completed will be specified in the instructions that accompany it from EAL. The ‘actual’ number of hours spent on the holistic assessment and the period over which it is completed, must be logged by the learner and verified by Centre staff.

Setting a deadline for completing the holistic assessment

The Centre must specify a due date when learners must complete the holistic assessment. The due date must fall within the designated period (see above) and be communicated clearly to learners. In setting the due date, consideration should be given to ensuring that:

* Learners have a realistic period of time in which to complete the holistic assessment, taking into consideration the specified number of hours and any possible limitations on access to equipment, materials, etc
* Sufficient time will be available for grading, moderation and external verification after the due date has passed
* Contingency arrangements need to be made in the event of learner absence and in extreme cases centres are advised to make a request for special consideration and/or reasonable adjustment.

Resources

Access to resources should be limited to those that are appropriate to the tasks to be completed as part of the holistic assessment, taking account of any requirement for learners to select appropriate tools and materials, if this is specified in the assessment criteria.

The nature of the holistic practical assessment is “open book”. This dictates that access to the internet may be a requirement but will be appropriately restricted in order for learners to access (e.g.) programming manuals, maintenance manuals, relevant formulas, etc. Centres will need to ensure access to unauthorised electronic or wi-fi enabled devices, such as laptops, mobile phones, mobile watches, etc. is restricted. This is to ensure confidentiality of all assessments. EAL recommends that all learner’s unauthorised electronic devices and wi-fi enabled devices, such as mobile phones/watches, are collected by the supervisor at the start of each session.

Learners should be provided with the flexibility to be able to move in the allocated workshop space from one station to another.

Supervision

Learners are not required to be directly supervised under high control conditions with invigilators and high-profile codes of conduct rules on display for learners to adhere to. However, there needs to be sufficient levels of supervision to enable the learner's work to be authenticated (e.g. by delivery staff). This measure will ensure that the progress of the response, at each stage of the development, to the assessment task the learner submits is their own.

The assessor will ensure that interactions between learners are kept to a minimum and are solely for the purpose of accessing the required facilities. At no time should learners be discussing information directly or indirectly related to the assessment.

Learner collaboration

Learners must complete and evidence their work individually. Collaboration between learners undertaking any aspect of the holistic assessment should only be allowed where tasks explicitly state that this is acceptable.

Completion and submission

Any material evidence and other supporting information submitted by learners for the holistic assessment will be detailed in the Learner Assessment Pack.

Advice and Feedback from Assessors

Assessors may review learners’ work and provide oral and/or written advice at a general level and, subsequently, allow learners to progress with their task. General advice of this nature does not need to be recorded or considered when the work is being assessed.

Assessors should not give any assistance which goes beyond general advice, for example:

* provide detailed specific advice on how to deliver any aspect of what is being assessed in the assessment criteria
* give detailed feedback on production mistakes which limits learners’ opportunities to show initiative themselves
* intervene personally to improve the product outcome

Assessors must not provisionally assess work (e.g. conduct a formative assessment) and then allow the learner to revise it. Failure of centre staff to adhere to this may constitute malpractice.

Late submission

Learners must complete their holistic assessment and hand in all relevant materials to the Centre by the due date. Any request to extend the submission date must be considered in accordance with EAL’s policy for Special Consideration.

Assessment decisions and annotation

Assessors are responsible for making assessment decisions of work, in accordance with the assessment criteria detailed in the relevant specification and guidance documents. Assessor annotation should be used to provide evidence to indicate how and why assessment decisions have been awarded. This will facilitate the standardisation of assessment decisions within the centre and enable the moderator to check that assessment decisions are in line with the assessment criteria.

Grading the holistic assessment

Centre assessors should allocate a grade for the holistic assessment for each learner using the Assessment Checklist provided. No other sources of information should be used to make judgements about the quality and sufficiency of the evidence.

All materials should be retained securely and confidentially by the Centre, in accordance with EAL policy.

Retaking Internal Holistic Assessments

Learners who fail to achieve a pass in any specific area of the holistic assessment/s will be permitted a retake opportunity after feedback and appropriate tuition have taken place.

The learner will be allowed a maximum of two retake opportunities (three attempts in total) for each section within the Assessment Checklist. Learners who fail to achieve after three attempts, will be required to re-register on the qualification.

All assessment documents that pass or refer must be recorded and retained by the Centre and made available on request.

Standardisation of Holistic Assessment

Members of the internal quality assurance team at the Centre should work with tutors / assessors to ensure that the correct procedures relating to the delivery of the holistic assessment are followed and ensure assessment decisions taken by different assessors are consistent, fair and reliable. Key activities will include:

* Meeting with tutor / assessors (individually and collectively) throughout the course to discuss quality assurance and standardisation issues and provide support and guidance where needed
* Observing tutor / assessors and giving them feedback to help improve their assessment technique
* Sampling learner evidence across different learner cohorts to ensure that appropriate standards have been met
* Arranging cross-marking of learner work to compare results and agree benchmarks

In addition, once all learners have undertaken and completed the holistic assessment and grading has been carried out, internal moderation should be undertaken by a nominated member of the quality assurance team. This will involve checking and / or re-marking a sample of learner’s work to:

* Ensure that assessors have been consistent in their use of the Assessment Checklist
* Ensure that grades have been allocated fairly and consistently for all learners
* Check the authenticity of learner evidence
* If appropriate, agree changes to grades where anomalies have been detected.

Centres/Organisations must have a moderation process in place to ensure that the assessing of internal assessments is both valid and reliable, through which adjustments to results are made and recorded accordingly. This ensures that the assessment process remains current and standards are consistently applied.

Internal moderation should be based on a sample of at least 25% of learners who have completed the holistic assessment and cover all assessors who have been involved in grading decisions. The sample should include any borderline cases that have been identified for review by assessors. If there are fewer than five learners who have completed the holistic assessment, then all learners’ work should be moderated.

Where inconsistencies or other discrepancies are identified, or where there is a disagreement on the grades allocated for particular learners, the level of sampling should be increased. All supporting records should include the comparison of assessment decisions from a representative sample of assessments including purposely highlighting where adjustments were necessary.

The outcomes from internal moderation of holistic assessment, including any proposed changes to allocated grades, should be recorded and made available to the External Quality Assurer.

Centres must maintain an assessment and feedback record for each learner, which details the evidence evaluated against the outcomes and the feedback given to the learner. The record will form part of the Learner Assessment Pack. These records must be available to the External Quality Assurer.

Centres/Organisations can utilise EAL’s IQA documents to support their moderation activities, which can be obtained through Smarter Touch.

Further guidance on holistic assessment is provided within the Assessor Pack.

Questioning component

At appropriate opportunities throughout the duration of the practical holistic assessment, the assessor will ask 10 open questions to assess any underpinning technical knowledge that did not naturally occur during the observation. The assessor may ask open questions to enable to learner to underpin the skills demonstrated too. The assessor may also ask follow-up questions where clarification is required. Examples of open question types have been provided in Section 3 of the Assessor Pack. Questioning must be completed within the total time allowed for the practical holistic assessment. All questions, together with the learner’s responses must be recorded and attached to the assessment recording document in the Learner Assessment Pack. The questioning component must be conducted on a one-to-one basis, under controlled conditions free from influence. A quiet room free from distraction should be made available to the learner if they wish to use it. However, due to the nature of the questions, the learner may choose to demonstrate part, or all, of their understanding whilst within the working area (e.g., by providing a narrative response during a walk through if appropriate).

The assessor should:

* Use open questions to provide opportunities for all learners to demonstrate attainment
* Use follow-up questions, giving the learner the opportunity to explore the discussion point fully. The questions should be thoughtful, relevant and pitched at the appropriate level
* Discuss the learner’s activities with them, looking for evidence of specific knowledge, procedures and processes, and decision making, together with their skills. Questioning should provide a gradual ‘handing over’ to the learner. You would expect the learner to be taking the lead in the discussion after the initial opening questions / brief

What to avoid:

* Using one question type throughout
* Answering the question yourself instead of expanding on it to get a response
* Overloading the learner with too many questions, allowing them no time to think or to answer fully
* Disregarding answers
* Spending too long on one area of discussion, reducing the time available for other areas
* Asking complex questions too early in the discussion
* Asking closed questions unless a ‘yes’ or ‘no’ answer is specifically required.

# Quality Control of Assessments

There are two major activities in which EAL interacts with the Centre in relation to the External Quality Control of Assessment for this qualification. These are:

* Recognition: When a Centre decides to offer the qualification, the EAL External Quality Assurer (EQA) ensures that the Centre is suitably equipped and prepared for delivery and assessment
* Engagement: Throughout the ongoing delivery of the qualification EAL, through monitoring and other mechanisms will review the quality and consistency of assessment and internal quality assurance and recommend actions to address issues of concern

Recognition

In granting approval, EAL, normally through its EQAs, will ensure that the prospective Centre:

* Meets any procedural requirements specified by EAL
* Has sufficient and appropriate physical and staff resources
* Meets relevant health and safety and / or equality and access requirements
* Has a robust plan for the delivery, assessment, and QA for the qualifications (including, where appropriate, scope for involving employers).

EAL may decide to visit the Centre to view the evidence provided.

Engagement

EAL, through EQA Engagement and other mechanisms will ensure that:

* A strategy is developed and deployed for the ongoing monitoring of the Centre – this will be based on an active risk assessment of the Centre, and will include details of the learner, assessor and internal quality assurer’s sampling strategy and the rationale behind this
* The Centre’s internal quality assurance processes are effective in learner assessment
* Outcomes of internal assessment are verified, through sampling, to ensure standards are being maintained
* Sanctions are applied to a Centre where necessary and that corrective actions are taken by the Centre and monitored by the EQA
* Reviews of EAL’s external auditing arrangements are undertaken.

# 8.0 Unit Content

## Unit: TOEC3-001 Engineering and environmental health and safety in the workplace

### GLH: 75

### Unit description

### This unit focuses on the essential knowledge required to ensure a comprehensive understanding of key aspects of both health and safety practices and environmental management.

### Summary of learning outcomes

1. Understand health and safety roles and responsibilities
2. Understand the application of health and safety in the engineering environment
3. Understand environmental management

Assessment

This unit is assessed by an externally set and marked on-screen multiple-choice exam, which assesses the knowledge requirements of learning outcomes 1 – 3.

Guidance

The learner should be briefed on what is involved and expected of them and be fully prepared for the on-screen multiple-choice exam.

| **Learning Outcome****The learner will:** | **Assessment Criteria****The learner can:** | **Coverage and Depth** |
| --- | --- | --- |
| 1. Understand health and safety roles and responsibilities
 | 1.1 | Recognise the roles of key people involved in workplace health and safety | Cover:* HSE inspectors
* Safety officers
* Safety representatives
* Environmental health officers

Look at the powers and roles of these key people in ensuring a safe working environment for all. |
| 1.2 | Recognise the roles of organisations involved in workplace health and safety | Cover:* Health and Safety Executive (HSE)
* Local authorities
* Trading standards
* Environmental health

Look at the powers and penalties at the disposal of these organisations and how they work with engineering companies. |
| 1.3 | State the key duties of the employee in conforming with health and safety requirements | Cover:Duties of employees under sections 7 and 8 of the HASAWA; to include the implications of not complying with regulations and procedures.The correct procedures and responsibilities for reporting accidents and injuries in the workplace as given in The Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR):* Recording and reporting: accidents, near misses or reportable occurrences
* Principles: incidents, accidents, minor or serious
 |
| 1.4 | State the key duties of the employer in the management of health and safety | Cover:Duties of employers under both the HASAWA section 2 and the Management of Health and safety at Work (MHSW) Regulations. |
| 1.5 | Recognise the content and application of key health and safety legislation | Cover:The content of a typical Health and Safety Policy Statement, to include:* Responsibilities
* Risks
* Consultation with employees
* Safe plant and equipment
* Safe handling and use of substances
* Information, instruction and supervision
* Induction training
* Accident, first aid monitoring
* Emergency, fire procedures
* Key areas of risk
* Lone working

The content, application and responsibilities within Key Health and Safety Legislation to include current issue of:* The Health and Safety at Work Act
* Control of Substances Hazardous to Health (COSHH) Regulations
* The Health and Safety (Safety Signs and Signals) Regulations
* The Provision and Use of Work Equipment Regulations
* The Health and Safety (Display Screen Equipment) Regulations
* The Personal Protective Equipment at Work (PPE) Regulations
* The Management of Health and Safety at Work Regulations
* The Workplace (Health, Safety and Welfare) Regulations
* The Manual Handling Operations Regulations
* First Aid at Work Regulations
 |
| 1. Understand the application of health and safety in the engineering environment
 | 2.1 | Recognise the procedures in performing a risk assessment activity | Cover:How the procedures apply to the learner:* What is risk assessment?
* What are risks/hazards?
* What are the 5 steps to risk assessment?
* Recording risk assessments
* When to perform a risk assessment
* Relationship with other safety regulations
 |
| 2.2 | State how to safely perform manual handling tasks | Cover:* Correct manual handling procedures and risk assessment
* The content of The Manual Handling Operations Regulations:
	+ Duties of employer
	+ Duties of employee
	+ Assessing loads and risk
* The use of mechanical aids to assist manual handling
* The correct handling/lifting technique
* The maximum recommended manual handling load weights at specified heights
* Distance from the body
 |
| 2.3 | State how to safely move loads |
| 2.4 | Recognise how to correctly store gases, oil, acids, adhesives and engineering materials | Cover:* The requirements of COSHH regulations
* The structure of storage buildings, stillages and shelving
* Control of ventilation, extraction and temperature
* Good housekeeping and stock management
* The storage of flammable liquids/compressed gases
* The storage of oil, acids and adhesives
 |
| 2.5 | Recognise the procedures for working in dangerous circumstances | Cover:* Confined spaces
* Trenches
* At height
* With chemicals / toxic substances
* Dust enriched atmospheres
* Damp/wet atmospheres
 |
| 2.6 | Recognise fire and emergency evacuation procedures | Cover:* The causes of fire and the fire triangle
* Types of extinguishers and the classes of fire
* Evacuation and fire procedures notices
* Escape route identification
* The role of fire marshals
 |

| **Learning Outcome****The learner will:** | **Assessment Criteria****The learner can:** | **Coverage and Depth**  |
| --- | --- | --- |
| 1. Understand environmental management
 | 3.1 | Recognise the relevant legislation and EU directives with regard to environmental management | Cover:The basic content and application of current environmental legislation and EU directives, to include:* ISO 14001
* Environmental Protection Act
* Pollution Prevention and Control Act
* Clean Air Act
* Radioactive Substances Act
* Controlled Waste Regulations
* Dangerous Substances and Preparations and Chemical Regulations
* Hazardous Waste Regulations
* Waste Electric and Electronic Equipment (WEEE) Regulations
 |
| 3.2 | Identify what other sources of energy are available other than fossil fuels | Cover:How are they harnessed and converted into usable energy, to include:* Solar
* Heat pump
* Hydroelectric (reservoirs)
* Tidal
* Wind power (wind farms)
* Waste end energy-producing incineration
 |
| 3.3 | Identify the types and likely causes of industrial emissions | Cover:* Air / pollution
* Noise
* Water
* Vibration
* Light
 |
| 3.4 | Recognise the requirements for the safe disposal of waste | Cover:* Labelling of waste materials
* Oils; cutting oil, sump oil, etc
* Contaminated PPE
* Radioactive waste
* Chemicals, dangerous substances, acids and adhesives
* Refrigeration gases
* Workshop waste; oily rags, swarf, etc
* The action required in the event of accidental spillage / release of substances
 |
| 3.5 | Identify ways in which industry may manage, reduce or control their emissions and meet carbon reduction targets  | Cover:* Designing products to be more sustainable
	+ Using less energy to manufacture products
	+ Using less material and packaging within products
	+ Increasing the services life of products; making products easier to repair and spare parts available
	+ Manufacture products from recyclable material and / or manufacture products from materials that can be recycled at the end of their life
* Recycling waste materials from the manufacturing process and / or services to recycle products at the end of their life
* Climate change agreements and impact on industry
* Mandatory carbon emissions reduction scheme for energy-intensive organisations in the public and private sectors; Carbon Reduction Commitments (CRC)
* Energy monitoring: Data logging to optimise energy performance
 |

Unit: TOEC3-002 Engineering organisational efficiency and improvement

GLH: 75

Unit description

This unit focuses on the essential knowledge required to ensure a comprehensive understanding of key aspects of modern production methods, quality control, business improvement and the rights and responsibilities of those employed within an engineering organisation.

Summary of learning outcomes

1. Understand production activities
2. Understand the application of quality control and quality assurance
3. Understand organisational improvement techniques and competitiveness
4. Understand personal rights and responsibilities within an organisation

Assessment

This unit is assessed by an externally set and marked on-screen multiple-choice exam, which assesses the knowledge requirements of learning outcomes 1 – 4.

Guidance

The learner should be briefed on what is involved and expected of them and be fully prepared for the on-screen multiple-choice exam.

| **Learning Outcome****The learner will:** | **Assessment Criteria****The learner can:** | **Coverage and Depth**  |
| --- | --- | --- |
| 1. Understand production activities
 | 1.1 | Explain the different types and methods of production | Cover:* Mass
* Flow
* Automated
* Batch
* One-off
 |
| 1.2 | Recognise the considerations that need to be made when selecting a production type or method | Cover:* Market requirements
* Design of product
* Plant and equipment availability
* Plant and equipment layout
* Personnel
* Production control
* Quality control
* Cost
* Reverse engineering

The methods and application of Cellular and Just in Time (JIT) production techniques to modern production needs. Explain and give examples of how Push andPull types of production are applied to meeting company and customer needs and expectations.The cost factors to be considered with the different production methods, to include both direct and indirect costs. |
| 1.3 | Identify the different stages of production planning | Cover:* Scheduling
* Loading
* Dispatching (co-ordination of pre-production activities)

The requirements necessary to produce a work schedule, to include:* Engineering drawings
* Technical data
* Personnel
* Machinery / tools
* Components
* Materials
* Consumables
* Time management
 |
| 1.4 | Explain how to apply typical process charts | Cover:* Flow charts / diagrams, to include Gantt charts
* The symbols used in flow charts
 |

| **Learning Outcome****The learner will:** | **Assessment Criteria****The learner can:** | **Coverage and Depth**  |
| --- | --- | --- |
| 1. Understand the application of quality control and quality assurance
 | 2.1 | Explain the meaning of the terms ‘Quality Control’ and ‘Quality Assurance’ | Cover:The meaning of the term ‘quality’ as fitness for purpose or meeting customer expectations.The meaning of the terms ‘quality control’ and ‘quality assurance’:* Quality control as carrying out the procedures identified in quality assurance
* Quality assurance as the writing and implementing the procedures that ensure
* Quality control takes place

When to apply quality control:* Design
* Purchasing
* Production planning
* Manufacture (process control)
* Final inspection and dispatch
 |
| 2.2 | Describe the role and stages of inspection activities | Cover:Inspection as the tool by which quality control is applied and the role of the Inspector as checking compliance with the quality standard and procedures.Statistical process control (SPC) as a means of measuring quality / performance is within agreed limits.Document control as an integral part of quality assurance that provides:* Evidence about the existence of a system
* A record of the correct operation

Quarantine as a clearly marked area that is controlled by the quality department that is used to store any defective work, whilst a decision is made if the work will be:* Scrapped
* Reworked
* Adjusted

Types and the purpose of sampling, to include:* Spot check and random sampling
* Process sampling and batch sampling

What is meant by mean time between failures (MTBF), in the context of sample size and frequency. |
| 2.3 | Explain the application and content of the BS EN ISO 9000 series of standards | Cover:BS EN ISO 9001, as an internationally recognised quality assurance standard, which is designed to bring together all the activities that may already exist in a company that support quality advantages including:* Involvement of all levels within a company
* Rationalised systems and procedures
* Improved costs
* Improved efficiency
* Consistent quality of product or service
* Customer confidence

The role of the Quality Manual, the Process/Procedures Manual and internal/external audits in compliance with BS EN ISO 9001. |
| 2.4 | Explain the role and responsibilities of the Quality Manager | Cover:The role of the quality manager / team as a functional role in terms of relationship with other managers / departments within the company. |
| 2.5 | List the elements of quality planning | Cover:The considerations to be made when developing a quality plan, to include:* Establishing quality requirements (customer expectations)
* Allocation of responsibilities (at all levels)
* Agree production times to ensure quality can be met
* Agree budgets to support quality activities
* The setting up of systems to measure quality and report progress
* Identification and calibration of quality equipment
* Ability to take corrective actions if non-conformity is found
 |
| 2.6 | Describe the principles of Total Quality Management (TQM) | Cover:The principles of Total Quality Management (TQM), as a way of thinking about goals, organisations, processes and people to ensure that the right things are done right first time. This thought process can change attitudes, behaviour and hence results for the better.The advantages of adopting TQM, to include:* Making an organisation more competitive
* Establishing a new culture which will enable growth and longevity
* Providing a working environment in which everyone can succeed
* Reducing stress, waste and friction
* Building teams, partnerships and co-operation
 |

| **Learning Outcome****The learner will:** | **Assessment Criteria****The learner can:** | **Coverage and Depth** |
| --- | --- | --- |
| 1. Understand organisational improvement techniques and competitiveness
 | 3.1 | Explain the meaning of the terms Lean Manufacture, Kaizen, Just in Time and Kanban and their overall advantages | Cover:Examples for the terms meanings:* Lean manufacture e.g., removal of waste of all kinds (time, motion, inventory, poor cost of quality etc.), stimulate productivity and quality and use value-added processes. (Low Quality = High Waste; High Quality = Low waste and Higher Values)
* Kaizen e.g., a philosophy that encompasses continuous improvement, ‘can we make it faster with less waste and fewer mistakes and also make it easier’
* Just in time (stockless production or lean production) e.g., manufacturing to order not to stock
* Kanban is an aspect of manufacturing that manages the overall supply chain efficiently and effectively

Examples of overall advantages:* Better quality products
* Making quality a responsibility of every worker, not just for quality control inspectors
* Reduced scrap and rework
* Reduced cycle times
* Lower setup times
* Smoother production flow
* Less inventory of raw materials, work-in-progress and finished goods
* Cost savings
* Higher productivity
* Higher worker participation
* More skilled workforce, able and willing to switch roles e.g., multi skilling and flexible workforce
* Reduced space requirements
* Improved relationships with supplier
* Improved safety
 |
| 3.2 | Recognise the importance of improving productivity | Cover:The meaning of the term ‘production’, using historical and present-day examples of practice to compare how it has developed in recent years.How improved productivity benefits the company, the region, the GDP of a country and also the individual employee in terms of:* Earnings
* Pension security
* Safety
* Working hours / conditions

How improved productivity means by definition less waste (show how this has an effect on the environment).How the national and global marketplaces are driven by competitiveness, therefore the importance for companies to improve productivity:* Multinationals, nationals and regional
* SMEs and sole traders
 |
| 3.3 | Recognise the need for continuous improvement to ensure organisational competitiveness | Cover:* What is ‘continuous improvement’?
* What benefits are gained as a result of continuous improvement?
* Who within an organisation is involved with continuous improvement and in which roles?
* What are the basic four stages of a continuous improvement cycle (plan, do, check, and action)?
* What are the underlying principles that support continuous improvement?
* How ‘flexible working’ and ‘multi-skilling’ apply to continuous improvement?

Why continuous improvement is important in the national and global marketplaces, toallow a company to keep its competitive edge:* Multinationals, nationals and regional
* SMEs and sole traders
 |
| 3.4 | Recognise how to manage the production process | Cover:* What is the importance of the layout of the production area?
* What are: batch production, synchronisation and lead-time?
* How can lead time be improved?
 |
| 3.5 | Recognise the importance of teamwork and the individual’s contribution to effective teamwork | Cover:Teamwork and individuals’ contribution; the meaning of the term ‘team’:T - together E - everyone A - achieves M – more.What are the stages of the development of a team?* What are the roles within a team (e.g., leaders, doers, thinkers and carers)?
* Why is it important to have balance in a team?
* What can individuals bring to a team?
* How can team building be used to bring a team together into and effective group?
* How effective communication within the team is important

What skills are important for effective teamworking?* Good communication, influencing, listening, problem solving, planning and organising, decision making, conflict resolution, reliability.
 |

| **Learning Outcome****The learner will:** | **Assessment Criteria****The learner can:** | **Coverage and Depth**  |
| --- | --- | --- |
| 1. Understand personal rights

and responsibilities within anorganisation | 4.1 | Identify the relevant organisational documentation and employment legislation in relation to personal rights and responsibilities | Cover:What is contained in each of the relevant organisational documentation and employment legislation listed below:* Contracts of Employment
* Employment Rights Act
* Staff Handbook
* Working Time Regulations
* Health and Safety at Work etc Act
* Data Protection Act
* Personnel Records
* Equal Opportunities Policies
* Human Rights Act
* Equalities Act
* Grievance Procedures
* Appraisals
* Discipline Procedures
 |
| 4.2 | Identify the personal opportunities for development and progression | Cover:The various development and progression opportunities listed below and what is required to achieve them (e.g., the necessary career path):* Company training programme
* Apprenticeships
* Organisational training opportunities
* Promotion
* Transfer
* Higher education
* Professional qualifications
 |

Unit: TOEC3-003 Essential mathematics and science for engineering and manufacturing

GLH: 60

Unit description

This unit enables the learner to develop knowledge and understanding of fundamental numeracy and science applied to engineering and manufacturing practice.

Summary of learning outcomes

1. Understand fundamental numeracy applied to engineering and manufacturing
2. Understand fundamental science applied engineering and manufacturing

Assessment

This unit is assessed by an externally set and marked on-screen multiple-choice exam, which assesses the knowledge requirements of learning outcomes 1 – 2.

Guidance

The learner should be briefed on what is involved and expected of them and be fully prepared for the on-screen multiple-choice exam.

| **Learning Outcome****The learner will:** | **Assessment Criteria****The learner can:** | **Coverage and Depth**Calculations should, wherever possible, be related to the engineering activities the learners are involved in. |
| --- | --- | --- |
| 1. Understand fundamental numeracy applied to engineering and manufacturing
 | 1.1 | Identify the metric and imperial systems and the preferred standard form | Cover:* Converting metres to centimetres and millimetres
* Converting feet to metres and centimetres
* Expressing large, small, and decimal numbers in preferred standard form
* Converting square millimetre (mm²) to square metres (m²)

  |
| 1.2 | Identify the techniques used for calculating approximation | Cover:* Calculating approximate material requirements
* Calculating approximate cost
* Calculating approximation to complete a task
 |
| 1.3 | Add, subtract, multiply and divide: whole numbers, fractions and decimals | Cover:* Add, subtract, multiply and divide: whole numbers
* Add, subtract, multiply and divide: fractions
* Add, subtract, multiply and divide: decimals (to 2 decimal places)
 |
| 1.4 | Convert fractions to decimals and decimals to fractions | Cover:* Converting fractions to decimals (to 2 decimal places)
* Converting decimals (to 2 decimal places) to fractions
 |
| 1.5 | Calculate average, mean, median and mode | Cover:* Calculating the mean of specific engineering data
* Calculating the median of specific engineering data
* Calculating the mode of specific engineering data
 |
| 1.6 | Calculate ratio, proportion and percentages | Cover:* Calculating ratio in an engineering context
* Calculating proportion in an engineering context
* Calculating percentages in an engineering context
 |
| 1.7 | Calculate area, surface area, mass, volume, capacity | Cover:* Calculating area (rectangles, squares, circles, triangles)
* Calculating surface area (cylinders and spheres)
* Calculating mass (solid objects and liquid substances)
* Calculating volume (rectangular prisms and cubes, cylinders and pyramids)
* Calculating capacity (spherical objects and cone-shaped objects)
 |
| 1.8 | Calculate probability | Cover:* Calculating single event probability
* Calculating two independent events probability
* Calculating dependant events probability
 |
| 1.9 | Calculate the square and square root of a number | Cover:* Square of whole numbers
* Square root of a number
* Definition and formula for obtaining the square of a number
* Definition and formula for obtaining the square root of a number
 |
| 1.10 | Transpose simple formulae | Cover:* Transposing formula, such as:
	+ Ohms law (V = IR)
	+ Area of a circle (A= πr²)
	+ Newton’s second law of motion (F = m x a)
* Methods of transposition such as: adding, subtracting, dividing or multiplying the same quantity both sides
* Methods of transposition by using the opposite sign method
 |
| 1.11 | Calculate spindle speeds  | Cover: * Calculating spindle speeds for twist drills of various diameters

Formula (Metric)Spindle Speed [Revolutions Per Minute (RPM)] = S x 1000 / π x DS (m/min) = Surface speed or cutting speed constant provided by the manufacturer for a given material D = Diameter of the twist drill |
| 1.12 | Solve problems using Pythagoras’ theorem for right-angle triangles  | Cover:* Finding the length of c of a right-angle triangle:

c2 = a2 + b2* Finding the length of b of a right-angle triangle:

b2 = c2 - a2* Finding the length of a of a right-angle triangle:

a2 = c2 - b2Using practical engineering examples, where appropriate. |
| 1.13 | Solve problems using trigonometry for right-angle triangles  | Cover:* Finding the length of the hypotenuse in a right-angle triangle: sin x = opposite / hypotenuse
* Finding the length of the adjacent side of the hypotenuse in a right-angle triangle: cos x = adjacent / hypotenuse
* Finding the length of the opposite side in a right-angle triangle: tan x = opposite / adjacent
* Calculating the size of an angle in a right-angle triangle using three primary trigonometric ratios for a right-angled triangle: sine (sin), cosine (cos), and tangent (tan)
 |

| **Learning Outcome****The learner will:** | **Assessment Criteria****The learner can:** | **Coverage and Depth** |
| --- | --- | --- |
| 1. Understand fundamental science applied to engineering and manufacturing
 | 2.1 | Recognise common SI units | Cover:* Length
* Area
* Volume
* Time
* Heat
* Temperature
* Mass
* Force
 |
| 2.2 | Identify the types of forces used in engineering | Cover:* Tension
* Compression
* Bending
* Torsion
* Shear
 |
| 2.3 | Identify the modes of heat transfer | Cover:* Conduction
* Convection
* Radiation
 |
| 2.4 | Identify how and why materials are selected with low frictional values | Cover:* Inhibit mechanical damage
* Reduce noise
* Reduce heat
 |
| 2.5 | Identify structures and states of matter | Cover:* Atoms
* Molecules
* Elements
* Mixtures
* Compounds
 |
| 2.6 | Identify lines of flux within magnetic fields | Cover:* Lines of flux for like poles
* Lines of flux for unlike poles
* Current passing along a straight wire
* Solenoids
* Transformer induction
 |
| 2.7 | Identify the causes of friction | Cover:* Surface roughness
* Surface contamination
* Inter-surface adhesion
 |
| 2.8 | Recognise the main principles of the basic theory of electricity | Cover:* Electron flow
* Conventional current flow
* Structure of an atom
* Charged particles
* Coulomb
* Ampere
 |
| 2.9 | Recognise the relationship between conductors, current, magnetic fields and relative movement | Cover:* Production of alternating current
* Production of direct current
* Generator principle (Fleming’s Right Hand Rule)
* Motor principle (Fleming’s Left Hand Rule)
 |
| 2.10 | Calculate moments and levers | Cover:* Calculating moments (m = force x perpendicular distance)
* Classes of levers
* Mechanical advantage (MA = Fo )

 Fi |
| 2.11 | Calculate heat input and change in length | Cover:* Calculating heat input (Amps x Volts) / Travel speed
* Calculating thermal expansion (ΔL = αLΔT)
 |
| 2.12 | Calculate resistors in series and parallel circuits | Cover:* Calculate resistors in series circuits
* Calculate resistors in parallel circuits
* Calculate resistors in equivalent circuits
 |
| 2.13 | Perform simple calculations using thebasics of electricity | Cover:* Simple circuits
* Power (W) = Voltage (V) x Current (A)
* Resistance
* Ohms law
 |

## Unit: TOEC3/004 The structure, properties and characteristics of common materials

### GLH: 60

Unit description

This unit enables the learner to develop knowledge and understanding of fundamental numeracy and science applied to engineering and manufacturing practice.

Summary of learning outcomes

1. Understand how to select engineering materials
2. Understand material properties and heat treatment processes

Assessment

This unit is assessed by an externally set and marked on-screen multiple-choice exam, which assesses the knowledge requirements of learning outcomes 1 – 2.

Guidance

The learner should be briefed on what is involved and expected of them and be fully prepared for the on-screen multiple-choice exam.

| **Learning Outcome****The learner will:** | **Assessment Criteria****The learner can:** | **Coverage and Depth**  |
| --- | --- | --- |
| 1. Understand how to select engineering materials
 | 1.1 | Identify the factors that make materials suitable for engineering applications | Cover:* Available forms of supply
* Cost
* Properties of material
* Application of product
* Manufacturing capability
* How a material reacts in different environments
 |
| 1.2 | Identify the classification, range and application of materials used in engineering | Cover:Material classification:* Metallic (pure metals and alloys)
* Non-metallic materials
* Composites
* Natural materials
* Thermoplastics
* Thermosetting plastics
* Ceramics

Range of materials:* Cast iron
* Carbon and alloy steels
* Stainless steel
* Aluminium
* Aluminium alloys
* Copper
* Brass
* Bronze
* Lead
* Nylon
* PVC
* Perspex
* Rubber
* Wood
* Glass
* Glass fibre
* Epoxy resins
* Carbon fibre
 |
| 1.3 | Identify the forms of supply of engineering materials | Cover:* Sheet
* Plate
* Bar
* Wire
* Section
* Extrusions
* Castings
* Wrought
* Forgings
* Pipe and tube
* Hot and cold rolled
 |
| 1. Understand material properties and heat treatment processes
 | 2.1 | Identify the properties associated with basic engineering materials | Cover:* Ductility
* Malleability
* Hardness
* Toughness
* Strength
* Brittleness
* Plasticity
* Elasticity
* Conductivity
* Dielectric strength
 |
| 2.2 | Identify the basic heat treatment process as applied to changing the properties of materials | Describe the heat treatment process as applied to changing the properties of materials: Cover:* Hardening
* Tempering
* Annealing
* Normalising
 |
| 2.3 | Identify how the properties are affected by the application of heat | Cover:* Thermal expansion
* Structural alterations
* Magnetism
* Electrical resistance
 |
| 2.4 | Identify why the different properties make materials suitable for different applications | Cover:* Heat resistance
* Thermal and electrical conductivity
* Thermal and electrical insulation
* Wear resistance
* Corrosion resistance
* Load bearing capacity
* Shear strength
* Weight
* Cost
* Tensile strength
* Ability to withstand low temperatures
* Factors why engineering materials can fail.
 |

## Unit: TOEMP3/001 Mechanical principles of engineering systems

### GLH: 75

Unit description

This unit is designed to enable learners to develop knowledge and understanding and provides a basis for further work in the areas of mechanical principles, engineering thermodynamics, fluid mechanics and other related applications of engineering science. It introduces the learner to the behaviour of loaded engineering materials and the analysis of a range of static engineering systems. They will also cover dynamic systems through the application of Newtonian mechanics.

The unit also considers the storage and transfer of energy that is often involved in the operation of mechanical systems. Learners will deal with the effects of heat transfer, the expansion and compression of gases and the characteristic behaviour of liquids at rest and in motion.

Summary of learning outcomes

1. Be able to determine the effects of loading in static engineering systems
2. Be able to determine work, power and energy transfer in dynamic engineering systems
3. Be able to determine the parameters of fluid systems
4. Be able to determine the effects of energy transfer in thermodynamic systems

Assessment

This unit is assessed by an internally set and Centre marked knowledge assessment, which assesses the knowledge and practical requirements of learning outcomes 1 – 4.

Guidance

The learner should be briefed on what is involved and expected of them and be fully prepared for the knowledge assessment. Learners will be required to apply their knowledge and understanding from unit TOEC3-003 Essential mathematics and science for engineering and manufacturing to be able to calculate problems based on the mechanical principles covered in this unit.

| **Learning Outcome****The learner will:** | **Assessment Criteria****The learner can:** | **Coverage and Depth** |
| --- | --- | --- |
| 1. Be able to determine the effects of loading in static engineering systems
 | 1.1 | Calculate the magnitude, direction and position of the line of action of the resultant and equilibrant of a non-concurrent coplanar force system containing a minimum of four forces acting in different directions | Cover:**Non-concurrent coplanar force systems:** graphical representation e.g., space and free body diagrams; resolution of forces in perpendicular directions e.g., **Fx = F cosθ, Fy = F sinθ;** vector addition of forces, resultant, equilibrant, line of action; conditions for static equilibrium **(Σ Fx = 0, Σ Fy = 0, Σ M = 0)**.  |
| 1.2 | Calculate thesupport reactions of a simply supported beam carrying at least two concentrated loads and a uniformly distributed load | Cover:**Simply supported beams:** conditions for static equilibrium; loading (concentrated loads, uniformly distributed loads, support reactions). |
| 1.3 | Calculate the induced direct stress, strain and dimensional change in a component subjected to direct uniaxial loading and the shear stress and strain in a component subjected to shear loading | Cover:**Loaded components**: elastic constants (modulus of elasticity, shear modulus); loading (uniaxial loading, shear loading); effects e.g. direct stress and strain including dimensional change, shear stress and strain, factor of safety. |
| 1. Be able to determine work, power and energy transfer in dynamic engineering systems
 | 2.1 | Solve problems that require the application of kinetic and dynamic principles to determine unknown system parameters | Cover:**Kinetic parameters**: such as: displacement (s), initial velocity (u), final velocity (v), uniform linear acceleration (a)Kinetic principles: equations for linear motion with uniform acceleration:**v = u + at, s = ut + 1 at2 , v2 = u2 + 2as, s = ½(u + v)t** **Dynamics parameters**: such as: tractive effort, braking force, inertia, frictional resistance, gravitational force, momentum, mechanical work (W = Fs), power dissipation (average power = W/T, instantaneous power = Fv), gravitational potential energy (PE = mgh), kinetic energy (KE = ½ mv2).**Dynamic principles**: Newton’s laws of motion, D’Alembert’s principle, principle of conservation of momentum, principle of conservation of energy. |
| 2.2 | Determine theretarding force on a freely falling body when it impacts upon a stationary object and is brought to rest without rebound, in a given distance | Cover:The principles applied in assessment criteria 2.1 can be directly linked to assessment criteria 2.2, although achievement of assessment criteria 2.2 will need to consider the impact of a freely falling body.  |
| 1. Be able to determine the parameters of fluid systems
 | 3.1 | Calculate the resultant thrust and overturning moment on a vertical rectangular retaining surface with one edge in the free surface of a liquid | Cover:**Thrust on a submerged surface**: hydrostatic pressure, hydrostatic thrust on an immersed plane surface **(F = pgAx);** Centre of pressure of a rectangular retaining surface with one edge in the free surface of a liquid.  |
| 3.2 | Determine the up thrust on an immersed body | Cover:**Immersed bodies:** Archimedes’ principle; fluid, such as: liquid, gas; immersion of a body, e.g., fully immersed, partly immersed; determination of density, e.g., using floatation, specific gravity bottle.  |
| 3.3 | Use the continuity of volume and mass flow for an incompressible fluid to determine the design characteristics of a gradually tapering pipe | **Design / flow characteristics of a gradually tapering pipe**: e.g., volume flow rate, mass flow rate, input and output flow velocities, input and output diameters, continuity of volume and mass for incompressible fluid flow. |
| 1. Be able to determine the effects of energy transfer in thermodynamic systems
 | 4.1 | Calculate the dimensional change when a solid material undergoes a change in temperature and the heat transfer that accompanies a change of temperature and phase | Cover:**Heat transfer**: heat transfer parameters, such as: temperature, pressure, mass, linear dimensions, time, specific heat capacity, specific latent heat of fusion, specific latent heat of vaporisation, linear expansivity; phase, e.g., solid, liquid, gas; heat transfer principles, e.g., sensible and latent heat transfer, thermal efficiency and power rating of heat exchangers; linear expansion.  |
| 4.2 | Determine the thermal efficiency of a heat transfer process from given values of flow rate, temperature change and input power  | Cover:**Heat transfer**: heat transfer parameters, such as: temperature, pressure, mass, linear dimensions, time, specific heat capacity, specific latent heat of fusion, specific latent heat of vaporisation, linear expansivity; phase, e.g., solid, liquid, gas; heat transfer principles, e.g., sensible and latent heat transfer, thermal efficiency and power rating of heat exchangers; linear expansion.  |
| 4.3 | Solve problems that require application of thermodynamic process equations for a perfect gas to determine the unknown parameters of the problems | Cover:**Thermodynamic process equations**: process parameters, such as: absolute temperature, absolute pressure, volume, mass, density. Boyle’s law (pV = constant), Charles’ law ( V/T= constant),general gas equation ( pV/T = constant), characteristic gas equation (pV = mRT)  |
| 4.4 | Determine the force induced in a rigidly held component that undergoes a change in temperature | Cover:This could be an extension task/s of assessment criteria 4.1 - the effects of heat transfer. |

Unit: TOEMP3/002 Apply manufacturing and assembly processes

GLH: 120

Unit description

This unit enables the learner to apply the skills to produce components and assemblies using manufacturing and assembly processes and techniques, using their acquired underpinning knowledge and understanding.

Summary of learning outcomes

1. Be able to apply safe working practices when applying manufacturing and assembly processes
2. Be able to plan and prepare the manufacturing and assembly activities
3. Be able to produce and refurbish components
4. Be able to assemble components and assemblies using manufacturing processes and techniques
5. Be able to carry out the required checks on components and assemblies
6. Be able to restore the work area on completion of the activity

Assessment

This unit is assessed by an externally set and Centre marked holistic assessment, which assesses the skill requirements and underpinning knowledge application of learning outcomes 1 – 6.

Guidance

The learner should be briefed on what is involved and expected of them and be fully prepared for the practical holistic assessment.

| **Learning Outcome****The learner will:** | **Assessment Criteria****The learner can:** | **Coverage and Depth**  |
| --- | --- | --- |
| 1. Be able to apply safe working practices when applying manufacturing and assembly processes
 | 1.1 | Comply with health and safety and environmental legislation and regulations relevant to producing components using manufacturing and assembly processes and techniques | The learner will need to comply with health and safety and environmental legislation and regulations relevant to the practical activity.The learner will need to select, and use, appropriate PPE throughout the duration of the practical assessment.The learner must dispose of waste in line with organisational procedures and waste regulations.This aligns with the knowledge contained within Unit: TOEC3-001 Engineering and environmental health and safety in the workplace. |
| 1.2 | Assess risk and hazards associated with producing components using manufacturing and assembly processes and techniques | The learner will need to assess the risks and hazards associated with the practical activity and produce an appropriate risk assessment.The learner will need to monitor working area practices to prevent, resolve, manage, and mitigate issues arising during tasks. Hazards such as:* Electricity, sharp edges, heavy objects, slips, trips and falls, noise, projectiles, wrist injuries from rotating tools, loose clothing / jewellery / hair

This aligns with knowledge contained within Unit: TOEC3-001 Engineering and environmental health and safety in the workplace. |
| 1.3 | Check all safety mechanisms are in place for power tools and manual machinery are set correctly for the required operations | The learner will need to check that all safety mechanisms are in place before starting work, such as:* Mechanisms for power tools and manual machinery such as electrical isolation switches (emergency stop buttons, main isolator, dead man switches, automatic cut out switches), guards and covers (in place and adjusted where needed), visual and audible warnings, mechanical brakes, interlocks
* Isolation mechanisms for assembly or maintenance activities.
 |
| 1. Be able to plan and prepare the manufacturing and assembly activities
 | 2.1 | Identify, obtain, and check the appropriate instructions, specifications, drawings and other relevant documentation | The learner will need to identify, obtain (source) and check the documentation is correct and current.Source appropriate documentation, such as:* Specifications, job instructions, manuals, standard operating procedures, detailed drawings or diagrams, data reference books, data sheets, calibration records, method statements, component documentation, assembly instructions, torque settings, tolerances, speed and feed information, inspection records.

The learner must report any inaccuracies in the technical documentation or missing information using correct procedures and limits of authority/responsibility.The learner will need to know how to:* confirm latest version of documents
* report problems / issues with information to supervisors / others, knowing lines of reporting and who to communicate to

The learner will need to use a range of communication methods (verbal, written, digital) to report and record problems, issue or information.The learner will need to know their limits of autonomy. |
| 2.2 | Plan the component/assembly task – materials, tools and equipment and assemble using appropriate tools and techniques before commencing work activities | The learner will need to interpret the relevant documentation (job instructions, specifications, detailed drawings/diagrams etc.)The learner will need to:* produce a plan of work utilising time management
* confirm the tools and equipment needed for the activity including right tool for the job
* identify materials / components / parts needed
* review and confirm the availability of resources including people
* evaluate and plan for minimising and maximising wastage, disposal, recyclability and sustainability created by the activity.
 |
| 2.3 | Prepare the work area for the component/assembly task, sourcing the required resources.  | The learner will need to prepare the work area in accordance with their work plan and / or risk assessment, including:* select the materials / components / parts / resources
* select and set up appropriate tools and equipment
* carry out pre-use checks on all tools and equipment
* check for, and report any defective materials, tools or equipment and communication methods (verbal, written, digital)
* apply safe isolation and calibration checks on tools and equipment

Tools and equipment: may include: * Hand tools, power or air tools, measurement tools, workholding devices
 |
| 2.4 | Set up appropriate powered machinery and tooling for material removal  | The learner will need to set up appropriate powered machinery, as required, including:* carry out set up checks
* apply appropriate safety protocols
* check tooling is suitable for job, prepared and ready for use

Powered machinery, may include:* Pillar drills, lathes, milling machines, grinding machines.

  |
| 2.5 | Prepare the materials to be marked out, cut, shaped and assembled using appropriate tools and techniques, minimising material wastage | The learner will need to prepare materials to be worked, including:* prepare suitable datum and marking out surfaces using appropriate tools and techniques
* accurately transfer measurements with consideration for tolerances
* minimise material wastage
* identify and resolve any actual problems with the materials and / or specification / instructions
* report any issues outside of their control using correct procedures.

Tools and techniques, such as:* Rules / straight edges, tape measures, plumb lines, vernier and digital calliper, vernier height gauges, pens / pencils, scribers, laser measurers, clinometers and spirit levels, engineers’ squares, micrometres, surface tables, depth gauges, vee blocks, dividers, trammels, punches.
 |
| 1. Be able to produce and refurbish components
 | 3.1 | Follow correct instructions, specifications, drawings and other relevant documents | The learner will need to use and interpret documents such as:* Specifications, job instructions, manuals, standard operating procedures, detailed drawings or diagrams, data reference books, data sheets, calibration records, method statements, component documentation, assembly instructions, torque settings, tolerances, speed and feed information, inspection records.
 |
| 3.2 | Use appropriate work holding equipment and hand tools to produce or refurbish the one-off components to the required specification | The learner will need to:* select the most suitable work holding device
* install, check, adapt and secure the device to bench / appropriate surface
* select and use appropriate hand tools.
 |
| 3.3 | Use correct manufacturing material removal processes, techniques and procedures to cut and shape or refurbish components accurately to required dimensions  | The learner will need to use a range of tools and machinery to carry out material removal processes, manufacturing processes and techniques, such as:* Hand tools - saw, wrench, spanner, pliers, screwdrivers, allen keys, files, engineers square, scriber, center punch, taps, reamers, hammer, punch
* Power tools - cordless drill, hammer drill, mag-base drill, electric screwdriver, band saw, angle grinder, bench grinder, sander, compressed air driven tools
* Manual machinery - lathes, pillar drills, milling machines

The learner must check tools during task, identify and report defects with tools and tooling.The learner will need to mount, adjust and set required work holding devices, work pieces and cutting tools on manual machinery, such as:* select most appropriate work holding device (machine vices, clamps, straps, bolts, magnetic devices)
* install and secure device
* check position is correct
* select appropriate cutting tools
* check cutting tools are suitable before us
* mount cutting tools securely.

The learner will need to use appropriate measuring and testing equipment to check worked material meets the specification, such as:* Micrometers, verniers, callipers, gauges.

The learner must take measures to minimise material wastage. |
| 3.4 | Use basic machining processes to cut and shape components accurately to required dimensions  | The learner will need to use machining processes to cut and shape components accurately to required dimensions, such as:* Drilling, milling, turning, sawing, pressing, boring, broaching, grinding

The learner will need to:* select the most appropriate method to produce or alter a component
* use / operate hand and machine cutting tools to manipulate materials into shape and profiles to meet the specification, take measures to minimise material wastage
* carry out in-production checks to check components are produced to the required quality standard
* adjust machine parameters or tooling, as required.

Machine parameters / tooling, such as:* screw threads, hand wheels, sliding guides, clamps, tool speed and feeds.
 |
| 1. Be able to assemble components and assemblies using manufacturing processes and techniques
 | 4.1 | Follow correct instructions, specifications, drawings and other relevant documents to assemble components or sub-assemblies | The learner will need to use technical information sources to assemble single components or small assemblies which may form part of a larger machine or system, such as:* hydraulic systems, pneumatic systems, drive systems, pipework, mechanical assemblies
* components, such as: keys, pipework, interfacing parts, threading, motors, valves, pumps etc.

Technical information sources, such as:* Specifications, job instructions, manuals, standard operating procedures, detailed drawings or diagrams, data reference books, data sheets, calibration records, method statements, component documentation, assembly instructions, torque settings, tolerances, speed and feed information, inspection records.
 |
| 4.2 | Use appropriate hand-fitting tools and techniques to assemble/disassemble components and sub-assemblies | The learner will need to use appropriate hand-fitting tools and techniques to assemble / disassemble components or sub-assemblies.Disassemble, such as:* Powering down, isolation, removal of components, functional safety (safety instrumented systems (SIS), safety integrity level (SIL)), disposal requirements, tools and equipment, documentation

Assemble, such as:* Structures, removal, powering up, documentation, attachments, fixings, tightening techniques, tools and equipment

Use appropriate equipment and tools, such as:* Spanners, socket sets, socket drives and extensions, screwdrivers, levers, pliers, hammers, centring devices, clamps, measuring devices, component specific tools and jigs, torque wrenches

The learner will need to:* check tools during task, identify and report defects with tools and tooling
* use appropriate measuring and testing equipment to check worked material meets the specification
* use working procedures and practices to ensure all items are identified, marked and organised to allow for efficient and accurate re-assembly of items.

Measuring and testing equipment, such as:* Rule, callipers (vernier, digital), micrometres (outside, depth), gauges (angle, slip, go/no-go), dial test indicator (DTI), coordinate measuring machines (CMM)
 |
| 4.3 | Use correct manufacturing processes, techniques and procedures to accurately assemble components to required specification  | The learner will need to use correct processes and procedures to assemble **one or more** mechanical components, such as:* Precision measuring (for compliance), threaded jointing, sealing, fixing, aligning, bending, mechanical jointing, pre-tensioning, torquing, sequential tightening, interference fit

The learner will need to:* follow all relevant processes when assembling and disassembling components, devices or systems
* apply requirements and specifications to ensure correct assembly and disassembly, considering technical data and instructions
* accurately position, install, calibrate and configure devices and equipment to agreed requirements and specifications
* consider and follow regulatory requirements throughout.

Assemble, such as:* Structures, removal, powering up, documentation, attachments, fixings, tightening techniques, tools and equipment.

Install, such as:* Job requirements, regulation requirements, commissioning, isolation, manufacturers specifications, replacement parts, 1st fix, 2nd fix of components, functional safety checks.

The learner will need to use appropriate measuring and testing equipment to check worked material meets the specification.Measuring and testing equipment such as:Rule, callipers (vernier, digital), micrometres (outside, depth), gauges (angle, slip, go/no-go), dial test indicator (DTI), coordinate measuring machines (CMM). |
| 4.4 | Secure components using specified connectors and securing devices | The learner will need to:* identify and select appropriate connectors and securing devices
* use appropriate tools, fixing and processes for different material types.

Connectors and securing devices, such as:* Threaded fixings, self-tapping devices, deforming fixing devices (rivets), blind fixings (single side access), anti-vibration devices, locking devices and methods (split pins and wire locking), quick release devices, sliding and interlocking devices, permanent fixings.

Tools, fixing and processes, such as:* Allen keys, power tools, spanners, wrenches, hammer.

The learner will need to use appropriate measuring and testing equipment to check worked material meets the specification, such as:Rule, callipers (vernier, digital), micrometres (outside, depth), gauges (angle, slip, go/no-go), dial test indicator (DTI), coordinate measuring machines (CMM). |
| 1. Be able to carry out the required checks on components and assemblies
 | 5.1 | Carry out the required checks using the correct procedures, processes and/or equipment | The learner will need to carry out a range of appropriate checks on component(s) to assess compliance with specifications. Checks, such as:* Dimensional checks, alignment checks, tolerance checks.

The learner will need to use a range of test/diagnostic equipment, measuring equipment.Measurement equipment such as:* Rule, callipers (vernier, digital), micrometres (outside, depth), gauges (angle, slip, go/no-go), dial test indicator (DTI), coordinate measuring machines (CMM).
 |
| 5.2 | Deal promptly and effectively with problems within the limits of their responsibility using approved diagnostic methods and techniques and report those which cannot be resolved to the appropriate personnel | The learner will need to:* identify potential risks, issues and problems with the immediate task to inform processes and agreed outcomes and timeframes
* monitor practical manufacturing and assembly activity
* deal promptly with problems within limits of their responsibility, using approved diagnostic methods and techniques and implement solutions
* report problems or issues that cannot be resolved to the appropriate personnel using correct documentation and / or procedures using appropriate methods (verbal, written, digital)
* identify potential areas for improvement.
 |
| 5.3 | Inspect the finished component or sub-assembly to ensure that it meets the required specification and quality requirements | The learner will need to inspect the finished component to ensure that it meets the required specification and quality requirements, such as: * accuracy
* dimensional (overall sizes, hole tolerances, mass)
* functional (orientation, alignment, mating parts)
* comparative (surface roughness, surface damage)
* completeness.

Methods of inspection, such as:* first-off
* in process
* final.
 |
| 5.4 | Complete any required documentation using the defined recording systems  | The learner will need to:* accurately record findings, data, risks and issues from tasks
* create technical reports to communicate work completed
* make amendments and recommendations at relevant stages, within the limits of own authority
* use records, information, and data to inform improved practices, recommendations, and continuous improvement
* communicate technical information, advice and suggestions for improvements using appropriate methods (verbal, written, digital)
* follow and implement document version control for relevant paperwork and technical documentation where updates are made, including maintenance schedules and representations.

Documentation, could include:* Testing and inspection records, calibration records, quality control documentation, job instructions, drawings / representations.
 |
| 1. Be able to restore the work area on completion of the activity
 | 6.1 | Restore the work area on completion of the work activity | The learner will need to:* reinstate work areas back to original condition upon completion of tasks
* manage the area ensuring the area is left in safe condition, such as following shut down procedures for power tools and/or manual machinery
* perform basic housekeeping of work area.
 |
| 6.2 | Return any resources and consumables to the appropriate location and in good condition | The learner can sort, maintain and store resources and consumables, such as:* return all resources, tools and equipment back to storage facilities
* maintain resources (replace any perished items, sharpening, re-grind tooling, charging battery powered equipment, complete basic maintenance)
* correctly store tools and equipment to prevent damage
* record and report defective tools and equipment using correct procedures, documentation, using appropriate methods (verbal, written, digital).
 |
| 6.3 | Dispose of waste in accordance with waste streams | The learner must follow disposal requirements appropriate to the waste and relevant legislation.Disposal of wastes, such as:* General waste, recycling, re-use, hazardous waste, non-hazardous waste.
 |

## Unit: TOEMP3/003 Mechanical engineering inspection and quality control

### GLH: 75

### Unit description

This unit enables the learner to develop the knowledge to understand terminology used in engineering inspection and quality control and the skills to be able to select, set up and use the correct tools and equipment to carry out quality control activities. The learner will understand how to inspect completed components or assemblies using diagnostic equipment to confirm compliance to the specification and / or be able to identify common faults on mechanical engineering systems. The learner will also understand the importance of analysing and recording findings.

This unit builds on the knowledge attained in unit TOEC3/002 Engineering organisational efficiency and improvement (Learning outcome 2)

Summary of learning outcomes

1. Understand the terminology used in engineering inspection and quality control
2. Be able to use resources associated with performing the inspection and / or testing process
3. Be able to carry out quality control inspections in accordance with procedures

Assessment

This unit is assessed by an internally set and Centre marked assessment, which assesses the knowledge and practical requirements of learning outcomes 1 – 3.

Guidance

The learner should be briefed on what is involved and expected of them and be fully prepared for the practical holistic assessment.

| **Learning Outcome****The learner will:** | **Assessment Criteria****The learner can:** | **Coverage and Depth**  |
| --- | --- | --- |
| 1. Understand the terminology used in engineering inspection and quality control
 | 1.1 | Explain the meaning of termsused with engineering inspection and quality control and how they are applied | Cover:* Variation
* Repeatability
* Reproducibility
* Accuracy
* Tolerance
* Limit
* Capability
* Comparison
* Gauging
* Measurement
* Calibration.

Look at how they are applied in inspection and quality control activities. |
| 1.2 | Explain the principles of measurement and why accuracy is important for inspection and quality control activities | Cover:* What can be measured and tested using equipment
* Techniques for carrying out measurements using measuring and testing equipment
* Accuracy and relative limitations and benefits of the stated equipment
* The application of principles and techniques in problem solving.

Measuring and testing equipment, such as: rule, callipers (digital, Vernier), micrometers (inside, outside, depth), gauges (angle, slip, go/no-go), dial test indicator (DTI), coordinate measuring machines (CMM).Principles, such as: precision, accuracy, uncertainty, resolution, calibration, tolerance. |
| 1.3 | Explain why calibration of measuring equipment is important and the consequences of using uncalibrated equipment | Cover:* What is calibration
* How it is maintained
* Record keeping accuracy
* Calibration records

Consequences of using uncalibrated equipment:* Such as production / measurement errors, inaccuracies, false readings, time / money / resources wasted, production delays etc,).
 |
| 1.4 | Explain how system monitoring can indicate problems with the manufacturing of components or the functioning of an assembly | Cover:* The types of monitoring methods
* How they are applied
* Examples of problems that may be picked up.
 |
| 1.5 | Explain how to detect and diagnose faults and how to identify resolution methods | Cover:* How to identify faults using fault detection and diagnosis methods
* How to identify and use resolution methods based on the fault diagnosis
* The advantages and limitations of detection methods and isolation systems
* How to follow relevant guidelines and instructions, limits of own authority and expertise, seeking advice and guidance, reporting faults and issues to the relevant personnel, where necessary using appropriate methods (verbal, written, digital).

Fault detection, such as:* Self-diagnostic, unit substitution, input output, half split technique, end to end, operator experience, tools and equipment

Fault diagnosis, such as:* Sensory checks, collection of fault data, self-diagnosis, inspection, material testing, tools and equipment

Resolution methods, such as:* Replace, repair, adjust, modify.

Technical information sources, such as:* Specifications, job instructions, manuals, standard operating procedures, detailed drawings or diagrams, data reference books, data sheets, calibration records, method statements, component documentation, assembly instructions, torque settings, tolerances, speed and feed information, inspection records.
 |
| 1.6 | Explain the reasons for quality inspection and testing and the impact of inadequate quality inspection and testing | Cover:* Why undertaking quality inspections are important?
* When additional testing may need to be carried out (e.g., material performance, durability, function etc.)
* The impacts of not carrying out quality inspection / testing / monitoring on the product (performance, safety, fit for purpose etc) and the wider commercial/business (reputational damage etc.)
 |
| 1.7 | Understand commercial considerations and how the role contributes to commercial operations | Cover:* Contractual arrangements (penalty clauses, targets)
* Commercial priorities (profit, stakeholder needs)
* Supply and demand
* Value added, efficiencies, quality
* Customer / client needs and interaction
* Competition
* Links to product, processes and service improvements
* The main responsibilities of the different roles in an organisation and how they affect the business in terms of accountabilities and inter-dependencies (limits of autonomy, teamwork, working with other teams/departments, working to targets, producing a high quality product, accountability etc.)
 |
| 1. Be able to use resources associated with performing the inspection and / or testing process
 | 2.1 | Identify the resourcerequirements for the inspection and/or testing process  | The learner can demonstrate that they can:* Identify and select right tool for the job / tool and equipment selection
* Source and obtain relevant documentation
* Refer to and implement risk assessment and control measures.
 |
| 2.2 | Set up, check, adjust and use inspection and testing equipment and documentation correctly | The learner can demonstrate that they can:* Set up, check, adjust and use a range of measurement, inspection and testing equipment
* Identify and report any defects with measurement, inspection and testing equipment
* Refer to and check their set up against appropriate documentation including the calibration record and manufacturer’s instructions, procedures or specification.

Inspection and testing equipment, such as:* Multimeters, diagnostic testers, measurement tools (micrometers, (internal, external, depth), Vernier callipers), pressure source, gauges, comparison plates

Documentation, such as:* Calibration record, quality standards, inspection records, specifications
 |
| 2.3 | Maintain equipment in a reliable and safe condition | The learner can demonstrate that they can:* Maintain equipment ensuring safety measures have been applied within limits of responsibility e.g., isolation of power source
* Update calibration records / log
* Using reporting procedures for broken or damaged tools and / or equipment
* Correct storage of equipment to prevent damage.
 |
| 1. Be able to carry out quality control inspections in accordance with procedures
 | 3.1 | Inspect completed components or sub-assemblies to confirm compliance to the specification | The learner can demonstrate that they can inspect completed components or sub-assemblies, such as:* Application of diagnostic and measurement techniques
* Use of tools and equipment to obtain accurate information and results on performance, condition and compliance.
 |
| 3.2 | Identify defects or faults with components or sub-assemblies at the appropriate stages of the work activity | The learner can demonstrate that they can:* Identify defects or faults with components or sub-assemblies
* Use a range of tools and equipment to identify / detect / locate and / or diagnose faults or defects.

Faults may be related to: * Component failure, worn, broken or defective parts, misalignments, unbalances, excessive noise, heat, vibration, seizures, corrosion, fluid leaks, product defects (dimensional, material issues, mating parts fit / alignment)

Tools, such as:* Spanners, socket sets, socket drives and extensions, screwdrivers, levers, pliers, hammers, centring devices, clamps, measuring devices, component specific tools and jigs, torque wrenches

Equipment, such as:* Multimeters, diagnostic testers, measurement tools micrometers, (internal, external, depth), Vernier callipers, pressure source, gauges, comparison plates
 |
| 3.3 | Use problem solving to analyse the findings and apply appropriate fix, where relevant | The learner can demonstrate that they can:* Interpret results and findings to diagnose fault / issues
* Apply problem solving techniques to those that may occur during set up or preparation, as in-production faults or system monitoring
* Apply appropriate fixes to one or more components or sub-assemblies.
 |
| 3.4 | Record findings, technical information and data using the defined recording systems and communication methods at the appropriate stages of the work activity | The learner can demonstrate that they can:* Interpret and record findings using defined recording systems as appropriate to the technical information and data
* Communicate findings using appropriate methods.

Communication methods, such as:* Record, manage, store, amend, upload data, collaborative technologies (shared drives, email, conferencing, software and programs, forums)

Technical information and data, such as:* Test data, test results, maintenance results and findings, fault information, inspection sheets, maintenance logs, repair methods.
 |
| 3.5 | Restore the work area on completion of the activity and return any resources to the appropriate location. | The learner can demonstrate that they can:* Restore the work area to original condition
* Leave the area in a safe condition
* Check and maintain all resources, tools and equipment prior to storage
* Identify and report defective or broken tools and tooling
* Dispose of all waste according to relevant waste procedures and legislation.
 |

# Appendix 1: Centre Exam Specifications

**Core knowledge exam 1**

|  |
| --- |
| **Units:** TOEC3/001 - Engineering and environmental health and safety in the workplace TOEC3/002 - Engineering organisational efficiency and improvement  |
| Assessment type: Multiple-choiceNumber of questions: 35Time allowed: 70 minutesClosed bookThe exam will cover the knowledge learning outcomes of the units, as follows: |
| **No** | **Learning outcome title** | **No of questions** |
| 1.1 | Understand health and safety roles and responsibilities | 7 |
| 1.2 | Understand the application of health and safety in the engineering environment | 6 |
| 1.3 | Understand environmental management | 5 |
| 2.1 | Understand production activities | 4 |
| 2.2 | Understand application of quality control and quality assurance | 6 |
| 2.3 | Understand organisational improvement techniques and competitiveness | 5 |
| 2.4 | Understand personal rights and responsibilities within an organisation | 2 |
| **Total:** | **35** |
| **NOTE:** The pass mark for the exam is 60%.  |

**Core knowledge exam 2**

|  |
| --- |
| **Units:** TOEC3/003 -Essential mathematics and science for engineering and manufacturing TOEC3/004 - The structure, properties and characteristics of common materials |
| Assessment type: Multiple-choiceNumber of questions: 35Time allowed: 70 minutesClosed book, non-programmable calculator permittedThe exam will cover the knowledge learning outcomes of the units, as follows: |
| **No** | **Learning outcome title** | **No of questions** |
| 3.1 | Understand fundamental numeracy applied to engineering and manufacturing | 13 |
| 3.2 | Understand fundamental science applied engineering and manufacturing | 13 |
| 4.1 | Understand how to select engineering materials | 4 |
| 4.2 | Understand material properties and heat treatment processes | 5 |
| **Total:** | **35** |
| **NOTE:** The pass mark for the exam is 60%.  |

# Appendix 2: Learner Registration and Certification

Learners must be registered with EAL on a code which relates to the qualification -this must be completed prior to assessment. Both learner registration and certification can be completed online at the EAL Website www.eal.org.uk. For paper-based registration and certification use the appropriate forms. These are located on the EAL Website, for guidance on registration and certification please refer to the Registration and Certification User Guide.

To register the learner on the chosen qualification / pathway code:

|  |  |
| --- | --- |
| **Qualification Title:** | **Code:** |
| EAL Level 3 Technical Occupation Entry in Mechanical Engineering Principles (Diploma) | 610/3912/3 |

For further information, please contact EAL Customer Experience:

Tel: +44 (0)1923 652 400

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