



City & Guilds Level 3 Advanced Technical Extended Diploma in Land-based Engineering (1080) (0171-38)

September 2024 Version 4.5

(For delivery from September 2024)

Qualification Handbook

Qualification at a glance

| | |
|---|--|
| Industry area | Land |
| City & Guilds qualification number | 0171-38 |
| Age group | 16-19 (Key Stage 5), 19+ |
| Entry requirements | Centres must ensure that any pre-requisites stated in the <i>What is this qualification about?</i> section are met. |
| Assessment | <p>To gain this qualification, candidates must successfully achieve the following assessments:</p> <ul style="list-style-type: none"> • One externally set, internally marked, externally moderated synoptic assignment • Four externally set, externally marked exams, sat under examination conditions • Five externally set, internally marked, externally verified assignments • Portfolio of evidence |
| Additional requirements to gain this qualification | Employer involvement in the delivery and/or assessment of this qualification is essential for all candidates and will be externally quality assured. |
| Grading | <p>This qualification is graded.</p> <p>For more information on grading, please see Section 7: Grading.</p> |
| Approvals | These qualifications require full centre and qualification approval |
| Support materials | <p>Sample assessments</p> <p>Guidance for delivery</p> <p>Guidance on use of marking grids</p> |
| Registration and certification | Registration and certification of this qualification is by the Walled Garden, and is subject to end dates. |
| External quality assurance | This qualification is externally quality assured by City & Guilds, and its internally marked synoptic assignments are subject to external moderation. Additional internally assessed units / assessments are subject to external verification. There is no direct claim status available for this qualification. |

| Title and level | Size (GLH) | TQT | City & Guilds qualification number | Ofqual accreditation number |
|---|------------|------|------------------------------------|-----------------------------|
| City & Guilds Level 3 Advanced Technical Extended Diploma in Land-based Engineering | 1080 | 1800 | 0171-38 | 601/7463/8 |

| Version and date | Change detail | Section |
|--------------------|---|---|
| V2.2 February 2017 | 301 assessment changed | 1. Introduction 5. Assessment |
| | Assessment modules and weightings updated | 1. Introduction 5. Assessment 6. Grading |
| V2 July 2016 | Small typographical errors | Throughout |
| V1.2 June 2016 | Amendment to assessment component numbers | Throughout |
| V1.1 May 2016 | Small typographical errors | Throughout |
| | TQT added for qualifications | 1. Introduction |
| | Assessment component titles amended | |
| | Employer involvement guidance updated throughout | 4. Employer involvement |
| | Summary of assessment methods and conditions | 5. Assessment |
| | Moderation and standardisation of assessment updated throughout | 6. Moderation and standardisation of assessment |
| | Awarding individual assessments Awarding grades and reporting results | 7. Grading |
| | Enquiries about results Re-sits and shelf-life of assessment results Malpractice Access arrangements and special consideration | 8. Administration |
| V3.0 June 2017 | Addition of the examination paper based module number | 1. Introduction – Assessment requirements and employer involvement 5. Assessment 5. Assessment – exam Specification 7. Grading – Awarding grades and reporting results |
| | Removal of AO 6-8 from Synoptic Assignments and the readjusted approximate weightings | 5. Assessment – Assessment Objectives |
| | Addition of Provisional Grade Boundaries for the Synoptic Assignment | 7. Grading |
| | Revised Exam Specification and AO weightings | 5. Assessment – Exam Specification |
| | Branding Changes | Throughout |

| Version and date | Change detail | Section |
|---------------------|---|---|
| V3.1 November 2017 | Unit number 362 changed to 329 Unit number 363 changed to 330 Unit number 364 changed to 331 Unit number 365 changed to 332 | 1. Introduction – Qualification structure Units |
| V4.0 August 2018 | Update to grading details | Section 7 |
| V4.2 May 2019 | Wording changed regarding retakes | 5. Assessment – Summary of assessment methods and conditions 8. Administration – Re- sits and shelf-life of assessment results |
| V4.3 May 2023 | Amended assessment method for unit 301 Component number for assessment component changed from 301 to 300 Clarified moderation and external verification processes Updated website links and references | 1. Introduction 5 Assessment 5 Assessment 6 Moderation and standardisation of assessment 3 Delivering Technicals qualifications - Support materials 8 Administration |
| V4.4 September 2023 | Revision to the exam specification for the health and safety test component (300) | 5 Exam specification |
| V4.5 September 2024 | Removal of evolve onscreen exam options (015, 016, 018) | 1 Assessment and employer involvement |

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| Unit 332 | Repair land-based combinable or root crop harvesting machinery | 64 |
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| Unit 353 | Repair land-based spark-ignition (petrol) engines | 82 |
| Unit 354 | Repair land-based vehicle systems | 87 |
| Unit 355 | Repair land-based electric systems | 91 |
| Unit 356 | Test land-based electronic systems | 95 |
| Unit 357 | Repair land-based hydraulic systems | 100 |
| Unit 358 | Repair land-based mechanical power transmission systems | 104 |
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1 Introduction

What is this qualification about?

The following purpose statement relates to the **City & Guilds Level 3 Advanced Technical Extended Diploma in Land-based Engineering (1080) (601/74,63/8)**.

| Area | Description |
|--|---|
| OVERVIEW | |
| Who is this qualification for? | This qualification is for you if you are 16 years or older, and want to work in land-based engineering. It is designed to provide you with a wide range of specialist technical practical skills and detailed knowledge and understanding which will equip you to progress to employment, or to further learning and training, within the land-based engineering industry. |
| What does this qualification cover? | <p>This qualification covers all of the skills, knowledge and understanding required to enter employment in the land-based engineering industry. You will study a wide range of areas that include health and safety, calculations for service engineering and workshop processes. You will learn how to repair engines, vehicle systems, electric systems and hydraulic systems. You will learn how to test electronic systems. In addition you will learn how to repair mechanical power transmission systems, synchromesh transmissions and clutches, powershift transmissions and hydrostatic or hydro-mechanical (CVT) transmissions. You will also learn how to repair cultivation or drilling machinery, application machinery, forage harvesting machinery and combinable or root crop harvesting machinery.</p> <p>Centres and providers work with local employers who will contribute to the knowledge and delivery of training. Employers will provide demonstrations and talks on the industry and where possible work placements will also be provided by the employers. This practical-based training is ideal preparation for gaining employment in the land-based engineering industry or specialist further study.</p> |
| WHAT COULD THIS QUALIFICATION LEAD TO? | |
| Will the qualification lead to employment, and if so, in which job role and at what level? | <p>This two-year qualification exposes you to the whole industry, and the opportunities within it. On completion, it is likely that you will enter the industry by working for a manufacturer, dealership or within an agricultural or horticultural workshop. As you will have gained a breadth and depth of skills and knowledge over a wide range of units, you could progress within work to become a:</p> <ul style="list-style-type: none">• land-based service engineer. |

| | |
|--|---|
| Why choose this qualification over similar qualifications? | You are likely to take this qualification full-time over at least 2 years in a college. You would take this qualification if you want to become a land-based service engineer. You will gain a wide range of skills and knowledge that employers recognise and value. |
| Will the qualification lead to further learning? | You may want to progress into Higher Education. |
| WHO SUPPORTS THIS QUALIFICATION? | |
| Employer/Higher Education Institutions | The British Agricultural and Garden Machinery Association (BAGMA) Institution of Agricultural Engineers (IAgrE) Agricultural Engineers Association (AEA). |

Qualification structure

For the City & Guilds Level 3 Advanced Technical Extended Diploma in Land-based Engineering (1080) the teaching programme must cover the content detailed in the structure below:

| Unit number | Unit title | GLH |
|------------------|---|-----|
| Mandatory | | |
| 301 | Principles of health and safety | 30 |
| 302 | Undertake and review work related experience in the land-based industries | 30 |
| 309 | Undertake specialist projects in the land-based sector | 60 |
| 329 | Repair land-based cultivation or drilling machinery | 60 |
| 330 | Repair land-based application machinery | 60 |
| 331 | Repair land-based forage harvesting machinery | 60 |
| 332 | Repair land-based combinable or root crop harvesting machinery | 60 |
| 350 | Calculations for land-based service engineering | 60 |
| 351 | Undertake land-based workshop processes | 60 |
| 352 | Repair land-based compression-ignition (diesel) engines | 60 |
| 353 | Repair land-based spark-ignition (petrol) engines | 60 |
| 354 | Repair land-based vehicle systems | 60 |
| 355 | Repair land-based electric systems | 60 |
| 356 | Test land-based electronic systems | 60 |
| 357 | Repair land-based hydraulic systems | 60 |
| 358 | Repair land-based mechanical power transmission systems | 60 |
| 359 | Repair land-based synchromesh transmissions and clutches | 60 |
| 360 | Repair land-based power shift transmissions | 60 |
| 361 | Repair land-based hydrostatic or hydro-mechanical (CVT) transmissions | 60 |

Total Qualification Time (TQT)

Total Qualification Time (TQT) is the total amount of time, in hours, expected to be spent by a Learner to achieve a qualification. It includes both guided learning hours (which are listed separately) and hours spent in preparation, study and assessment.

| Title and level | GLH | TQT |
|--|------|------|
| City & Guilds Level 3 Advanced Technical Extended Diploma in Land-based Engineering (1080) | 1080 | 1800 |

Assessment requirements and employer involvement

To achieve the **City & Guilds Level 3 Advanced Technical Extended Diploma in Land-based Engineering (1080)** candidates must successfully complete **all** the mandatory assessment components.

| Component number | Title |
|------------------|---|
| Mandatory | |
| 515 | Level 3 Land-based Engineering - Theory exam (1)* |
| 516 | Level 3 Land-based Engineering - Theory exam (1)* |
| 017 | Level 3 Land-based Engineering - Synoptic assignment (2)* |
| 518 | Level 3 Land-based Engineering - Theory exam (2)* |
| 300 | Level 3 Principles of health and safety – Theory exam (evolve online) |
| 302 | Level 3 Undertake and review work related experience in the land-based industries - Portfolio |
| 309 | Level 3 Undertake specialist projects in the Land-Based sector - Assignment |
| 329 | Level 3 Repair land-based cultivation or drilling machinery - Assignment |
| 330 | Level 3 Repair land-based application machinery - Assignment |
| 331 | Level 3 Repair land-based forage harvesting machinery - Assignment |
| 332 | Level 3 Repair land-based combinable or root crop harvesting machinery - Assignment |

Note – from 1 September 2023, centres may only enter candidates for the Level 3 Land-Based Engineering - Theory exam assessments through the paper-based components (515, 516, 518). There is no option to take these assessments as onscreen (evolve) exams.

Where candidates have previously successfully achieved an onscreen exam - the result will continue to count towards the Rules of Combination for this qualification.

In addition, candidates **must** complete the mandatory employer involvement requirement for this qualification **before** they can be awarded a qualification grade. For more information, please see guidance in *Section 4: Employer involvement*.

Employer involvement

| Component number | Title |
|------------------|----------------------|
| Mandatory | |
| 834 | Employer involvement |

**Number of mandatory assessments per assessment type*

2 Centre requirements

Approval

New centres will need to gain centre approval. Existing centres who wish to offer this qualification must go through City & Guilds' **full** Qualification Approval Process. There is no fast track approval for this qualification. Please refer to the City & Guilds website for further information on the approval process: www.cityandguilds.com

Resource requirements

Centre staff should familiarise themselves with the structure, content and assessment requirements of the qualification before designing a course programme.

Centre staffing

Staff delivering these qualifications must be able to demonstrate that they meet the following requirements:

- be technically competent in the areas in which they are delivering
- be able to deliver across the breadth and depth of the content of the qualification being taught
- have recent relevant teaching and assessment experience in the specific area they will be teaching, or be working towards this
- demonstrate continuing CPD.

Physical resources

Centres must be able to demonstrate that they have access to the equipment and technical resources required to deliver this qualification and its assessment.

Internal Quality Assurance

Internal quality assurance is key to ensuring accuracy and consistency of tutors and markers. Internal Quality Assurers (IQAs) monitor the work of all tutors involved with a qualification to ensure they are applying standards consistently throughout assessment activities. IQAs must have, and maintain, an appropriate level of technical competence and be qualified to make both marking and quality assurance decisions through a teaching qualification or recent, relevant experience.

Learner entry requirements

Centres must ensure that all learners have the opportunity to gain the qualification through appropriate study and training, and that any prerequisites stated in the *What is this qualification about?* section are met when registering on this qualification.

Age restrictions

This qualification is approved for learners aged 16 – 19, 19+

3 Delivering technical qualifications

Initial assessment and induction

An initial assessment of each learner should be made before the start of their programme to identify:

- if the learner has any specific learning or training needs,
- support and guidance they may need when working towards their qualification,
- the appropriate type and level of qualification.

We recommend that centres provide an introduction so that learners fully understand the requirements of the qualification, their responsibilities as a learner, and the responsibilities of the centre. This information can be recorded on a learning contract.

Employer involvement

Employer involvement is essential to maximise the value of each learner's experience. Centres are required to involve employers in the delivery of technical qualifications at Key Stage 5 and/or their assessment, for every learner. This must be in place or planned before delivery programmes begin in order to gain qualification approval. See *Section 4: Employer involvement* for more detail.

Support materials

The following resources are available for this qualification:

| Description | How to access |
|--|---|
| Sample assessments | Available on the qualification pages on the City & Guilds Website: www.cityandguilds.com |
| Technical Qualifications: Guide to Teaching, Learning and Assessment | Available on the City and Guilds website: 14-19-teaching-learning-assessment-guide-pdf.ashx (cityandguilds.com) |
| Quality Assurance Guide for Centres: Technical Qualifications and the Extended Project Qualification (EPQ) | Available on the City and Guilds website: technicals-quality-assurance-guide-for-centres-pdf.ashx (cityandguilds.com) |

4 Employer involvement

Employer involvement is a formal component of Key Stage 5 Technical qualifications. It does not contribute to the overall qualification grading, but is a mandatory requirement that all learners must meet. As such it is subject to external quality assurance by City & Guilds.

Department for Education (DfE) requirements state:

Employer involvement in the delivery and/or assessment of technical qualifications provides a clear 'line of sight' to work, enriches learning, raises the credibility of the qualification in the eyes of employers, parents and students and furthers collaboration between the learning and skills sector and industry.

[Technical qualifications] must:

- *require all students to undertake meaningful activity involving employers during their study; and*
- *be governed by quality assurance procedures run by the awarding organisation to confirm that education providers have secured employer involvement for every student.*

Extract from: ***Vocational qualifications for 16 to 19 year olds, 2017 and 2018 performance tables: technical guidance for awarding organisations, paragraphs 89-90***

City & Guilds will provide support, guidance and quality assurance of employer involvement.

Qualification approval

To be approved to offer City & Guilds technicals, centres must provide an Employer Involvement planner and tracker showing how every learner will be able to experience meaningful employer involvement, and from where sufficient and suitable employer representatives are expected to be sourced.

Centres must include in their planner a sufficient range of activities throughout the learning programme that provide a range of employer interactions for learners. Centres must also plan contingencies for learners who may be absent for employer involvement activities, so that they are not disadvantaged.

As part of the approval process, City & Guilds will review this planner and tracker. Centres which cannot show sufficient commitment from employers and/or a credible planner and tracker will be given an action for improvement with a realistic timescale for completion. **Approval will not be given** if employer involvement cannot be assured either at the start of the qualification, or through an appropriate plan of action to address this requirement before the learner is certificated.

Monitoring and reporting learner engagement

Employer involvement is a formal component of this qualification and is subject to quality assurance monitoring. Centres must record evidence that demonstrates that each learner has been involved in meaningful employer based activities against the mandatory content before claiming the employer involvement component for learners.

Centres must record the range and type of employer involvement each learner has experienced and submit confirmation that all learners have met the requirements to City & Guilds. If a centre cannot

provide evidence that learners have met the requirements to achieve the component, then the learner will not be able to achieve the overall Technical Qualification.

Types of involvement

Centres should note that to be eligible, employer involvement activities **must** relate to one or more elements of the mandatory content of this qualification.

As the aim of employer involvement is to enrich learning and to give learners a taste of the expectations of employers in the industry area they are studying, centres are encouraged to work creatively with local employers.

Employers can identify the areas of skills and knowledge in their particular industry that they would wish to see emphasised for learners who may apply to work with them in the future. Centres and employers can then establish the type of input, and which employer representative might be able to best support these aims.

To be of most benefit this must add to, rather than replace, the centre's programme of learning. Some examples of meaningful employer involvement are listed below. Employer involvement not related to the mandatory element of the qualification, although valuable in other ways, does not count towards this element of the qualification.

The DfE has provided the following examples of what does and does not count as meaningful employer involvement, as follows^{1,2}:

The following activities meet the requirement for meaningful employer involvement:

- *students undertake structured work-experience or work-placements that develop skills and knowledge relevant to the qualification³;*
- *students undertake project(s), exercises(s) and/or assessments/examination(s) set with input from industry practitioner(s);*
- *students take one or more units delivered or co-delivered by an industry practitioner(s). This could take the form of master classes or guest lectures;*
- *industry practitioners operate as 'expert witnesses' that contribute to the assessment of a student's work or practice, operating within a specified assessment framework. This may be a specific project(s), exercise(s) or examination(s), or all assessments for a qualification.*

In all cases participating industry practitioners and employers must be relevant to the industry sector or occupation/occupational group to which the qualification relates.

The following activities, whilst valuable, do not meet the requirement for meaningful employer involvement:

- *employers' or industry practitioners' input to the initial design and content of a qualification;*
- *employers hosting visits, providing premises, facilities or equipment;*
- *employers or industry practitioners providing talks or contributing to delivery on employability, general careers advice, CV writing, interview training, etc.;*

¹ As extracted from: Vocational qualifications for 16 to 19 year olds 2017 and 2018 performance tables: technical guidance for awarding organisations

² This list has been informed by a call for examples of good practice in employer involvement in the delivery and assessment of technical qualifications - **Employer involvement in the delivery and assessment of vocational qualifications**

³ **DfE work experience guidance**

- *student attendance at career fairs, events or other networking opportunities;*
- *simulated or provider-based working environments, e.g. hairdressing salons, florists, restaurants, travel agents, small manufacturing units, car servicing facilities;*
- *employers providing students with job references.*

Types of evidence

For each employer involvement activity, centres are required to provide evidence of which learners undertook it, e.g. a candidate attendance register. The types of additional evidence required to support a claim for this component will vary depending on the nature of the involvement. For a guest lecture it is expected that a synopsis of the lecture and register would be taken which each learner and the guest speaker will have signed; expert witnesses will be identified and will have signed the relevant assessment paperwork for each learner they have been involved in assessing; evidence of contribution from employers to the development of locally set or adapted assignments.

Quality assurance process

As the employer involvement component is a requirement for achieving the Key Stage 5 Technical qualifications, it is subject to external quality assurance by City & Guilds at the approval stage and when centres wish to claim certification for learners.

Evidence will be validated by City & Guilds before learners can achieve the employer involvement component. Where employer involvement is not judged to be sufficient, certificates cannot be claimed for learners.

Sufficiency of involvement for each learner

It is expected that the centre will plan a range of activities that provide sufficient opportunities for each learner to interact directly with a range of individuals employed in the related industry. Centres must also provide contingencies for learners who may be absent for part of their teaching, so they are not disadvantaged. Any absence that results in a learner missing arranged activities must be documented. Where learners are unable to undertake all employer involvement activities due to temporary illness, temporary injury or other indisposition, centres should contact City & Guilds for further guidance.

Live involvement

Learners will gain most benefit from direct interaction with employers and/or their staff; however the use of technology (e.g. the use of live webinars) is encouraged to maximise the range of interactions. Where learners are able to interact in real time with employers, including through the use of technology, this will be classed as 'live involvement'.

It is considered good practice to record learning activities, where possible, to allow learners to revisit their experience and to provide a contingency for absent learners. This is not classed as live involvement however, and any involvement of this type for a learner must be identified as contingency.

Timing

A learner who has not met the minimum requirements cannot be awarded the component, and will therefore not achieve the qualification. It is therefore important that centres give consideration to scheduling employer involvement activities, and that enough time is allotted throughout delivery and assessment of the qualification to ensure that requirements are fully met.

5 Assessment

Summary of assessment methods and conditions

| Component numbers | Assessment method | Description and conditions |
|-------------------|-------------------------|--|
| 017 | Synoptic assignment | <p>The synoptic assignment is externally set, internally marked and externally moderated. The assignment requires candidates to identify and use effectively in an integrated way an appropriate selection of skills, techniques, concepts, theories, and knowledge from across the content area. Candidates will be judged against the assessment objectives.</p> <p>Assignments will be released to centres as per dates indicated in the Assessment and Examination timetable published on our website.</p> <p>Centres will be required to maintain the security of all live assessment materials. Assignments will be password protected and released to centres through a secure method.</p> <p>There will be one opportunity within each academic year to sit the assignment. Candidates who fail the assignment will have one re-sit opportunity. The re-sit opportunity will be in the next academic year, and will be the assignment set for that academic year once released to centres. If the re-sit is failed, the candidate will fail the qualification.</p> <p>Please note that for externally set assignments City & Guilds provides guidance and support to centres on the marking and moderation process.</p> |
| 515 516 518 | Externally marked exams | <p>The exams are externally set and externally marked, and will be taken as a paper based test (515, 516, 518).</p> <p>The exams are designed to assess the candidate’s depth and breadth of understanding across content in the qualification at the end of the period of learning, using a range of question types and will be sat under invigilated examination conditions. See JCQ requirements for details: http://www.jcq.org.uk/exams-office/ice---instructions-for-conducting-examinations</p> <p>The exam specification shows the coverage of the exam across the qualification content.</p> <p>Candidates who fail the exam at the first sitting will have a maximum of two opportunities to retake. If the candidate fails the exam three times then they will fail the qualification. (Note: the third and final retake opportunity applies to Level 3 only.) For exam dates, please refer to the Assessment and Examination timetable.</p> |

| Component numbers | Assessment method | Description and conditions |
|-------------------------|------------------------------|---|
| 302 | Portfolio of evidence | This unit will be evidenced by a portfolio of evidence. |
| 300 | Evolve online on-demand exam | <p>This exam is externally set and externally marked and will be taken online through City & Guilds' computer-based testing platform under invigilated exam conditions. The exam is available on-demand and can be taken at any time in the year.</p> <p>There is no maximum number of retake attempts for this exam , however, learners should be given sufficient time and tutor support before resitting.</p> |
| 309, 329, 330, 331, 332 | Unit assignments | <p>The unit assignments are externally set, internally marked and externally verified. The assignment requires candidates to identify and use effectively skills, knowledge and understanding from across the unit content area. Candidates will be judged against the unit grading criteria.</p> <p>Arrangements for release, security and re-sitting assignments are the same as detailed for the synoptic assignment.</p> |

What is synoptic assessment?

Technical qualifications are based around the development of a toolkit of knowledge, understanding and skills that an individual needs in order to have the capability to work in a particular industry or occupational area. Individuals in all technical areas are expected to be able to apply their knowledge, understanding and skills in decision making to solve problems and achieve given outcomes independently and confidently.

City & Guilds technical qualifications require candidates to draw together their learning from across the qualification to solve problems or achieve specific outcomes by explicitly assessing this through the synoptic assignment component.

In this externally set, internally marked and externally moderated assessment the focus is on bringing together, selecting and applying learning from across the qualification rather than demonstrating achievement against units or subsets of the qualification content. The candidate will be given an appropriately levelled, substantial, occupationally relevant problem to solve or outcome to achieve. For example this might be in the form of a briefing from a client, leaving the candidate with the scope to select and carry out the processes required to achieve the client's wishes, as they would in the workplace.

Candidates will be marked against assessment objectives (AOs) such as their breadth and accuracy of knowledge, understanding of concepts, and the quality of their technical skills as well as their ability to use what they have learned in an integrated way to achieve a considered and high quality outcome.

How the assignment is synoptic for this qualification

The typical assignment brief could be to carry out diagnostics and evaluations on land-based machines of different types and with different characteristics. This will require the candidate to use diagnostic and evaluation skills; and understanding of how the different systems of a vehicle work together, selecting tools and tests. They will need to draw on their skills and knowledge from across the qualification to complete records and vehicle handovers to customers; inclusive of recommendations on actions required. Candidates will also have the opportunity to complete appraisals of land-based machines and components for different purposes. They will need to draw on their knowledge across all components of the machine and use their inspection skills to compile detailed condition reports with proposals for future action.

External exam for stretch, challenge and integration

The external externally set, externally marked exams (515, 516, 518) will draw from across the mandatory content of the qualification, using a range of shorter questions to confirm breadth of knowledge and understanding. Extended response questions are included, giving candidates the opportunity to demonstrate higher level understanding and integration through discussion, analysis and evaluation, and ensuring the assessment can differentiate between 'just able' and higher achieving candidates.

Assessment objectives

The assessments for this qualification are set against a set of assessment objectives (AOs) which are used across all City & Guilds Technicals to promote consistency among qualifications of a similar purpose. They are designed to allow judgement of the candidate to be made across a number of different categories of performance.

Each assessment for the qualification has been allocated a set number of marks against these AOs based on weightings recommended by stakeholders of the qualification. This mark allocation remains the same for all versions of the assessments, ensuring consistency across assessment versions and over time.

The following table explains all AOs in detail, including approximate weightings for the synoptic assignments. In some cases, due to the nature of a qualification's content, it is not appropriate to award marks for some AOs. Where this is the case these have been marked as N/A. Weightings for exams (AOs 1, 2 and 4 only) can be found with the exam specification.

| Assessment objective | City & Guilds Level 3 Advanced Technical Extended Diploma in Land-based Engineering (1080) Typical expected evidence of knowledge, understanding and skills | Approximate weighting (Assignment) |
|--|---|------------------------------------|
| AO1 Recalls knowledge from across the breadth of the qualification. | Legislation and regulations, risk assessment protocols, workshop processes, technical terminology, operating principles of machines and components, component identification, component functionality, tools and workshop equipment, specialist diagnostic test equipment. | 15% |
| AO2 Demonstrates understanding of concepts, theories and processes from across the breadth of the qualification. | Risks assessment processes, understanding of operating principles of machines and components, servicing and maintenance procedures, diagnostic test procedures, use and interpretation of technical data and schematic diagrams, interpretation of diagnostic test results. | 20% |
| AO3 Demonstrates technical skills from across the breadth of the qualification. | Safe working practices, selection and use of tools and workshop equipment, selection and use of diagnostic equipment, servicing and maintenance procedures, diagnostic test procedures, evaluation of diagnostic test results, repair procedures, verification of integrity of repairs. | 35% |
| AO4 Applies knowledge, understanding and skills from across the breadth of the qualification in an integrated and holistic way to achieve specified purposes. | Applying knowledge and understanding to a particular scenario or problem – justifying decisions and approaches taken, e.g. planning process, contingencies, completion of reports, reflection and evaluation. | 20% |
| AO5 Demonstrates perseverance in achieving high standards and attention to detail while showing an | Compliance with protocols and procedures, verification of diagnostic test results and evaluations, verification of integrity of repair before handover to customer, verification of condition of machinery or equipment before | 10% |

understanding of wider
impact of their actions.

handover to customer, verification of recorded
details and final reports.

Exam specifications

AO weightings per exam

| Assessment Objective | Exam 515 weighting (approx. %) | Exam 516 weighting (approx. %) | Exam 518 weighting (approx. %) |
|---|--------------------------------|--------------------------------|--------------------------------|
| AO1 Recalls knowledge from across the breadth of the qualification. | 20 | 20 | 20 |
| AO2 Demonstrates understanding of concepts, theories and processes from across the breadth of the qualification. | 60 | 60 | 60 |
| AO4 Applies knowledge, understanding and skills from across the breadth of the qualification in an integrated and holistic way to achieve specified purposes. | 20 | 20 | 20 |

The way the exams covers the content of the qualification is laid out in the tables below:

Assessment type: Examiner marked, written exam

Assessment conditions: Invigilated examination conditions

Grading: X/P/M/D

| Exam 515 | Duration: 2 hours | | |
|--------------|---|-----------------|------------|
| Unit | Title | Number of marks | % |
| 350 | Calculations for land-based service engineering | 24 | 40 |
| 352 | Repair land-based compression-ignition (diesel) engines | 12 | 20 |
| 353 | Repair land-based spark-ignition (petrol) engines | 12 | 20 |
| N/A | Integration across the units | 12 | 20 |
| Total | | 60 | 100 |

Assessment type: Examiner marked, written exam

Assessment conditions: Invigilated examination conditions

Grading: X/P/M/D

| Exam 516 | Duration: 2 hours | | |
|-----------------|-------------------------------------|------------------------|------------|
| Unit | Title | Number of marks | % |
| 354 | Repair land-based vehicle systems | 12 | 20 |
| 355 | Repair land-based electric systems | 12 | 20 |
| 356 | Test land-based electronic systems | 12 | 20 |
| 357 | Repair land-based hydraulic systems | 12 | 20 |
| N/A | Integration across the units | 12 | 20 |
| Total | | 60 | 100 |

Assessment type: Examiner marked, written exam

Assessment conditions: Invigilated examination conditions

Grading: X/P/M/D

| Exam 518 | Duration: 2 hours | | |
|-----------------|---|------------------------|------------|
| Unit | Title | Number of marks | % |
| 358 | Repair land-based mechanical power transmission systems | 15 | 25 |
| 359 | Repair land-based synchromesh transmissions and clutches | 15 | 25 |
| 360 | Repair land-based powershift transmissions | | |
| 361 | Repair land-based hydrostatic or hydro-mechanical (CVT) transmissions | 18 | 30 |
| N/A | Integration across the units | 12 | 20 |
| Total | | 60 | 100 |

Assessment type: Multiple-choice exam, delivered online *

Assessment conditions: Invigilated examination conditions

Grading: X/P

| Level 3 Principles of health and safety - Theory exam (300) | | | |
|--|---|------------------------|------------|
| Duration: 1 hour | | | |
| Unit | Learning outcome | Number of marks | % |
| Level 3 Principles of health and safety (301) | 1. Understand health and safety legislation | 9 | 30 |
| | 2. Understand the risk assessment process | 8 | 26 |
| | 3. Understand first aid requirements | 7 | 23 |
| | 4. Understand safe manual handling principles | 2 | 6 |
| | 5. Understand the use of fire extinguishers | 4 | 15 |
| Total | | 30 | 100 |

*These exams are sat under invigilated examination conditions, as defined by the JCQ:
<http://www.jcq.org.uk/exams-office/ice---instructions-for-conducting-examinations>.

Entry for exams can be made through the City & Guilds Walled Garden.

6 Moderation and standardisation of assessment

City & Guilds' externally set synoptic assignments for technical qualifications are designed to draw from across the qualifications' content, and to contribute a significant proportion towards the learner's final qualification grade. They are subject to a rigorous external quality assurance process known as external moderation.

Moderation is the process where external quality assurers are standardised to a national standard in order to review centre marking of internally marked assessments. These external quality assurers are referred to as 'moderators'. Moderators will review a representative sample of 'candidate work' across the mark range from every centre. Their marks act as a benchmark to inform City & Guilds whether centre marking is in line with City & Guilds' standard.

Where moderation shows that the centre is applying the marking criteria within a reasonable range of mark tolerance, centre marks for the whole cohort will be accepted. Where moderation shows that the centre is either consistently too lenient or consistently too harsh in comparison to the national standard, an appropriate adjustment (up or down) will be made to the marks of the whole cohort, retaining the centre's rank ordering. Due to the nature of the assessment and the marking grid across Assessment Objectives (AOs), it is not expected that the tutors mark and the moderators mark will match exactly.

Where centre application of the marking criteria is inconsistent, an appropriate adjustment for the whole cohort may not be possible on the basis of the sample of candidate work. In these instances a complete remark of the candidate work may be necessary.

Additional unit and optional unit assessments are also subject to external quality assurance through a verification process. This involves external quality assurers scrutinising IQA records; sampling candidates' work across a range of units and also sampling across the mark/grade range. Centres are then provided with feedback and actions to ensure that results are valid and reliable.

For more detailed information, on the quality assurance process for synoptic assignments and additional unit and optional unit assessments please refer to 'Quality Assurance Guide for Centres: Technical Qualifications and the EPQ available to download on the City & Guilds website.

It is vital that centres familiarise themselves with this process, and how it impacts on their delivery plan within the academic year.

Supervision and authentication of internally assessed work

The Head of Centre is responsible for ensuring that internally assessed work is conducted in accordance with City & Guilds' requirements.

City & Guilds requires both tutors and candidates to sign declarations of authenticity. If the tutor is unable to sign the authentication statement for a particular candidate, then the candidate's work cannot be accepted for assessment.

Internal standardisation

For internally marked work the centre is required to conduct internal standardisation to ensure that all work at the centre has been marked and / or graded to the same standard. It is the Internal Quality Assurer's (IOA's) responsibility to ensure that standardisation has taken place, and that the training includes the use of reference and archive materials such as work from previous years as appropriate.

Internal appeal

Centres must have an internal process in place for candidates to appeal the marking of internally marked components, ie the synoptic assignment and any optional unit assignments. This must take place before the submission of marks or grades for external quality assurance. The internal process must include candidates being informed of the marks (or grades) the centre has given for internally assessed components, as they will need these to make the decision about whether or not to appeal.

Post-quality assurance procedures

Once the external quality assurance processes have been completed, feedback is provided to the centre on the standard of the internal assessment, highlighting areas of good practice, and potential areas for improvement. This will inform future centre assessment, and standardisation activities, as well as external quality assurance and risk management activity.

City & Guilds will then carry out awarding, the process by which grade boundaries are set with reference to the candidate evidence available on the platform.

Centres retaining evidence

Centres must retain assessment records for each candidate for a minimum of three years. To help prevent plagiarism or unfair advantage in future versions, candidate work may not be returned to candidates. Samples may however be retained by the centre as examples for future standardisation of marking.

7 Grading

Awarding individual assessments

Individual assessments will be graded, by City & Guilds, as pass/merit/distinction where relevant. The grade boundaries for pass and distinction for each assessment will be set through a process of professional judgement by technical experts. Merit will usually be set at the midpoint between pass and distinction. The grade descriptors for pass and distinction, and other relevant information (eg archived samples of candidate work and statistical evidence) will be used to determine the mark at which candidate performance in the assessment best aligns with the grade descriptor in the context of the qualification's purpose. Boundaries will be set for each version of each assessment to take into account relative difficulty.

Please note that as the merit grade will usually be set at the arithmetical midpoint between pass and distinction, there are no descriptors for the merit grade for the qualification overall.

Grade descriptors

To achieve a pass, a candidate will be able to:

- Demonstrate the knowledge and understanding required to work in the occupational area, its principles, practices and legislation.
- Describe some of the main factors impacting on the occupation to show good understanding of how work tasks are shaped by the broader social, environmental and business environment it operates within.
- Use the technical industry specific terminology used in the industry accurately.
- Demonstrate the application of relevant theory and understanding to solve non-routine problems.
- Interpret a brief for complex work related tasks, identifying the key aspects, and showing a secure understanding of the application of concepts to specific work related tasks.
- Carry out planning which shows an ability to identify and analyse the relevant information in the brief and use knowledge and understanding from across the qualification (including complex technical information) to interpret what a fit for purpose outcome would be and develop a plausible plan to achieve it.
- Achieve an outcome which successfully meets the key requirements of the brief.
- Identify and reflect on the most obvious measures of success for the task and evaluate how successful they have been in meeting the intentions of the plan.
- Work safely throughout, independently carrying out tasks and procedures, and having some confidence in attempting the more complex tasks.

To achieve a distinction, a candidate will be able to:

- Demonstrate the excellent knowledge and understanding required to work to a high level in the occupational area, its principles, practices and legislation.
- Analyse the impact of different factors on the occupation to show deep understanding of how work tasks are shaped by the broader social, environmental and business environment it operates within.
- Demonstrate the application of relevant theory and understanding to provide efficient and effective solutions to complex and non-routine problems.
- Analyse the brief in detail, showing confident understanding of concepts and themes from across the qualification content, bringing these together to develop a clear and stretching plan that would credibly achieve an outcome that is highly fit for purpose.

- Achieve an outcome which shows an attention to detail in its planning, development and completion, so that it completely meets or exceeds the expectations of the brief to a high standard.
- Carry out an evaluation in a systematic way, focussing on relevant quality points, identifying areas of development/improvement as well as assessing the fitness for purpose of the outcome.

Awarding grades and reporting results

The overall qualification grade will be calculated based on aggregation of the candidate's achievement in each of the assessments for the mandatory units, taking into account the assessments' weighting. The qualification will be reported on a ten grade scale: Pass Pass Pass, Pass Pass Merit, Pass Merit Merit, Merit Merit Merit, Merit Merit Distinction, Merit Distinction Distinction, Distinction Distinction Distinction, Distinction Distinction Distinction*, Distinction Distinction* Distinction*, Distinction* Distinction* Distinction*.

All assessments **must** be achieved at a minimum of pass for the qualification to be awarded. Candidates who fail to reach the minimum standard for grade pass for an assessment(s) will not have a qualification grade awarded and will not receive a qualification certificate.

The approximate pass grade boundary for the synoptic assignment in this qualification are:

| Synoptic Assignment | Approximate Pass Mark (%) |
|---------------------|---------------------------|
| 017 | 40 |

Please note that each synoptic assignment is subject to an awarding process before final grade boundaries are confirmed.

The contribution of assessments towards the overall qualification grade is as follows:

| Assessment method | Grade scale | % contribution |
|---------------------------|-------------|----------------|
| Synoptic Assignment (017) | X/P/M/D | 60% |
| Exam (515) | X/P/M/D | 10% |
| Exam (516) | X/P/M/D | 15% |
| Exam (518) | X/P/M/D | 15% |

Both synoptic assignments and exams are awarded (see 'Awarding individual assessments', at the start of Section 7, above), and candidates' grades converted to points. The minimum points available for each assessment grade is listed in the table below. The range of points between the pass, merit and distinction boundaries will be accessible to candidates. For example a candidate that achieves a middle to high pass in an assessment will receive between 8 and 10 points, a candidate that achieves a low to middle merit in an assessment will receive between 12 and 14 points. The points above the minimum for the grade for each assessment are calculated based on the candidate's score in that assessment.

| | Pass | Merit | Distinction |
|----------------------|------|-------|-------------|
| Assignment (017) 60% | 6 | 12 | 18 |
| Exam (515) 10% | 6 | 12 | 18 |
| Exam (516) 15% | 6 | 12 | 18 |
| Exam (518) 15% | 6 | 12 | 18 |

The weighted average of candidate's points for each assessment is calculated, and the overall grade of the qualification will then be determined using the following criteria.

| Qualification Grade | Minimum points |
|--|----------------|
| Distinction*, Distinction*, Distinction* | 20.5 |
| Distinction, Distinction*, Distinction* | 19.3 |
| Distinction, Distinction, Distinction* | 18.2 |
| Distinction, Distinction, Distinction | 17 |
| Merit, Distinction, Distinction | 15 |
| Merit, Merit, Distinction | 13 |
| Merit, Merit, Merit | 11 |
| Pass, Merit, Merit | 9.3 |
| Pass, Pass, Merit | 7.7 |
| Pass, Pass, Pass | 6 |

Candidates achieving Distinction*, Distinction*, Distinction* will be the highest achieving of the Distinction candidates.

8 Administration

Approved centres must have effective quality assurance systems to ensure valid and reliable delivery and assessment of qualifications. Quality assurance includes initial centre registration by City & Guilds and the centre's own internal procedures for monitoring quality assurance procedures.

Consistent quality assurance requires City & Guilds and its associated centres to work together closely; our Quality Assurance Model encompasses both internal quality assurance (activities and processes undertaken within centres) and external quality assurance (activities and processes undertaken by City & Guilds).

For this qualification, standards and rigorous quality assurance are maintained by the use of:

- internal quality assurance
- City & Guilds external moderation (synoptic assessments)
- City & Guilds external verification (additional unit / optional assessments).

In order to carry out the quality assurance role, Internal Quality Assurers (IQAs) must have and maintain an appropriate level of technical competence and have recent relevant assessment experience. For more information on the requirements, refer to *Section 2: Centre requirements* in this handbook.

To meet the quality assurance criteria for this qualification, the centre must ensure that the following procedures are followed:

- suitable training of staff involved in the assessment of the qualification to ensure they understand the process of marking and standardisation
- completion by the person responsible for internal standardisation of the Centre Declaration Sheet to confirm that internal standardisation has taken place
- the completion by candidates and supervisors/tutors of the record form for each candidate's work.

External quality assurance

City & Guilds will undertake external moderation and verification activities to ensure that the quality assurance criteria for this qualification are being met. Centres must ensure that they co-operate with City & Guilds staff and representatives when undertaking these activities.

City & Guilds requires the Head of Centre to:

- facilitate any inspection of the centre which is undertaken on behalf of City & Guilds
- make arrangements to receive, check and keep assessment material secure at all times
- maintain the security of City & Guilds confidential material from receipt to the time when it is no longer confidential
- keep completed assignment work and examination scripts secure from the time they are collected from the candidates to their dispatch to City & Guilds.

Enquiries about results

The services available for enquiries about results include a review of marking for exam results and review of moderation for synoptic assignments. Requests must be submitted within the specified

period after the publication of results for individual assessments. Please see the **City & Guilds website** for more information.

Re-sits and shelf-life of assessment results

Re-sits and shelf-life of assessment results Candidates who have failed an exam or wish to re-take it in an attempt to improve their grade, can do so **twice**. The best result will count towards the final qualification. See guidance on individual assessment types in Section 5.

Factors affecting individual learners

If work is lost, City & Guilds should be notified immediately of the date of the loss, how it occurred, and who was responsible for the loss. Centres should use the JCQ form, JCQ/LCW, to inform City & Guilds Customer Services of the circumstances.

Learners who move from one centre to another during the course may require individual attention. Possible courses of action depend on the stage at which the move takes place. Centres should contact City & Guilds at the earliest possible stage for advice about appropriate arrangements in individual cases.

Malpractice

Please refer to the City & Guilds guidance notes *Managing cases of suspected malpractice in examinations and assessments*. This document sets out the procedures to be followed in identifying and reporting malpractice by candidates and/or centre staff and the actions which City & Guilds may subsequently take. The document includes examples of candidate and centre malpractice and explains the responsibilities of centre staff to report actual or suspected malpractice. Centres can access this document on the City & Guilds website.

Examples of candidate malpractice are detailed below (please note that this is not an exhaustive list):

- falsification of assessment evidence or results documentation
- plagiarism of any nature
- collusion with others
- copying from another candidate (including the use of ICT to aid copying), or allowing work to be copied
- deliberate destruction of another's work
- false declaration of authenticity in relation to assessments
- impersonation.

These actions constitute malpractice, for which a penalty (e.g. disqualification from the assessment) will be applied.

Where suspected malpractice is identified by a centre after the candidate has signed the declaration of authentication, the Head of Centre must submit full details of the case to City & Guilds at the earliest opportunity. Please refer to the form in the document *Managing cases of suspected malpractice in examinations and assessments*.

Access arrangements

Access arrangements are adjustments that allow candidates with disabilities, special educational needs and temporary injuries to access the assessment and demonstrate their skills and knowledge without changing the demands of the assessment. These arrangements must be made before assessment takes place.

It is the responsibility of the centre to ensure at the start of a programme of learning that candidates will be able to access the requirements of the qualification.

Please refer to the JCO access arrangements and reasonable adjustments and Access arrangements - when and how applications need to be made to City & Guilds for more information. Both are available on the **City & Guilds website**.

Special consideration

We can give special consideration to candidates who have had a temporary illness, injury or indisposition at the time of the examination. Where we do this, it is given after the examination.

Applications for either access arrangements or special consideration should be submitted to City & Guilds by the Examinations Officer at the centre. For more information please consult the current version of the JCO document, A guide to the special consideration process. This document is available on the **City & Guilds website**

| | |
|--------|------------|
| UAN: | A/507/4634 |
| Level: | 3 |
| GLH: | 30 |

What is this unit about?

This unit aims to provide learners with an understanding of the principles of health and safety and identify how these can be applied in practice within land-based or related industries. This unit is primarily aimed at learners within a centre-based setting looking to progress into the sector or further education and training.

Learners will be able to recognise common health and safety practices and processes which they will encounter within the workplace. The land-based sector has one of the worst fatal accident records of any major industrial sector and a lack of basic training and/or competency is often a contributory factor. There is a need for new entrants to these industries to gain essential health and safety knowledge in order to minimise harm to themselves and to improve attitudes and behaviour in the workplace. In addition, learners will have the opportunity to consider factors which are specific to their workplace.

This unit must be taught alongside **all** technical units within the qualification ensuring learners gain an appreciation of its importance and so that they are equipped with knowledge and understanding to protect themselves and others when working in the industry.

Learning outcomes

In this unit, learners will

1. understand health and safety legislation
2. understand the risk assessment process
3. understand first aid requirements
4. understand safe manual handling principles
5. understand the use of fire extinguishers.

Scope of content

This section gives details of the scope of content to be covered in the teaching of the unit to ensure that all the learning outcomes can be achieved.

Learning outcome

1. Understand health and safety legislation

Topics

- 1.1 Impact of good and bad practice upon individuals and businesses
- 1.2 Key legislation relating to health, safety and welfare
- 1.3 Statutory duties of employers, employees and the self-employed
- 1.4 Consequences of not complying with statutory duties
- 1.5 How individuals can contribute to establishing a good health and safety culture

Topic 1.1

Learners will know direct and indirect consequences of poor standards of workplace health and safety practice on both businesses and individuals, to include

Financial, e.g.

- fines and legal fees
- compensation claims
- increased insurance premiums
- equipment repair/replacement costs
- staff recruitment and training costs

emotional, e.g.

- guilt and grief
- stress

reputation, e.g.

- loss of reputation
- bad publicity

employees, e.g.

- reduced staff morale and productivity
- increased staff turnover and sickness

social, e.g.

- loss of independence
- reduced social activity.

Topic 1.2

Learners will know key legislation relating to health, safety and welfare within their workplace, for example, Health and Safety at Work etc. Act 1974 and the Management of Health and Safety at Work Regulations 1999. Learners will understand the importance of accident and incident reporting in accordance with the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR) 2013. Learners will understand the legal status and practical implications of approved codes of practice and industry specific best practice guidance.

Topic 1.3

Learners will know the statutory duties of employers, employees and the self-employed, to include

employers

- provide a safe working environment
- provide safe equipment and systems of work
- provide information, instruction, training and supervision
- arrange for the safe storage, transport and use of articles and substances
- provide adequate welfare facilities

employees

- take reasonable care of their own health and safety
- take reasonable care of other people who may be affected by what they do or don't do at work
- cooperate with their employer on health and safety
- not interfere with or misuse anything provided for their health, safety or welfare.

Topic 1.4

Learners will know the powers of health and safety enforcement officers (e.g. inspection, investigation and guidance) and identify the range of enforcement actions and penalties that may be imposed (e.g. prohibition and improvement notices, intervention fees and prosecutions).

Topic 1.5

Learners will understand how individuals can contribute to establishing a good health and safety culture within their workplace, for example

- promptly report defective safety equipment or other matters of concern
- always use control measures and personal protective equipment (PPE) as instructed
- help others to work safely by sharing knowledge and good practice
- set a good example to others by always working safely
- follow instructions and safe working procedures.

Learning outcome:

2. Understand the risk assessment process

Topics

- 2.1 Principles of risk assessment
- 2.2 Workplace hazards
- 2.3 Risk assessment processes

This outcome provides learners with knowledge of the requirements and importance of carrying out risk assessments. Learners will be expected to carry out risk assessments in practice when performing industry specific activities.

Topic 2.1

Learners will understand the legal requirement to carry out suitable and sufficient risk assessments. They will understand the responsibilities of employers, employees and self-employed within the risk assessment process and identify when expert advice and guidance may be required (e.g. lack of experience or knowledge).

Topic 2.2

Learners will know common hazards associated with a workplace which could result in serious harm to themselves or others (e.g. visitors, colleagues, members of the public).

Topic 2.3

Learners will understand how to undertake a detailed risk assessment within the context of their workplace, following the Health and Safety Executive 'Five Steps to Risk Assessment', to include

- identification of hazards
- identification of who might be harmed and how they might be harmed
- evaluation of risks and decide how levels of risk may be controlled
- recording and implementation of results, as well as communication to others who may be affected
- reviewing risk assessments and suggesting when risk assessments should be reviewed.

Learners will also know the hierarchy of risk control

- elimination
- substitution
- safe working procedures
- training, instruction and supervision
- personal and respiratory protective equipment (PPE/RPE).

Learning outcome:

3. Understand first aid requirements

Topics

- 3.1 Planning for emergencies and first aid provision in the workplace
- 3.2 Procedures when encountering an accident or medical emergency
- 3.3 First aid for common emergencies

In this outcome learners will explore the importance of planning and managing common first aid emergencies which may arise in the workplace, with an emphasis upon their workplace. Learners should be aware of the aims of first aid (e.g. preserve life, prevent injuries from worsening, promote recovery). Evidence towards this outcome could come from a current first aid training qualification (e.g. appointed persons or first aid at work).

Topic 3.1

Learners will understand the importance of emergency planning, especially for lone or isolated working, and the responsibilities of a first aider. Learners will also know the minimum requirements for first aid at work and identify supplementary arrangements which may be appropriate for their workplace.

Topic 3.2

Learners will know the procedures to follow when encountering an accident or medical emergency. Learners will know how to check the incident site to minimize risk to themselves and assess the situation. Learners will also know how and when to contact the emergency services and how to prioritise activities (e.g. 'DRABC').

Topic 3.3

Learners will know how to manage the following common situations as well as other significant situations appropriate to their workplace

- wounds and burns
- choking
- severe bleeding
- shock
- concussion
- unconscious casualties
- falls from height
- suspected broken limbs and dislocations
- heart attacks.

Learners will know how to recognise their own limitations and explain how to monitor the condition of the casualty and prevent an injury from worsening.

Learning outcome:

4. Understand safe manual handling principles

Topics

- 4.1 Principles of safe manual handling
- 4.2 Safe manual handling of common items

In this outcome learners will need to investigate the principles of risk assessment relevant to manual handling in order to plan for and safely move a range of common items associated with their workplace. Learners should have access to a range of common mechanical aids and these should be used as appropriate.

Topic 4.1

Learners will understand how manual handling at work should be minimised and identify appropriate alternatives and mechanical aids. They will know the common causes of injuries associated with poor manual handling within their workplace.

Topic 4.2

Learners will understand how to safely move a range of common items within their workplace. They will know appropriate mechanical aids for a range of common manual handling activities within their workplace.

Learning outcome:

5. Understand the use of fire extinguishers

Topics

- 5.1 Use of fire extinguishers

Topic 5.1

Learners will know the types, uses and colours of portable fire extinguishers, to include

- water

- dry powder
- foam
- CO₂.

Learners will know how to recognise their own limitations when managing fires in the workplace.

Guidance for delivery

On completion of this unit, the learner will have developed an understanding of some of the key underlying principles and practices of health and safety to help prepare them to enter the workplace. It will be important that delivery relates to situations that are vocationally relevant to the learners.

Visiting speakers (e.g. paramedics, health and safety consultants or inspectors) could enhance the relevance of the subject to learners.

Employer engagement

Employer engagement is essential in order to maximise the value of learners' experience. A partnership approach should be adopted where possible with employers with whom the consortium has links, and with employers used for placements.

It would be helpful for tutors to maintain contact with a range of employers. These employers may be able to help with keeping examples of legislation, policies and codes of practice, which will be used in the taught content, up to date.

Suggested learning resources

Books

- Farmwise: Your Essential Guide to Health and Safety in Agriculture Health and Safety Executive
Published by: HSE books, 2013
ISBN 0717665097
- Health & Safety at Work Essentials. 8th Edition Chadder P. and Duncan M.
Published by: Lawpack Publishing Ltd, 2014
ISBN: 1910143006
- Health and Safety at Work: An Essential Guide for Managers. 9th Edition Stranks, J
Published by: Kogan Page Ltd, 2010
ISBN: 0749461195

Websites

- Health and Safety Executive (HSE) <http://www.hse.gov.uk>
- The Royal Society for the Prevention of Accidents (ROSPA) <http://www.rosipa.com/>

Unit 302

Undertake and review work related experience in the land-based industries

| | |
|---------------|------------|
| UAN: | F/507/4635 |
| Level: | 3 |
| GLH: | 30 |

What is this unit about?

The aim of this unit is to give learners the skills needed to identify, participate in and review work experience in the environmental and land-based sector. The unit is primarily aimed at learners within a centre-based setting looking to progress into the sector or further education and training.

Learning outcomes

In this unit, learners will

1. determine employment opportunities in the environmental and land-based industries
2. prepare for a work related experience in the environmental and land-based industries
3. understand the importance of effective interpersonal skills in the workplace
4. review a work related experience in the environmental and land-based industries .

Scope of content

This section gives details of the scope of content to be covered in the teaching of the unit to ensure that all the learning outcomes can be achieved.

Learning outcome:

1. Determine employment opportunities in the environmental and land-based industries

Topics

1.1 Career and progression opportunities within an environmental and land-based industry

In this outcome, learners will explore the different job roles and responsibilities, and the job titles commonly associated with them in their specialist sector. This background understanding is likely to require some formal classroom teaching. Learners should be encouraged to explore the range of employment opportunities and career paths within their specialist sector. Learners will then consider the skills and qualifications that are required for appropriate jobs for themselves and should be encouraged to think about skills and qualifications that they may need to acquire to achieve their employment and career ambitions. This should help them to identify suitable work related experience.

Topic 1.1

Learners will know the job roles relevant to the land-based sector, to include

- managerial
- supervisory
- team worker
- trainee
- volunteer
- common job titles within the relevant sector
- main duties and responsibilities.

Learners will also know the skills, qualifications and experience needed to fulfil duties and responsibilities of appropriate jobs, to include

- job specific
- vocational
- personal.

Learning outcome:

2. Prepare for a work related experience in the environmental and land-based industries

Topics

2.1 Appropriate work related experience and the application process

2.2 Interview skills

This outcome involves learners going through the process of applying for work related experience. They will need to locate suitable job adverts or work related experience opportunities, but can be supported by centres suggesting suitable placements. When applying for work related experience learners should produce, as a minimum, a detailed curriculum vitae and letter of application using a

computer. It will be beneficial for learners to attend a real or simulated interview, and reflect on their performance outlining how they could improve their effectiveness.

Topic 2.1

Learners will find a suitable job opportunity based on qualifications, skills, experience and future development to achieve employment goals.

They will use a range of sources of information about work opportunities, e.g.

- trade magazines
- websites.

Learners will complete

- application form (if applicable)
- curriculum vitae
- letter of application.

Topic 2.2

Learners will know how to prepare for an interview, e.g.

- research the business and job role
- prepare suitable dress and personal presentation
- find out required information in advance
- prepare suitable questions to ask.

Learners will also know how to behave in an interview, e.g.

- attend punctually and dress appropriately
- answer questions
- complete other exams (e.g. practical, aptitude)
- reflect on interview performance.

Learning outcome:

3. Understand the importance of effective interpersonal skills in the workplace

Topics

3.1 The importance of effective interpersonal skills in the workplace

It would be appropriate for employers to be invited to outline to learners their expectations in the workplace.

Topic 3.1

Learners will understand the importance of effective interpersonal skills in the workplace when dealing with customers and colleagues, to include

- effective communication (e.g. addressing others face to face, appropriate telephone manner, effective written communication, use of social media)
- courtesy and helpfulness
- appropriate dress and body language
- product knowledge

- use of technical terms.

Learning outcome:

4. Review a work related experience in the environmental and land-based industries

Topics

- 4.1 Present evidence of activities and achievements during a work related experience
- 4.2 Review a work related experience, identifying strengths and areas for improvement
- 4.3 Evaluate future career aspirations

In this outcome, learners will use evidence from their work related experience to present a report (e.g. written or visual), on the business, job role, learning and achievements. They will then review the effectiveness of the workplace, making realistic and justified suggestions for improvement. Review of their own workplace performance and achievements should include all of the content identified, with reference to relevant evidence, e.g. reports, progress reviews, and the extent to which their aims, objectives/targets have been achieved. Learners should consider further training and experience that will help them to achieve their career ambitions.

Topic 4.1

Learners will present evidence of activities and achievements during a work related experience to include, as appropriate

- name of work related experience provider
- nature of the organisation (e.g. type of business, products or services, customers)
- organisation structure chart
- main duties and responsibilities
- regular daily working routine
- evidence of safe working practices (e.g. PPE, risk assessments).

Topic 4.2

Learners will review work related experience, identifying strengths and areas for improvement, to include

- work rate
- work quality and effectiveness
- punctuality
- attendance
- reliability
- dress and personal presentation
- working relationships with others
- work experience aims, objectives and targets.

Topic 4.3

Learners will evaluate career aspirations, to include

- advantages and disadvantages of identified pathways
- suitability to personal interests, skills and qualifications.

Guidance for delivery

Learners on vocational courses should have experience of the type of work that they hope to do, and of the expectations of potential future employers.

Ideally this unit should be undertaken in a real business environment relevant to the subject interest of the learner, but actual work experience may be gained by a number of routes, e.g. as part of an industrial placement whilst within the programme, whilst working on a planned daily or weekly basis on the centre's commercial and/or educational facilities, whilst undertaking voluntary work within the industry, as previous relevant work related experience in industry or as a member of a group of learners invited to carry out practical work in a suitable business.

Throughout the unit, the emphasis should be on safe working practices. It is expected that learners will be familiar with accepted practices and behaviours within the context in which they are working.

Learners should complete a minimum of 150 hours of work related experience to achieve this unit. If work related experience is in industry, centres should be mindful of their responsibilities for ensuring that placements have appropriate supervision, insurance and health and safety policies in place.

It is recommended that a summary report is completed by the employer at the end of the placement.

Unit 309

Undertake specialist projects in the land-based sector

| | |
|---------------|------------|
| UAN: | D/507/4643 |
| Level: | 3 |
| GLH: | 60 |

What is this unit about?

The purpose of this unit is for learners to gain an understanding of the principles of undertaking a specialist project and how this can be put into practice. This unit is primarily aimed at learners within a centre-based setting looking to progress into the sector or to further education and training.

Learners will develop project knowledge and skills by studying a chosen topic area through a project. They will explore topic areas that interest them and select one topic for a project. They will plan and carry out a specialist project working to meet deadlines and monitoring performance. Learners will prepare an evaluative report looking at how the project performed, if it met the aims and objectives and how improvements could be made in the future.

Learning outcomes

In this unit, learners will

1. develop proposals for a specialist project
2. plan for a specialist project
3. carry out a specialist project
4. evaluate a specialist project.

Scope of content

This section gives details of the scope of content to be covered in the teaching of the unit to ensure that all the learning outcomes can be achieved.

Learning outcome:

1. Develop proposals for a specialist project

Topics

- 1.1 Research topics
- 1.2 Project proposal

In this outcome, learners will need to identify a suitable topic for a specialist project. This should be relevant to their programme of study and have a particular interest for them. Ideal project topics could have a practical or theoretical focus, but all projects should include potential for research into existing literature and information sources as well as a practical investigation or application, so should be chosen in agreement with the tutor. Learners are likely to need guidance on suitable project topics and tutor support to ensure that selected topics are achievable in the timescale and with the resources available. The proposal should outline the aims and objectives, information sources, resource requirements, and the methodology by which the learner intends to complete the project, as well as their justification for topic selection. If appropriate to the investigation, a hypothesis should be included as part of the methodology.

Topic 1.1

Learners will use a range of information sources to research topics for a specialist project, to include

- textbooks
- journals
- magazines
- internet
- trade literature
- television and radio
- subject experts.

Learners will comment on the validity and reliability of each type of information source.

Learners will carry out research using methods appropriate to the topic, for example

- literature review
- trials or experiments
- practical activities
- questionnaires
- interviews
- surveys.

Topic 1.2

Learners will produce proposals for a specialist project, to include

- title
- aims/objectives
- methodology
- information sources

- resources required for completion of the project, e.g. advice and support, computers, materials
- justification of proposed project.

Learning outcome:

2. Plan for a specialist project

Topics

2.1 Operation and resource planning

2.2 Resource selection

In this outcome, learners will complete a detailed action plan for completion of a specialist project within the set timescale. This should include, as a minimum

- a detailed breakdown of key milestones from starting the project up to submission of the completed project report
- resources required at each stage (and reasons for their selection)
- time expected for completion and interim target completion dates.

Learners should also consider possible setbacks to their planned schedule and contingency plans to ensure timely completion of the project.

Topic 2.1

Learners will plan operations required to carry out a selected specialist project, to include

- project planning techniques
 - critical path analysis
 - gantt charts
- sequencing of activities
- working to deadlines
- allowing for other commitments
- project action plan
 - aims
 - objectives
 - specific operations/tasks
 - start and completion dates
 - time required
 - resources required
 - possible disruptions to plan, e.g. illness, IT problems, resource problems, financial problems
 - contingencies
 - remedial actions.

Topic 2.2

Learners will justify reasons selected based on suitability, availability and cost, to include (where applicable)

- people
- time
- buildings
- equipment
- animals
- materials
- literature and media, e.g. internet, trade magazines
- IT applications
- budget.

Learning outcome:

3. Carry out a specialist project

Topics

- 3.1 Progress monitoring
- 3.2 Health and safety implications

In this outcome, learners will conduct and complete a specialist project, collecting supporting evidence as appropriate, e.g. literature review, artefacts, witness statements, photographs, videos. Whilst doing this, they should maintain a log or diary of all actions, and regularly monitor their progress against their action plan. It would be appropriate for tutors/supervisors to conduct progress reviews at key stages of the project. Learners should discuss any health and safety implications of their work, and identify any relevant regulations, legislation or codes of practice. Risk assessments may contribute to evidence of this.

Topic 3.1

When carrying out a specialist project, learners will monitor progress against deadlines using a diary or action log.

Learners will monitor performance against

- planned schedule, e.g. daily progress, weekly progress, monthly progress
- budget
- other appropriate measures for each task.

Learners will capture reasons and remedial actions if falling behind schedule using a diary or action log.

Deadlines can be defined as interim, key milestones or final, and should be reviewed at regular intervals by tutors/supervisors.

Topic 3.2

Learners will discuss the health and safety implications, where applicable, of a specialist project, taking into consideration

- health and safety
- risk assessment
- personal protective equipment (PPE)
- regulations and legislation
- codes of practice.

Learning outcome:

4. Evaluate a specialist project

Topics

- 4.1 Report project
- 4.2 Project evaluation and areas for improvement

In this outcome, learners will produce a summary report of a specialist project and the process undertaken. This should include, as a minimum

- title
- aims/objectives

- review of existing literature/information
- methodology
- results/findings
- conclusions
- references.

Topic 4.1

Learners will report on a specialist project either in a written report format, or verbally through a presentation.

Topic 4.2

Learners will evaluate achievements and areas for improvement for a specialist project, to include

- conduct and management of the project
 - action plan
 - keeping to deadlines
 - problems and remedial actions
 - results/findings
 - strengths and weaknesses
- areas for improvement
 - planning
 - implementation methodology
 - results/findings
 - report
 - topics for further investigation.

Guidance for delivery

This unit is designed to encourage and develop learners' independent thinking and research skills. The concept of a project is applicable across all of the vocational areas in the environmental and land-based sector, and learners should be guided and encouraged to select a project topic that is particularly relevant to their interests. Suitable project concepts could include

- trial or experiment
- investigation of an issue important to the sector
- production of a structure or artefact
- training programme
- improvements to a process
- investigation of a new product or service.

All referencing should comply with academic conventions.

The evaluation should encompass the strengths and weaknesses of the finished project and the process undertaken. Learners should also consider the usefulness and importance of project planning, and ways in which the project could have been improved.

Unit 329

Repair land-based cultivation or drilling machinery

| | |
|---------------|------------|
| UAN: | M/507/7000 |
| Level: | 3 |
| GLH: | 60 |

What is this unit about?

The purpose of this unit is to enable learners to understand and repair land-based cultivation or drilling machinery. This machinery plays a vital role in the land-based sector, enabling the establishment of a wide and varied range of crops.

Learning outcomes

In this unit, learners will

1. understand land-based cultivation and drilling machinery
2. inspect, repair and overhaul a land-based cultivation or drilling machine.

Scope of content

This section gives details of the scope of content to be covered in the teaching of the unit to ensure that all the learning outcomes can be achieved.

Learning outcome:

1. Understand land-based cultivation and drilling machinery

Topics

- 1.1 The function and working principles of land-based cultivation machinery
- 1.2 The function and working principles of land-based drilling machinery

Topic 1.1

Learners will understand the function and working principles of land-based cultivation machinery. The topic will include

- ploughs
- stubble cultivators
- tine and disc harrows
- power harrows
- rotavators
- bed formers and tillers
- the role of primary and secondary cultivators
- powered versus non-powered cultivators
- impact of operator settings/behaviour on machine performance and component longevity
- impact of soil type and ground conditions on machine performance and component longevity
- typical component failure, trouble-shooting and repairs.

Topic 1.2

Learners will understand the function and working principles of land-based drilling machinery. The topic will include

- seed drills
- mechanical versus pneumatic seed delivery systems
- non-powered cultivator/drill combinations
- power harrow/drill combinations
- min-till drills
- strip-till drills
- no-till drills
- precision planters
- importance of correct calibration and drilling/planting rate
- impact of operator settings/behaviour on machine performance and component longevity
- impact of soil type and ground conditions on machine performance and component longevity
- typical component failure, trouble-shooting and repairs.

Learning outcome:

2. Inspect, repair and overhaul a land-based cultivation or drilling machine

Topics

2.1 Inspect, repair and overhaul a land-based cultivation or drilling machine

Topic 2.1

Learners will inspect, repair and overhaul a land-based cultivation or drilling machine. The selected machine will be relevant to local needs.

Activities will include

- inspect the machine's frame and/or structural elements
- inspect the machine's hopper/tank (if applicable)
- inspect the machine's soil-engaging components and wearing parts
- inspect the machine's driveline components (if applicable)
- inspect the machine's seed metering/delivery systems (if applicable)
- evaluate the condition of the components, assessing the fitness for purpose of each
- repair and/or replace components
- carry out repairs and/or overhaul procedures
- reinstate the machine
- verify the integrity of the repair/overhaul
- recommend actions for future servicing or maintenance
- attach the machine to a suitable tractor (if applicable)
- check settings and alignment and prepare the machine for use
- calibrate the machine for a number of different seed types (if applicable).

Guidance for delivery

Centres are encouraged to introduce employers and product specialists from industry to provide interesting and relevant information to learners. It would be helpful for tutors and centres to maintain close contact with industry to ensure ongoing access to suitable and up-to-date equipment for learners to work on.

It is accepted that some formal lectures will be necessary at level 3 but for this unit it is essential that they are they are linked directly with interactive workshop lessons working on real equipment.

Suggested learning resources

Books

Farm Machinery, 6th Edition
Published by: Old Pond Publishing, 2016
ISBN: 9781910456064
Bell, B

Farm Machinery, 12th Edition
Published by: Wiley-Blackwell, 1992
ISBN: 9780632031597
Culpin C

Miscellaneous manufacturers' publications and manuals

Journals

Profi International

Websites

Health and Safety Executive <http://www.hse.gov.uk>

How Stuff Works <http://www.howstuffworks.com>

Institution of Agricultural Engineers <http://www.iagre.org>

Land-based Engineering <http://landbasedengineering.com>

| | |
|---------------|------------|
| UAN: | T/507/7001 |
| Level: | 3 |
| GLH: | 60 |

What is this unit about?

The purpose of this unit is to enable learners to understand and repair land-based application machinery. This machinery plays a vital role in the land-based sector, enabling the growth, care and protection of a wide and varied range of crops.

Learning outcomes

In this unit, learners will

1. understand land-based application machinery
2. inspect, repair and overhaul a land-based application machine.

Scope of content

This section gives details of the scope of content to be covered in the teaching of the unit to ensure that all the learning outcomes can be achieved.

Learning outcome:

1. Understand land-based application machinery

Topics

- 1.1 The function and working principles of land-based application machinery for solid waste
- 1.2 The function and working principles of land-based application machinery for liquid waste
- 1.3 The function and working principles of land-based application machinery for artificial granular fertilizer
- 1.4 The function and working principles of land-based application machinery for liquid chemicals

Topic 1.1

Learners will understand the function and working principles of land-based application machinery for solid waste.

The topic will include

- rotary side spreaders
- dual spreaders
- rear-discharge spreaders (with and without slurry doors)
- impact of operator settings/behaviour on machine performance and component longevity
- impact of material/waste type on machine performance and component longevity
- typical component failure, trouble-shooting and repairs.

Topic 1.2

Learners will understand the function and working principles of land-based application machinery for liquid waste.

The topic will include

- slurry tankers
- umbilical spreading systems (pumps, reels, etc.)
- dribble bars
- trailing shoes
- injectors (tine-based, disc-based)
- macerators/choppers
- impact of operator settings/behaviour on machine performance and component longevity
- impact of material/waste type on machine performance and component longevity
- typical component failure, trouble-shooting and repairs.

Topic 1.3

Learners will understand the function and working principles of land-based application machinery for artificial granular fertiliser.

The topic will include

- mounted and trailed fertiliser broadcasters
- spreading mechanisms (single-disc, twin-disc, reciprocating spout, etc.)

- direction of disc rotation on twin-disc machines (inward-turning versus outward-turning discs)
- headland/boundary spreading systems/kits
- coefficient of variation (CV) and tray tests
- impact of operator settings/behaviour on machine performance and component longevity
- impact of fertiliser type on machine performance and component longevity
- typical component failure, trouble-shooting and repairs.

Topic 1.4

Learners will understand the function and working principles of land-based application machinery for liquid chemicals.

The topic will include

- mounted, trailed and self-propelled sprayers
- types of pump (diaphragm, piston, etc.)
- types of nozzle (flat fan, flood, cone, etc.)
- induction/mixing tank/hopper
- impact of operator settings/behaviour on machine performance and component longevity
- typical component failure, trouble-shooting and repairs.

Learning outcome:

2. Inspect, repair and overhaul a land-based application machine

Topics

2.1 Inspect, repair and overhaul a land-based application machine

Topic 2.1

Learners will inspect, repair and overhaul a land-based application machine. The selected machine will be relevant to local needs.

Activities will include

- inspect the machine's frame and/or structural elements
- inspect the machine's hopper/tank (if applicable)
- inspect the machine's wearing parts
- inspect the machine's driveline components
- inspect the machine's conveyor, metering or delivery system
- inspect the machine's spreading, broadcasting, spraying or distribution system
- evaluate the condition of the components, assessing the fitness for purpose of each
- repair and/or replace components
- carry out repairs and/or overhaul procedures
- reinstate the machine
- verify the integrity of the repair/overhaul
- recommend actions for future servicing or maintenance
- attach the machine to a suitable tractor (if applicable)
- check settings and prepare the machine for use.

Guidance for delivery

Centres are encouraged to introduce employers and product specialists from industry to provide interesting and relevant information to learners. It would be helpful for tutors and centres to maintain close contact with industry to ensure ongoing access to suitable and up-to-date equipment for learners to work on.

It is accepted that some formal lectures will be necessary at level 3 but for this unit it is essential that they are they are linked directly with interactive workshop lessons working on real equipment.

Suggested learning resources

Books

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Land-based Engineering
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<http://www.howstuffworks.com>
<http://www.iagre.org>
<http://landbasedengineering.com>

Unit 331

Repair land-based forage harvesting machinery

| | |
|---------------|------------|
| UAN: | A/507/7002 |
| Level: | 3 |
| GLH: | 60 |

What is this unit about?

The purpose of this unit is to enable learners to understand and repair land-based forage harvesting machinery. Forage harvesting machinery includes a wide array of equipment, such as mowers, tedders, rakes, balers, self-loading forage wagons and forage harvesters.

Learning outcomes

In this unit, learners will

1. understand land-based forage harvesting machinery
2. inspect, repair and overhaul a land-based forage harvesting machine.

Scope of content

This section gives details of the scope of content to be covered in the teaching of the unit to ensure that all the learning outcomes can be achieved.

Learning outcome:

1. Understand land-based forage harvesting machinery

Topics

- 1.1 The function and working principles of land-based mowers, conditioners and mower-conditioners
- 1.2 The function and working principles of land-based tedders and rakes
- 1.3 The function and working principles of land-based balers and wrappers
- 1.4 The function and working principles of land-based self-loading forage wagons
- 1.5 The function and working principles of land-based forage harvesters

Topic 1.1

Learners will understand the function and working principles of land-based forage harvesting machinery.

The topic will include

- mowers (discs, drums, flails, etc.)
- groupers (belts, deflectors, motors, etc.)
- conditioners (tines, impellers, etc.)
- impact of operator settings/behaviour on machine performance and component longevity
- impact of crop type/condition on machine performance and component longevity
- typical component failure, trouble-shooting and repairs.

Topic 1.2

Learners will understand the function and working principles of land-based tedders and rakes.

The topic will include

- tedders (tines, rotors, mounted, trailed, etc.)
- rakes (tines, rotors, mounted, trailed, single-rotor, twin-rotor, centre-delivery, side-delivery, etc.)
- impact of operator settings/behaviour on machine performance and component longevity
- impact of crop type/condition on machine performance and component longevity
- typical component failure, trouble-shooting and repairs.

Topic 1.3

Learners will understand the function and working principles of land-based balers and wrappers.

The topic will include

- round and square balers (pick-up reels, feed augers, rotors, knife banks, plungers, chambers, tying/netting systems, etc.)
- bale wrappers (mounted, trailed, loading arms, turntables, belts, rollers, film dispensers, unloading ramps, etc.)
- impact of operator settings/behaviour on machine performance and component longevity
- impact of crop type/condition on machine performance and component longevity
- typical component failure, trouble-shooting and repairs.

Topic 1.4

Learners will understand the function and working principles of land-based self-loading forage wagons.

The topic will include

- self-loading forage wagons (pick-up reels, feed augers, rotors, knife banks, chain and slat conveyors, height-adjustable drawbars, steering axles, etc.)
- impact of operator settings/behaviour on machine performance and component longevity
- impact of crop type/condition on machine performance and component longevity
- typical component failure, trouble-shooting and repairs.

Topic 1.5

Learners will understand the function and working principles of land-based forage harvesters.

The topic will include

- forage harvesters (pick-up reels, feed augers, feed rollers, chopping cylinders/drums/flywheels, crop blowers/accelerators, trailed, self-propelled, etc.)
- impact of operator settings/behaviour on machine performance and component longevity
- impact of crop type/condition on machine performance and component longevity
- typical component failure, trouble-shooting and repairs.

Learning outcome:

2. Inspect, repair and overhaul a land-based forage harvesting machine

Topics

2.1 Inspect, repair and overhaul a land-based forage harvesting machine

Topic 2.1

Learners will inspect, repair and overhaul a land-based forage harvesting machine. The machine will be a mower-conditioner, baler, self-loading forage wagon or forage harvester.

Activities will include

- inspect the crop cutting, lifting and/or processing systems, including wearing parts and driveline components, prior to disassembly
- disassemble the machine (as required), to enable access to the components
- inspect the components following disassembly
- evaluate the condition of the components, assessing the fitness for purpose of each
- repair and/or replace components
- carry out repairs and/or overhaul procedures
- reinstate the machine
- verify the integrity of the repair/overhaul
- recommend actions for future servicing or maintenance
- check settings and prepare the machine for operation.

Guidance for delivery

Centres are encouraged to introduce employers and product specialists from industry to provide interesting and relevant information to learners. It would be helpful for tutors and centres to maintain close contact with industry to ensure ongoing access to suitable and up-to-date equipment for learners to work on.

It is accepted that some formal lectures will be necessary at level 3 but for this unit it is essential that they are they are linked directly with interactive workshop lessons working on real equipment.

Suggested learning resources

Books

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Farm Machinery, 12th Edition
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Culpin C

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Journals

Profi International

Websites

Health and Safety Executive <http://www.hse.gov.uk>

How Stuff Works <http://www.howstuffworks.com>

Institution of Agricultural Engineers <http://www.iagre.org>

Land-based Engineering <http://landbasedengineering.com>

Unit 332

Repair land-based combinable or root crop harvesting machinery

| | |
|---------------|------------|
| UAN: | F/507/7003 |
| Level: | 3 |
| GLH: | 60 |

What is this unit about?

The purpose of this unit is to enable learners to understand and repair land-based combinable or root crop harvesting machinery. Combinable and root crop harvesting machinery includes combine harvesters and root crop harvesting equipment.

Learning outcomes

In this unit, learners will

1. understand land-based combinable and root crop harvesting machinery
2. inspect, repair and overhaul a land-based combinable or root crop harvesting machine.

Scope of content

This section gives details of the scope of content to be covered in the teaching of the unit to ensure that all the learning outcomes can be achieved.

Learning outcome:

1. Understand land-based combinable and root crop harvesting machinery

Topics

- 1.1 The function and working principles of land-based swathers and combine harvesters
- 1.2 The function and working principles of land-based beet harvesters
- 1.3 The function and working principles of land-based potato harvesters

Topic 1.1

Learners will understand the function and working principles of land-based swathers and combine harvesters.

The topic will include

- swathers (cutter-bars, crop lifters, knives, reels, feed augers, etc.)
- combine harvesters (cutter-bars, crop lifters, knives, reels, feed augers, stripper headers, crop elevators, drums, concaves, rasp bars, secondary/additional drums, straw walkers, rotors, sieves, fans, grain pans, clean grain elevators, returns systems, re-threshers, tanks, unloading augers, grain loss sensing systems, yield monitoring systems, etc.)
- conventional (straw walker) versus rotary combine harvesters
- rotary versus hybrid rotary combine harvesters
- impact of operator settings/behaviour on machine performance and component longevity
- impact of crop type/conditions on machine performance and component longevity
- typical component failure, trouble-shooting and repairs.

Topic 1.2

Learners will understand the function and working principles of land-based beet harvesters.

The topic will include

- beet harvesters (trailed, self-propelled, wheeled, tracked, toppers, scalpers, lifters, shares, turbines, carousels, rollers, elevators, webs, bunkers, etc.)
- different approaches to crop extraction/lifting
- specialist beet cleaning/loading equipment
- impact of operator settings/behaviour on machine performance and component longevity
- impact of crop type/conditions on machine performance and component longevity
- typical component failure, trouble-shooting and repairs.

Topic 1.3

Learners will understand the function and working principles of land-based potato harvesters.

The topic will include

- potato harvesters (trailed, self-propelled, wheeled, tracked, toppers, pulverisers, diablo rollers, feed rolls, elevators, separator rolls, conveyors, picking tables, bunkers, etc.)
- different approaches to crop extraction/lifting
- impact of operator settings/behaviour on machine performance and component longevity
- impact of crop type/conditions on machine performance and component longevity

- typical component failure, trouble-shooting and repairs.

Learning outcome:

2. Inspect, repair and overhaul a land-based combinable or root crop harvesting machine

Topics

2.1 Inspect, repair and overhaul a land-based combinable or root crop harvesting machine

Topic 2.1

Learners will inspect, repair and overhaul a land-based combinable or root crop harvesting machine. The machine will be a combine harvester or a root crop harvester (potato harvester, beet harvester, etc.).

Activities will include

- inspect the crop cutting, lifting and/or processing systems, including wearing parts and driveline components, prior to disassembly
- disassemble the machine (as required), to enable access to the components
- inspect the components following disassembly
- evaluate the condition of the components, assessing the fitness for purpose of each
- repair and/or replace components
- carry out repairs and/or overhaul procedures
- reinstate the machine
- verify the integrity of the repair/overhaul
- recommend actions for future servicing or maintenance
- check settings and prepare the machine for operation.

Guidance for delivery

Centres are encouraged to introduce employers and product specialists from industry to provide interesting and relevant information to learners. It would be helpful for tutors and centres to maintain close contact with industry to ensure ongoing access to suitable and up-to-date equipment for learners to work on.

It is accepted that some formal lectures will be necessary at level 3 but for this unit it is essential that they are they are linked directly with interactive workshop lessons working on real equipment.

Suggested learning resources

Books

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Culpin C

Miscellaneous manufacturers' publications and manuals

Journals

Profi International

Websites

Health and Safety Executive <http://www.hse.gov.uk>

How Stuff Works <http://www.howstuffworks.com>

Institution of Agricultural Engineers <http://www.iagre.org>

Land-based Engineering <http://landbasedengineering.com>

Unit 350

Calculations for land-based service engineering

| | |
|---------------|------------|
| UAN: | D/507/6988 |
| Level: | 3 |
| GLH: | 60 |

What is this unit about?

The purpose of this unit is to enable learners to understand calculations that are relevant to land-based service engineering. These calculations underpin topics such as engines, electrics, electronics and hydraulics. They are also relevant to a wide and varied range of workshop processes.

Learning outcomes

In this unit, learners will

1. understand land-based service engineering calculations.

Scope of content

This section gives details of the scope of content to be covered in the teaching of the unit to ensure that all the learning outcomes can be achieved.

Learning outcome:

1. Understand land-based service engineering calculations

Topics

- 1.1 Units of measure
- 1.2 Unit of measure prefixes and rounding off
- 1.3 Unit of measure conversion factors
- 1.4 Relevant mathematical, engineering and scientific principles and formulae
- 1.5 Use of charts and graphs and related calculations

Topic 1.1

Learners will understand units of measure, how they correspond to the following parameters and how they apply to land-based service engineering activities, including

- force
- torque
- energy
- power
- fuel consumption
- temperature
- weight
- density
- specific gravity
- area
- angle
- volume
- flow
- pressure
- speed
- velocity
- acceleration/deceleration
- voltage
- current
- resistance
- noise.

Topic 1.2

Learners will understand unit of measure prefixes and rounding off, including

- metric prefixes (micro, milli, centi, deci, deca, hecto, kilo, mega, etc.)
- significance of numbers of decimal places and rounding off.

Topic 1.3

Learners will understand unit of measure conversion factors, including

- metric to imperial
- imperial to metric.

Topic 1.4

Learners will understand relevant mathematical, engineering and scientific principles and formulae. Learners will understand the basic premise underlying each of the following principles and formulae and recognise how they apply to land-based service engineering activities

- Pythagoras' Theorem
- mathematical formulae for areas (triangles, circles, segments of circles, irregular shapes, etc.)
- mathematical formulae for volumes (cubes, cylinders, cones, irregular objects, etc.)
- mathematical formulae for circumference (circles, segments of circles, etc.)
- Law of the Lever (centre of gravity, conditions of equilibrium, etc.)
- simple and compound gear sets/trains
- Newton's Laws of Motion
- Laws of Friction (and coefficient of friction)
- Archimedes' Principle
- Pascal's Law
- Boyle's Law
- Hooke's Law
- Ohm's Law.

Topic 1.5

Learners will understand the use of charts and graphs and related calculations, including

- bar charts
- pie charts
- histograms
- frequency distributions
- range, mean, median, mode and associated calculations
- land-based service engineering applications of scatter (x-axis/y-axis) plots (engine speed-torque plots/curves, oscilloscope time/voltage plots, etc.)
- land-based service engineering calculations based on scatter (x-axis/y-axis) plots (torque back-up % from engine speed-torque plots/curves, etc.)
- analysis, including calculations, of charts, graphs and associated data from manufacturers' technical specifications (engine performance under load, fuel consumption under load, 3-point linkage performance across its full arc of travel, etc.).

Guidance for delivery

Centres are encouraged to introduce employers and product specialists from industry to provide interesting and relevant information to learners. It would be helpful for tutors and centres to maintain close contact with industry to ensure ongoing access to suitable and up-to-date methodologies for learners.

It is accepted that some formal lectures will be necessary at level 3 but for this unit it is essential that they are they are linked directly with interactive workshop lessons.

Suggested learning resources

Books

Farm Machinery, 6th Edition
Published by: Old Pond Publishing, 2016
ISBN: 9781910456064

Bell, B

Farm Machinery, 12th Edition
Published by: Wiley-Blackwell, 1992
ISBN: 9780632031597

Culpin C

Hillier's Fundamentals of Motor Vehicle Technology, 6th Edition
Published by: Nelson Thornes, 2012
ISBN: 9781408515181

Calex UK

Miscellaneous manufacturers' publications and manuals

Journals

Profi International

Websites

CDX Automotive (Light Vehicle / Heavy Vehicle) <http://www.cdxtextbook.com>

How Stuff Works <http://www.howstuffworks.com>

Institution of Agricultural Engineers <http://www.iagre.org>

Land-based Engineering <http://landbasedengineering.com>

| | |
|---------------|------------|
| UAN: | T/507/6995 |
| Level: | 3 |
| GLH: | 60 |

What is this unit about?

The purpose of this unit is to enable learners to undertake and evaluate land-based workshop processes. Such activities are fundamental to the maintenance, repair and overhaul of land-based machines and vehicles.

Learning outcomes

In this unit, learners will

1. select, use and evaluate land-based tools and workshop equipment.

Scope of content

This section gives details of the scope of content to be covered in the teaching of the unit to ensure that all the learning outcomes can be achieved.

Learning outcome:

1. Select, use and evaluate land-based tools and workshop equipment

Topics

- 1.1 Select, use and evaluate land-based tools
- 1.2 Select, use and evaluate land-based workshop cutting equipment
- 1.3 Select, use and evaluate land-based workshop joining equipment

Topic 1.1

Learners will select and use land-based tools. In each case, learners will evaluate the tools, by recommending suitable alternatives or justifying why the selected tool is the only or most suitable option (for a given task and material).

Activities will be undertaken in the course of maintenance, repairs or overhauls to land-based machines or vehicles.

Spanners and/or wrenches used will include

- open-end and ring spanner/wrench
- combination spanner/wrench
- offset spanner/wrench
- flare-nut spanner/wrench
- adjustable spanner/wrench
- torque wrench
- pipe wrench.

Sockets and accessories used will include

- 1/4in, 3/8in, 1/2in and/or 3/4in socket
- 6-point and/or 12-point socket
- metric and/or imperial socket
- bit socket
- standard and/or deep socket
- normal-use and impact socket
- ratchet driver
- sliding T-handle driver
- extension bar
- universal joint.

Screwdrivers, keys and bits used will include

- slotted-head (flat) screwdriver/key/bit
- Philips-head screwdriver/key/bit
- hex and/or ball hex screwdriver/key/bit

- torx screwdriver/key/bit.

Pliers used will include

- combination pliers
- long-nose pliers
- groove-joint pliers
- locking (lock-grip) pliers
- Circlip pliers
- end-cutting pliers
- wire-stripping pliers
- crimping pliers/tools
- insulated pliers.

Hammers and punches used will include

- lump/sledge hammer
- ball-peen hammer
- dead-blow hammer
- soft-face hammer
- pin punch
- automatic centre punch.

Measuring tools used will include

- measuring tape/rule
- Vernier calliper
- micrometer
- feeler gauge.

Power tools used will include

- electric power tool (grinder, etc.)
- pneumatic tool (impact wrench, etc.).

Press/pulling tools will include

- multi-jaw pulling tool
- hydraulic press.

Workshop lifting equipment used will include

- axle stand
- hydraulic jack.

Topic 1.2

Learners will select and use land-based workshop cutting equipment. In each case, learners will evaluate the equipment, by recommending suitable alternatives or justifying why the selected equipment is the only or most suitable option (for a given task and material).

Equipment will be selected for specific tasks, taking account of the nature of the task and the properties of the material being cut.

Equipment will include

- hacksaw
- shears
- chisel
- hand-held and/or bench grinder
- hand-held and/or bench/pillar drill
- gas cutting equipment and/or plasma cutter.

Topic 1.3

Learners will select and use land-based workshop joining equipment. In each case, learners will evaluate the equipment, by recommending suitable alternatives or justifying why the selected equipment is the only or most suitable option (for a given task and material).

Equipment will be selected for specific tasks, taking account of the nature of the task and the properties of the material being joined.

Equipment will include

- threaded fastener
- riveter
- adhesive
- manual metal arc (MMA) and/or metal inert gas (MIG) welder.

Guidance for delivery

Centres are encouraged to introduce employers and product specialists from industry to provide interesting and relevant information to learners. It would be helpful for tutors and centres to maintain close contact with industry to ensure ongoing access to suitable and up-to-date equipment for learners to work on.

It is accepted that some formal lectures will be necessary at level 3 but for this unit it is essential that they are they are linked directly with interactive workshop lessons working on real equipment.

Suggested learning resources

Books

Farm and Welding Workshop Pearce, A
Published by: Old Pond Publishing, 2007
ISBN: 9781905523306

Farm Machinery, 6th Edition Bell, B
Published by: Old Pond Publishing, 2016
ISBN: 9781910456064

Farm Machinery, 12th Edition Culpin C
Published by: Wiley-Blackwell, 1992
ISBN: 9780632031597

Miscellaneous manufacturers' publications and manuals

Journals

Profi International
Practical Farm Ideas

Websites

CDX Automotive (Light Vehicle / Heavy Vehicle) <http://www.cdxtextbook.com>

Health and Safety Executive <http://www.hse.gov.uk>

How Stuff Works <http://www.howstuffworks.com>

Institution of Agricultural Engineers <http://www.iagre.org>

Land-based Engineering <http://landbasedengineering.com>

Unit 352

Repair land-based compression-ignition (diesel) engines

| | |
|---------------|------------|
| UAN: | H/507/6989 |
| Level: | 3 |
| GLH: | 60 |

What is this unit about?

The purpose of this unit is to enable learners to understand and repair land-based compression-ignition (diesel) engines. These engines are fitted to a wide and varied range of land-based vehicles and equipment, including tractors.

Learning outcomes

In this unit, learners will

1. understand land-based compression-ignition (diesel) engines
2. test, repair and rebuild a land-based compression-ignition (diesel) engine.

Scope of content

This section gives details of the scope of content to be covered in the teaching of the unit to ensure that all the learning outcomes can be achieved.

Learning outcome:

1. Understand land-based compression-ignition (diesel) engines

Topics

- 1.1 The function and working principles of land-based compression-ignition (diesel) engines
- 1.2 Land-based compression-ignition (diesel) engine lubrication systems
- 1.3 Land-based compression-ignition (diesel) engine cooling systems
- 1.4 Land-based compression-ignition (diesel) engine fuel systems
- 1.5 Land-based compression-ignition (diesel) engine emissions control systems

Engine-related electric systems are covered in Unit 355 Repair land-based electric systems. Engine-related electronic systems are covered in Unit 356 Test land-based electronic systems.

Topic 1.1

Learners will understand the function and working principles of land-based compression-ignition (diesel) engines.

The topic will include

- function of an engine
- relationship between power, torque and speed
- the 4-stroke cycle
- the compression-ignition principle
- number and configuration of cylinders (inline, V, firing order, etc.)
- engine construction (long/short stroke, wet/dry liner, etc.)
- materials used (steel, cast iron, aluminium, etc.)
- main engine components (block, cylinder, liner, cylinder head, crankshaft, flywheel, balancer, timing gears/pulleys/belts, camshaft, connecting rods, pistons, piston rings, head gasket, valves, valve stems, valve springs, rocker shaft, rocker arms, inlet and exhaust manifolds, turbocharger, intercooler, etc.)
- typical component failure, trouble-shooting and repairs.

Topic 1.2

Learners will understand land-based compression-ignition (diesel) engine lubrication systems.

The topic will include

- function of lubrication systems
- oil pump and pressure valves
- oil filters, bypass valves and strainers
- oil ways, galleries and sealing components
- methods of component lubrication (force-feed, splash-feed, etc.)
- oil selection (type, grade, quality, additives, etc.)
- typical component failure, trouble-shooting and repairs.

Topic 1.3

Learners will understand land-based compression-ignition (diesel) engine cooling systems.

The topic will include

- function of cooling systems
- methods of dissipating heat

- air cooling versus liquid cooling systems
- air cooling system components (fan, fan belt, jackets and shrouds, cooling fins, etc.)
- liquid cooling system components (water pump, radiator, fan, fan belt, thermostat, bypass, etc.)
- liquid coolant (ethylene glycol, dilution rate, etc.)
- cavitation within liquid cooling systems (causes, effects, solutions)
- engine overheating (causes, effects, solutions)
- typical component failure, trouble-shooting and repairs.

Topic 1.4

Learners will understand land-based compression-ignition (diesel) engine fuel systems.

The topic will include

- function of fuel systems
- mechanically-controlled versus electronically-controlled fuel systems
- fuel system components (tank, lift pump, fuel pump, injection pump, common rail, fuel injectors, electronic injectors, unit injectors, mechanical governors, metering devices, sensors, electronic control unit (ECU), fuel return, fuel bleeding, cold start devices, etc.)
- fuel selection (cetane rating, filtration, quality, etc.)
- fuel system contamination (causes, effects, solutions)
- typical component failure, trouble-shooting and repairs.

Topic 1.5

Learners will understand land-based compression-ignition (diesel) emissions control systems.

The topic will include

- function of emissions control systems
- typical pollutants (hydrocarbons, particulates, oxides of nitrogen, etc.)
- exhaust gas recirculation (EGR)
- diesel particulate filter (DPF)
- diesel exhaust fluid (DEF) (Ad-Blue)
- selective catalytic reduction (SCR)
- typical component failure, trouble-shooting and repairs.

Learning outcome:

2. Test, repair and rebuild a land-based compression-ignition (diesel) engine

Topics

2.1 Test a land-based compression-ignition (diesel) engine for a range of faults

2.2 Inspect, assess, repair and rebuild a land-based compression-ignition (diesel) engine

Engine-related electric systems are covered in Unit 355 Repair Land-based Electric Systems.
Engine-related electronic systems are covered in Unit 356 Test Land-based Electronic Systems.

Topic 2.1

Learners will test a land-based compression-ignition (diesel) engine for a range of faults. Activities will be carried out on a substantial 4-stroke, liquid-cooled engine, preferably an engine suitable for use in a tractor or similar land-based machine.

For each test, learners will record and evaluate their findings. They will compare these findings with the manufacturer's specifications and explain or justify any deviations.

Activities will include

- cylinder compression test
- oil pressure test
- static timing check/test and dynamic timing test
- coolant system pressure test
- coolant fluid hydrometer test
- fuel injector test (mechanical fuel injector pop test, etc.) and/or fuel injection system test
- dynamometer test (power, torque, torque back-up, etc.).

Topic 2.2

Learners will inspect, assess, repair and rebuild a land-based compression-ignition (diesel) engine. Activities will be carried out on a substantial 4-stroke, liquid-cooled engine, preferably an engine suitable for use in a tractor or similar land-based machine.

For each inspection or measurement, learners will assess the component's fitness for purpose or reason for failure.

Activities will include

- disassemble the engine to be worked on
- remove the head, connecting rods, pistons, camshaft, crankshaft, timing components, gaskets/residues/sealants, etc.
- chemically clean and degrease components (where required)
- inspect the cylinders/block
- inspect the crankshaft and measure journal ovality, lift and/or end-float
- inspect the main bearings, big-end bearings and thrust washers
- inspect the connecting rods and pistons (alignment, matched weighting, etc.)
- inspect the piston rings and measure the piston ring gaps
- inspect the cylinder bore/liner (leaking seals, cavitation damage, etc.) and measure ovality and/or taper
- inspect the timing gears/pulleys/belts
- inspect the flywheel (run-out, etc.) and/or balancer
- assess and/or measure cylinder head distortion
- inspect the head gasket
- inspect the camshaft and rocker components
- inspect the cam followers, pushrods and valve rotators (if applicable)
- inspect the valves (protrusion, etc.) and seats and measure the valve stems, guides, springs and operating system (tappet) clearance
- inspect the inlet and exhaust manifolds
- inspect ancillary components (pumps, filters, etc.)
- repair and/or replace components, taking account of the manufacturer's specifications (as required)
- rebuild and fully reinstate the engine and any ancillary components
- verify the integrity of the repair/overhaul
- recommend actions for future servicing or maintenance.

Guidance for delivery

Centres are encouraged to introduce employers and product specialists from industry to provide interesting and relevant information to learners. It would be helpful for tutors and centres to maintain close contact with industry to ensure ongoing access to suitable and up-to-date equipment for learners to work on.

It is accepted that some formal lectures will be necessary at level 3 but for this unit it is essential that they are they are linked directly with interactive workshop lessons working on real equipment.

Suggested learning resources

Books

| | |
|--|----------|
| Farm Machinery, 6 th Edition Published by: Old Pond Publishing, 2016 ISBN: 9781910456064 | Bell, B |
| Farm Machinery, 12 th Edition Published by: Wiley-Blackwell, 1992 ISBN: 9780632031597 | Culpin C |
| Hillier's Fundamentals of Motor Vehicle Technology, 6 th Edition Published by: Nelson Thornes, 2012 ISBN: 9781408515181 | Calex UK |

Miscellaneous manufacturers' publications and manuals

Journals

Profi International

Websites

| | |
|--|---|
| CDX Automotive (Light Vehicle / Heavy Vehicle) | http://www.cdxtextbook.com |
| Health and Safety Executive | http://www.hse.gov.uk |
| How Stuff Works | http://www.howstuffworks.com |
| Institution of Agricultural Engineers | http://www.iagre.org |
| Land-based Engineering | http://landbasedengineering.com |

Unit 353

Repair land-based spark-ignition (petrol) engines

| | |
|---------------|------------|
| UAN: | Y/507/6990 |
| Level: | 3 |
| GLH: | 60 |

What is this unit about?

The purpose of this unit is to enable learners to understand and repair spark-ignition (petrol) engines. These engines are fitted to a wide and varied range of land-based vehicles and equipment.

Learning outcomes

In this unit, learners will

1. understand land-based spark-ignition (petrol) engines
2. test, repair and rebuild a land-based spark-ignition (petrol) engine.

Scope of content

This section gives details of the scope of content to be covered in the teaching of the unit to ensure that all the learning outcomes can be achieved.

Learning outcome:

1. Understand land-based spark-ignition (petrol) engines

Topics

- 1.1 The function and working principles of land-based spark-ignition (petrol) engines
- 1.2 Land-based spark-ignition (petrol) engine lubrication systems
- 1.3 Land-based spark-ignition (petrol) engine cooling systems
- 1.4 Land-based spark-ignition (petrol) engine fuel systems
- 1.5 Land-based spark-ignition (petrol) engine emissions control systems

Engine-related electric systems are covered in Unit 355 Repair land-based electric systems. Engine-related electronic systems are covered in Unit 356 Test land-based electronic systems.

Topic 1.1

Learners will understand the function and working principles of land-based spark-ignition (petrol) engines.

The topic will include

- function of an engine
- relationship between power, torque and speed
- the 2-stroke and 4-stroke cycles
- the spark-ignition principle
- number and configuration of cylinders (inline, V, firing order, etc.)
- engine construction (long/short stroke, wet/dry liner, etc.)
- materials used (steel, cast iron, aluminium, etc.)
- main engine components (block, cylinder, liner, cylinder head, crankshaft, flywheel, balancer, timing gears/pulleys/belts, camshaft, connecting rods, pistons, piston rings, head gasket, valves, valve stems, valve springs, rocker shaft, rocker arms, inlet and exhaust manifolds, turbocharger, intercooler, etc.)
- typical component failure, trouble-shooting and repairs.

Topic 1.2

Learners will understand land-based spark-ignition (petrol) engine lubrication systems.

The topic will include

- function of lubrication systems
- 2-stroke and 4-stroke lubrication systems
- oil pump and pressure valves
- oil filters, bypass valves and strainers
- oil ways, galleries and sealing components
- methods of component lubrication (force-feed, splash-feed, etc.)
- oil selection (type, grade, quality, additives, etc.)
- typical component failure, trouble-shooting and repairs.

Topic 1.3

Learners will understand land-based spark-ignition (petrol) engine cooling systems.

The topic will include

- function of cooling systems

- methods of dissipating heat
- air cooling versus liquid cooling systems
- air cooling system components (fan, fan belt, jackets and shrouds, cooling fins, etc.)
- liquid cooling system components (water pump, radiator, fan, fan belt, thermostat, bypass, etc.)
- liquid coolant (ethylene glycol, dilution rate, etc.)
- cavitation within liquid cooling systems
- engine overheating (causes, effects, solutions)
- typical component failure, trouble-shooting and repairs.

Topic 1.4

Learners will understand land-based spark-ignition (petrol) engine fuel systems.

The topic will include

- function of fuel systems
- mechanically-controlled versus electronically-controlled fuel systems
- fuel system components (tank, lift pump, fuel pump, carburettor, spark plugs, fuel injectors, electronic injectors, metering devices, sensors, electronic control unit (ECU), fuel return, fuel bleeding, cold start devices, etc.)
- fuel selection (octane rating, filtration, quality, etc.)
- fuel system contamination (causes, effects, solutions)
- typical component failure, trouble-shooting and repairs.

Topic 1.5

Learners will understand land-based spark-ignition (petrol) engine emissions control systems.

The topic will include

- function of emissions control systems
- typical pollutants (hydrocarbons, particulates, oxides of nitrogen, etc.)
- emissions control systems and components
- typical component failure, trouble-shooting and repairs.

Learning outcome:

2. Test, repair and rebuild a land-based spark-ignition (petrol) engine

Topics

- 2.1 Test a land-based spark-ignition (petrol) engine for a range of faults
- 2.2 Inspect, assess, repair and rebuild a land-based spark-ignition (petrol) engine

Engine-related electric systems are covered in Unit 355 Repair land-based electric systems. Engine-related electronic systems are covered in Unit 356 Test land-based electronic systems.

Topic 2.1

Learners will test a land-based spark-ignition (petrol) engine for a range of faults. Activities will be carried out on a suitable engine, preferably an engine suitable for use in a land-based machine or vehicle.

For each test, learners will record and evaluate their findings. They will compare these with the manufacturer's specifications and explain or justify any deviations.

Activities will include

- cylinder/crankcase compression test

- oil pressure test
- static timing check/test and dynamic timing test
- coolant system pressure test
- coolant fluid hydrometer test
- fuel injector test (mechanical fuel injector pop test, etc.) and/or injection system test.

Topic 2.2

Learners will inspect, assess, repair and rebuild a land-based spark-ignition (petrol) engine. Activities will be carried out on a substantial engine, preferably an engine suitable for use in a land-based machine or vehicle.

For each inspection or measurement, learners will assess the component's fitness for purpose or reason for failure.

Activities will include

- disassemble the engine to be worked on
- remove the head, connecting rods, pistons, camshaft, crankshaft, timing components, gaskets/residues/sealants, etc.
- chemically clean and degrease components (where required)
- inspect the cylinders/block
- inspect the crankshaft and measure journal ovality, lift and/or end-float
- inspect the main bearings, big-end bearings and thrust washers
- inspect the connecting rods and pistons (alignment, matched weighting, etc.)
- inspect the piston rings and measure the piston ring gaps
- inspect the cylinder bore/liner (leaking seals, cavitation damage, etc.) and measure ovality and/or taper
- inspect the timing gears/pulleys/belts
- inspect the flywheel (run-out, etc.) and/or balancer
- assess and/or measure cylinder head distortion
- inspect the head gasket
- inspect the camshaft and rocker components
- inspect the cam followers, pushrods and valve rotators (if applicable)
- inspect the valves (protrusion, etc.) and seats and measure the valve stems, guides, springs and operating system (tappet) clearance
- inspect the inlet and exhaust manifolds
- inspect ancillary components (pumps, filters, etc.)
- repair and/or replace components, taking account of the manufacturer's specifications (as required)
- rebuild and fully reinstate the engine and any ancillary components
- verify the integrity of the repair/overhaul
- recommend actions for future servicing or maintenance.

Guidance for delivery

Centres are encouraged to introduce employers and product specialists from industry to provide interesting and relevant information to learners. It would be helpful for tutors and centres to maintain close contact with industry to ensure ongoing access to suitable and up-to-date equipment for learners to work on.

It is accepted that some formal lectures will be necessary at level 3 but for this unit it is essential that they are they are linked directly with interactive workshop lessons working on real equipment.

Suggested learning resources

Books

| | |
|--|----------|
| Farm Machinery, 6 th Edition Published by: Old Pond Publishing, 2016 ISBN: 9781910456064 | Bell, B |
| Farm Machinery, 12 th Edition Published by: Wiley-Blackwell, 1992 ISBN: 9780632031597 | Culpin C |
| Hillier's Fundamentals of Motor Vehicle Technology, 6 th Edition Published by: Nelson Thornes, 2012 ISBN: 9781408515181 | Calex UK |

Miscellaneous manufacturers' publications and manuals

Journals

Profi International

Websites

| | |
|--|---|
| CDX Automotive (Light Vehicle / Heavy Vehicle) | http://www.cdxtextbook.com |
| Health and Safety Executive | http://www.hse.gov.uk |
| How Stuff Works | http://www.howstuffworks.com |
| Institution of Agricultural Engineers | http://www.iagre.org |
| Land-based Engineering | http://landbasedengineering.com |

| | |
|---------------|------------|
| UAN: | D/507/6991 |
| Level: | 3 |
| GLH: | 60 |

What is this unit about?

The purpose of this unit is to enable learners to understand and repair land-based vehicle systems. These systems underpin a wide and varied range of land-based machines and vehicles, including tractors.

Learning outcomes

In this unit, learners will

1. understand land-based vehicle systems
2. repair and overhaul land-based vehicle systems.

Scope of content

This section gives details of the scope of content to be covered in the teaching of the unit to ensure that all the learning outcomes can be achieved.

Learning outcome:

1. Understand land-based vehicle systems

Topics

1.1 The function and working principles of land-based braking systems

1.2 The function and working principles of land-based steering systems

Topic 1.1

Learners will understand the function and working principles of land-based braking systems.

The topic will include

- basic drum brakes (drum, shoe, lining, cam, spring, methods of adjustment, etc.)
- basic disc brakes (hub, disc/rotor, pad, piston, calliper, etc.)
- hydraulic actuation systems (master cylinder, brake/slave cylinder, balancing valve, etc.)
- pneumatic actuation systems (compressor, reservoir, drain valve, control valve, brake chamber, etc.)
- enclosed, oil-immersed, multi-plate disc brakes
- emergency break-away braking systems
- load-compensating braking systems
- ABS (anti-lock braking system)
- EBS (electronic braking system)
- typical component failure, trouble-shooting and repairs.

Topic 1.2

Learners will understand the function and working principles of land-based steering systems.

The topic will include

- manual steering (steering box, drag link, track rod, ball joint, steering arm, need for lubrication and maintenance, methods of alignment, toe-in/toe-out, etc.)
- power-assisted steering (hydraulic pump, reservoir, hydraulic ram/cylinder, control valve, etc.)
- hydrostatic steering (hydraulic pump, reservoir, hydraulic ram/cylinder, control valve, etc.)
- centre-pivot (articulated chassis) steering
- 4-wheel steering (incorporating crab steering)
- skid-steer systems
- typical component failure, trouble-shooting and repairs.

Learning outcome:

2. Repair and overhaul land-based vehicle systems

Topics

2.1 Repair and overhaul a land-based braking system

2.2 Repair and overhaul a land-based steering system

Topic 2.1

Learners will repair and overhaul a land-based braking system. Activities will be carried out on a complex braking system, typically on a tractor.

Activities will include

- inspect and test the operation of the braking system prior to disassembly (where required)
- disassemble the machine (as required), to enable access to the braking components
- inspect the braking components following disassembly
- diagnose and evaluate faults
- carry out repairs and overhaul procedures
- reinstate the braking system and the machine
- verify the integrity of the repair and ensure the braking system is correctly adjusted.

Topic 2.2

Learners will repair and overhaul a land-based steering system. Activities will be carried out on a complex steering system, typically on a tractor.

Activities will include

- inspect and test the operation of the steering system prior to disassembly (where required)
- disassemble the machine (as required), to enable access to the steering components
- inspect the steering components following disassembly
- diagnose and evaluate faults
- carry out repairs and overhaul procedures
- reinstate the steering system and the machine
- verify the integrity of the repair and ensure the steering system is correctly aligned.

Guidance for delivery

Centres are encouraged to introduce employers and product specialists from industry to provide interesting and relevant information to learners. It would be helpful for tutors and centres to maintain close contact with industry to ensure ongoing access to suitable and up-to-date equipment for learners to work on.

It is accepted that some formal lectures will be necessary at level 3 but for this unit it is essential that they are they are linked directly with interactive workshop lessons working on real equipment.

Suggested learning resources

Books

| | |
|--|----------|
| Farm Machinery, 6 th Edition Published by: Old Pond Publishing, 2016 ISBN: 9781910456064 | Bell, B |
| Farm Machinery, 12 th Edition Published by: Wiley-Blackwell, 1992 ISBN: 9780632031597 | Culpin C |
| Hillier's Fundamentals of Motor Vehicle Technology, 6 th Edition Published by: Nelson Thornes, 2012 ISBN: 9781408515181 | Calex UK |

Miscellaneous manufacturers' publications and manuals

Journals

Profi International

Websites

| | |
|--|---|
| CDX Automotive (Light Vehicle / Heavy Vehicle) | http://www.cdxtextbook.com |
| Health and Safety Executive | http://www.hse.gov.uk |
| How Stuff Works | http://www.howstuffworks.com |
| Institution of Agricultural Engineers | http://www.iagre.org |
| Land-based Engineering | http://landbasedengineering.com |

Unit 355

Repair land-based electric systems

| | |
|---------------|------------|
| UAN: | H/507/6992 |
| Level: | 3 |
| GLH: | 60 |

What is this unit about?

The purpose of this unit is to enable learners to understand and repair land-based electric systems. These systems are fundamental to the operation of a wide and varied range of land-based machines and vehicles.

Learning outcomes

In this unit, learners will

1. understand land-based electric systems and components
2. test and repair a land-based electric system and components.

Scope of content

This section gives details of the scope of content to be covered in the teaching of the unit to ensure that all the learning outcomes can be achieved.

Learning outcome:

1. Understand land-based electric systems and components

Topics

- 1.1 Electric principles (units, symbols, calculations, etc.)
- 1.2 Sources of electric energy
- 1.3 The function and working principles of electric components
- 1.4 How to design and build electric systems (circuits)
- 1.5 The function and use of electric test equipment

Topic 1.1

Learners will understand electric principles (units, symbols, calculations, etc.). The topic will include

- voltage
- current
- resistance
- power
- relationship between work and power (rate at which work is done)
- Ohm's law
- power equation
- electric risks and hazards.

Topic 1.2

Learners will understand sources of electric energy. The topic will include

- electro-chemical energy (batteries, etc.)
- electro-magnetic energy (alternators, motors, etc.).

Topic 1.3

Learners will understand the function and working principles of electric components. The topic will include

- battery types and sizes
- wire types and sizes (including colour coding)
- circuit protection devices
- fixed and variable resistors
- diodes
- switches
- relays
- solenoids
- starters
- alternators
- lights (including LEDs).

Topic 1.4

Learners will understand how to design and build electric systems (circuits). The topic will include

- identification and interpretation of electric circuits and wiring diagrams
- components and symbols

- series and parallel connections
- alternating current and direct current.

Topic 1.5

Learners will understand the function and use of electric test equipment. The topic will include

- common electric faults
- testing methodologies for circuits and components
- use of a hydrometer (to test a lead acid battery)
- use of a continuity tester
- use of a multimeter
- interpretation of findings.

Learning outcome:

2. Test and repair a land-based electric system and components

Topics

- 2.1 Test a land-based electric system for a range of faults, interpret findings and take corrective action
- 2.2 Remove, inspect, repair and reinstate a starter and alternator

Topic 2.1

Learners will test a land-based electric system for a range of faults, interpret findings and take corrective action. Activities will be carried out on an electric system on a land-based machine or vehicle. The system will have series and parallel connections. Components within the system will, at a minimum, include a battery, light, gauge, relay, solenoid, starter and alternator.

Activities will include

- select appropriate test equipment
- test circuit and component operation across a range of parameters (voltage, earth (ground), current, open circuit, short circuit, poor connection, resistance, battery electrolyte condition, etc.)
- collate data
- compare data with the manufacturer's specifications
- diagnose the cause of identified faults (variance from manufacturer's specifications)
- take corrective action to rectify faults
- verify the integrity of the corrective action.

Topic 2.2

Learners will remove, inspect, repair and reinstate a starter and alternator. Activities will be carried out on a starter and alternator on a land-based machine or vehicle.

Activities will include

- inspect and test the operation of the starter and alternator prior to removal
- remove the starter and alternator, following correct procedures
- disassemble the starter and alternator
- inspect the components following disassembly
- evaluate the condition of the starter and alternator and diagnose any faults
- repair and/or replace components (as required)
- reinstate the starter and alternator
- verify the correct operation of the starting and charging systems (by testing the starter and alternator again).

Guidance for delivery

Centres are encouraged to introduce employers and product specialists from industry to provide interesting and relevant information to learners. It would be helpful for tutors and centres to maintain close contact with industry to ensure ongoing access to suitable and up-to-date equipment for learners to work on.

It is accepted that some formal lectures will be necessary at level 3 but for this unit it is essential that they are they are linked directly with interactive workshop lessons working on real equipment.

Suggested learning resources

Books

| | |
|--|----------|
| Farm Machinery, 6 th Edition Published by: Old Pond Publishing, 2016 ISBN: 9781910456064 | Bell, B |
| Farm Machinery, 12 th Edition Published by: Wiley-Blackwell, 1992 ISBN: 9780632031597 | Culpin C |
| Hillier's Fundamentals of Motor Vehicle Technology, 6 th Edition Published by: Nelson Thornes, 2012 ISBN: 9781408515181 | Calex UK |

Miscellaneous manufacturers' publications and manuals

Journals

Profi International

Websites

| | |
|--|---|
| CDX Automotive (Light Vehicle / Heavy Vehicle) | http://www.cdxtextbook.com |
| Health and Safety Executive | http://www.hse.gov.uk |
| How Stuff Works | http://www.howstuffworks.com |
| Institution of Agricultural Engineers | http://www.iagre.org |
| Land-based Engineering | http://landbasedengineering.com |

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|---------------|------------|
| UAN: | K/507/6993 |
| Level: | 3 |
| GLH: | 60 |

What is this unit about?

This purpose of this unit is to enable learners to understand and test land-based electronic systems. These systems are fundamental to the operation of a wide and varied range of land-based machines and vehicles, including tractors.

Learning outcomes

In this unit, learners will

1. understand land-based electronic systems
2. test a land-based electronic system.

Scope of content

This section gives details of the scope of content to be covered in the teaching of the unit to ensure that all the learning outcomes can be achieved.

Learning outcome:

1. Understand land-based electronic systems

Topics

- 1.1 Electronic system applications in land-based equipment
- 1.2 Basic electronic principles and components
- 1.3 Types of electronic signals
- 1.4 How electronic signals are generated, communicated and received (in an engine management system)
- 1.5 The role of an oscilloscope in fault diagnosis
- 1.6 The role of a scan tool in fault diagnosis

Topic 1.1

Learners will understand electronic system applications in land-based equipment.

The topic will include

- CAN (controller area network) bus communication standard/protocol
- vehicle management systems (including engine management systems)
- headland management systems (tractors, harvesters, etc.)
- in-cab performance monitors (tractors, harvesters, etc.) and remote telematic monitoring systems
- tractor-mounted (in-cab) implement control boxes
- ISOBUS communication standard/protocol
- GPS technology and equipment (parallel swathing, automatic steering, yield mapping, variable-rate application, etc.).

Topic 1.2

Learners will understand basic electronic principles and components.

The topic will include

- basic concept of electronics and the conduction of electricity through a vacuum, gas or semiconductor
- types of semiconductor (N-type, P-type, etc.)
- diodes
- resistors
- variable resistors (rheostats, potentiometers, etc.)
- thermistors
- transistors.

Topic 1.3

Learners will understand types of electronic signals.

The topic will include

- input signals (signals from switches, sensors, etc., that provide information about operating conditions and driver commands)
- output signals (signals that cause electric or electronic devices such as lights, relays, motors, etc., to operate)

- analogue signals (signals that represent a continuously variable voltage)
- digital signals (signals with just two voltage levels).

Topic 1.4

Learners will understand how electronic signals are generated, communicated and received (in an engine management system).

The topic will include

- role of an electronic control unit (ECU) in receiving, processing and generating analogue and digital signals
- typical input signals sent by switches, sensors, etc., to an engine's electronic control unit (ECU) (coolant temperature, air/fuel ratio, mass air-flow, crankshaft position, camshaft position, throttle position, etc.)
- typical output signals (commands) sent by an engine's electronic control unit (ECU) (warning lights, electronic fuel injectors, etc.)
- electronic control unit (ECU) conversion of analogue signals to digital signals to enable processing of input signals
- use of built-in look-up tables or instructions by an electronic control unit (ECU) to enable processing of input signals and generation of output signals (commands).

Topic 1.5

Learners will understand the role of an oscilloscope in fault diagnosis.

The topic will include

- the representation of voltage (X-axis) and time (Y-axis) on an oscilloscope's display
- adjustment of the time setting on an oscilloscope's display to represent values in an appropriate scale
- use of an oscilloscope to confirm that an input device (switch, sensor, etc.) produces the required signals at the time they are needed
- use of an oscilloscope to confirm that an electronic control unit (ECU) processes input signals and produces the required output signals at the time they are needed
- use of an oscilloscope to confirm that an output device responds to the electronic control unit's (ECU's) signals and operates correctly.

Topic 1.6

Learners will understand the role of a scan tool in fault diagnosis.

The topic will include

- selection of an appropriate and compatible scan tool (hand-held/laptop-based diagnostic/interrogation equipment) for a machine or vehicle
- connection of a scan tool to a machine or vehicle
- operation of a scan tool, monitoring of a machine's or vehicle's warning lights and generation of diagnostic trouble codes (fault codes)
- use of diagnostic trouble codes (fault codes) to identify and rectify underlying faults
- use of a scan tool to reset or clear diagnostic trouble codes (fault codes), having rectified underlying faults
- requirement for ongoing scan tool software upgrades.

Learning outcome:

2. Test a land-based electronic system

Topics

2.1 Identify components in a land-based electronic system

2.2 Test a land-based electronic system and use the results to rectify an underlying fault

Topic 2.1

Learners will identify components in a land-based electronic system.

Activities will include

- identify input devices (switches, sensors, etc.), making reference to the manufacturer's data and/or schematics
- identify the electronic control unit (ECU), making reference to the manufacturer's data and/or schematics
- identify output devices (controllers, actuators, etc.) , making reference to the manufacturer's data and/or schematics.

Topic 2.2

Learners will test a land-based electronic system and use the results to rectify an underlying fault.

Activities (using an oscilloscope) will include

- use an oscilloscope to analyse a constant voltage signal (battery, etc.)
- use an oscilloscope to analyse a variable voltage signal (throttle position sensor, etc.)
- use an oscilloscope to test if an input device (switch, sensor, etc.) produces the required signals at the time they are needed
- use an oscilloscope to test if an electronic control unit (ECU) processes input signals and produces the required output signals at the time they are needed
- use an oscilloscope to test if an output device responds to the electronic control unit's (ECU's) signals and operates correctly
- use an oscilloscope to test an electronic system with an underlying fault
- use the results to identify the underlying fault
- rectify the underlying fault
- verify the integrity of the corrective action (by testing the system again).

Activities (using a scan tool) will include

- select an appropriate and compatible scan tool (hand-held/laptop-based diagnostic/interrogation equipment)
- connect a scan tool to the faulty machine or vehicle (of which the electronic system is part)
- operate a scan tool
- monitor warning lights
- note any diagnostic trouble codes (fault codes) generated by the scan tool
- use the diagnostic trouble codes (fault codes) to identify the underlying fault
- rectify the underlying fault and use a scan tool to reset or clear diagnostic trouble codes (fault codes)
- verify the integrity of the corrective action (by testing the system again).

Guidance for delivery

Centres are encouraged to introduce employers and product specialists from industry to provide interesting and relevant information to learners. It would be helpful for tutors and centres to maintain close contact with industry to ensure ongoing access to suitable and up-to-date equipment for learners to work on.

It is accepted that some formal lectures will be necessary at level 3 but for this unit it is essential that they are they are linked directly with interactive workshop lessons working on real equipment.

Suggested learning resources

Books

| | |
|--|----------|
| Farm Machinery, 6 th Edition Published by: Old Pond Publishing, 2016 ISBN: 9781910456064 | Bell, B |
| Farm Machinery, 12 th Edition Published by: Wiley-Blackwell, 1992 ISBN: 9780632031597 | Culpin C |
| Hillier's Fundamentals of Motor Vehicle Technology, 6 th Edition Published by: Nelson Thornes, 2012 ISBN: 9781408515181 | Calex UK |

Miscellaneous manufacturers' publications and manuals

Journals

Profi International

Websites

| | |
|--|---|
| CDX Automotive (Light Vehicle / Heavy Vehicle) | http://www.cdxtextbook.com |
| Health and Safety Executive | http://www.hse.gov.uk |
| How Stuff Works | http://www.howstuffworks.com |
| Institution of Agricultural Engineers | http://www.iagre.org |
| Land-based Engineering | http://landbasedengineering.com |

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|---------------|------------|
| UAN: | M/507/6994 |
| Level: | 3 |
| GLH: | 60 |

What is this unit about?

The purpose of this unit is to enable learners to understand and repair land-based hydraulic systems. These systems are fundamental to the operation of a wide and varied range of land-based machines and vehicles, including tractors.

Learning outcomes

In this unit, learners will

1. understand land-based hydraulic systems and components
2. test and repair a land-based hydraulic system and components.

Scope of content

This section gives details of the scope of content to be covered in the teaching of the unit to ensure that all the learning outcomes can be achieved.

Learning outcome:

1. Understand land-based hydraulic systems and components

Topics

- 1.1 Hydraulic principles (units, calculations)
- 1.2 The function and working principles of hydraulic components
- 1.3 The design, layout and application of hydraulic systems (circuits)
- 1.4 The function and use of hydraulic test equipment

Topic 1.1

Learners will understand hydraulic principles (units, calculations, etc.).

The topic will include

- Pascal's Law
- basic hydraulic equations, units and calculations
- concept of hydraulic flow and pressure
- types of hydraulic fluid
- hydraulic risks and hazards.

Topic 1.2

Learners will understand the function and working principles of hydraulic components.

The topic will include

- fluids and filters
- lines and fittings (connectors)
- pumps (positive-displacement, non positive-displacement, transfer, power, etc.)
- reservoirs (vented, sealed, etc.)
- valves (spools, blocks/chests, open-centre, closed-centre, lever-controlled, cable-controlled, solenoid-controlled, etc.)
- actuators (rams/cylinders, motors, etc.).

Topic 1.3

Learners will understand the design, layout and application of hydraulic systems (circuits).

The topic will include

- circuits diagrams and symbols
- open and closed systems
- load-sensing systems (load-sensing lines, variable-displacement pumps, etc.)
- land-based applications of hydraulic systems (3-point linkages, hydrostatic transmission systems, etc.).

Topic 1.4

Learners will understand the function and use of hydraulic test equipment.

The topic will include

- pressure gauges
- flow gauges
- specialist hydraulic tools.

Learning outcome:

2. Test and repair a land-based hydraulic system and components

Topics

- 2.1 Test a land-based hydraulic system for a range of faults, interpret findings and take corrective action
- 2.2 Remove, inspect, repair and reinstate a hydraulic pump

Topic 2.1

Learners will test a land-based hydraulic system for a range of faults, interpret findings and take corrective action. Activities will be carried out on a hydraulic system on a land-based machine or vehicle. Components will include a solenoid-controlled valve and a variable-displacement, piston-type pump.

Activities will include

- select appropriate test equipment
- test system and component operation across a range of parameters (pressure, flow, temperature, sensory, etc.)
- collate data
- compare data with the manufacturer's specifications
- diagnose the cause of identified faults (variance from manufacturer's specification)
- take corrective action to rectify faults
- verify the integrity of the corrective action (by testing the system and the components again).

Topic 2.2

Learners will remove, inspect, repair and reinstate a hydraulic pump. Activities will be carried out on a hydraulic pump on a land-based machine or vehicle. The pump will be a variable-displacement, piston-type unit.

Activities will include

- inspect and test the operation of the hydraulic pump prior to removal (where required)
- remove the hydraulic pump, following correct procedures
- disassemble the hydraulic pump
- inspect the components following disassembly
- evaluate the condition of the hydraulic pump and diagnose any faults
- repair and/or replace components (as required)
- reinstate the hydraulic pump
- verify the correct operation of the hydraulic system (of which the hydraulic pump is part).

Guidance for delivery

Centres are encouraged to introduce employers and product specialists from industry to provide interesting and relevant information to learners. It would be helpful for tutors and centres to maintain close contact with industry to ensure ongoing access to suitable and up-to-date equipment for learners to work on.

It is accepted that some formal lectures will be necessary at level 3 but for this unit it is essential that they are they are linked directly with interactive workshop lessons working on real equipment.

Suggested learning resources

Books

| | |
|--|----------|
| Farm Machinery, 6 th Edition Published by: Old Pond Publishing, 2016 ISBN: 9781910456064 | Bell, B |
| Farm Machinery, 12 th Edition Published by: Wiley-Blackwell, 1992 ISBN: 9780632031597 | Culpin C |
| Hillier's Fundamentals of Motor Vehicle Technology, 6 th Edition Published by: Nelson Thornes, 2012 ISBN: 9781408515181 | Calex UK |

Miscellaneous manufacturers' publications and manuals

Journals

Profi International

Websites

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| How Stuff Works | http://www.howstuffworks.com |
| Institution of Agricultural Engineers | http://www.iagre.org |
| Land-based Engineering | http://landbasedengineering.com |

Unit 358

Repair land-based mechanical power transmission systems

| | |
|---------------|------------|
| UAN: | A/507/6996 |
| Level: | 3 |
| GLH: | 60 |

What is this unit about?

The purpose of this unit is to enable learners to understand and repair land-based mechanical power transmission systems. These systems underpin a wide and varied range of land-based machines and vehicles.

Learning outcomes

In this unit, learners will

1. understand land-based mechanical power transmission systems
2. inspect, test and repair land-based mechanical power transmission systems.

Scope of content

This section gives details of the scope of content to be covered in the teaching of the unit to ensure that all the learning outcomes can be achieved.

Learning outcome:

1. Understand land-based mechanical power transmission systems

Topics

- 1.1 The function and working principles of land-based mechanical power transmission systems
- 1.2 Land-based mechanical power transmission system failure and trouble-shooting

Topic 1.1

Learners will understand the function and working principles of mechanical power transmission systems.

The topic will include

- relationship between power, torque and speed
- drive shafts and universal joints (PTO shaft risks and hazards)
- protection and overrun devices (shear bolts, slip clutches, etc.)
- bushings or friction bearings (steel, bronze, nylon, etc.)
- bearings (ball, roller, tapered roller, radial, thrust, sealed, sintered, etc.)
- belt drive systems (V, multi-strand, pulleys, etc.)
- chain drive systems (rollers, links, sprockets, size, pitch, dimension, etc.)
- gear drive systems (spur, helical, bevel, hypoid, etc.).

Topic 1.2

Learners will understand land-based mechanical power transmission system failure and trouble-shooting.

The topic will include

- types and symptoms of component failure due to excessive load, friction, heat, speed, etc.
- types and symptoms of component failure due to excessive wear, fatigue, etc.
- types and symptoms of component failure due to misalignment
- types and symptoms of component failure due to lack of lubrication
- trouble-shooting methodologies
- repair strategies.

Learning outcome:

2. Inspect, test and repair land-based mechanical power transmission systems

Topics

- 2.1 Inspect, test and repair land-based mechanical power transmission systems

Topic 2.1

Learners will inspect, test and repair the following mechanical power transmission systems

- universal joint (including the removal and replacement of a cross and/or yoke).
- overrun device
- bushing or friction bearing (including removal from a shaft using an appropriate puller and/or press and replacement/reinstatement)

- ball/roller bearing (including removal from a shaft using an appropriate puller and/or press and replacement/reinstatement)
- belt drive system (including the removal and replacement/reinstatement of a belt and pulley)
- chain drive system (including the removal and replacement/reinstatement of a chain and sprocket)
- gear drive system (including the removal and replacement/reinstatement of a gear wheel/cog)

Activities will include

- inspect and test the operation of each system prior to disassembly (assessing wear, damage, misalignment, vibration, noise, etc.)
- disassemble each system (as required), to enable access to the components
- inspect the components following disassembly
- diagnose and evaluate faults
- carry out repairs and/or overhaul procedures
- reinstate each system
- verify the integrity of the repairs/overhauls
- recommend actions for future servicing or maintenance.

Activities will be carried out on land-based machines or vehicles.

Guidance for delivery

Centres are encouraged to introduce employers and product specialists from industry to provide interesting and relevant information to learners. It would be helpful for tutors and centres to maintain close contact with industry to ensure ongoing access to suitable and up-to-date equipment for learners to work on.

It is accepted that some formal lectures will be necessary at level 3 but for this unit it is essential that they are they are linked directly with interactive workshop lessons working on real equipment.

Suggested learning resources

Books

Farm Machinery, 6th Edition
Published by: Old Pond Publishing, 2016
ISBN: 9781910456064
Bell, B

Farm Machinery, 12th Edition
Published by: Wiley-Blackwell, 1992
ISBN: 9780632031597
Culpin C

Miscellaneous manufacturers' publications and manuals

Journals

Profi International

Websites

CDX Automotive (Light Vehicle / Heavy Vehicle) <http://www.cdxtextbook.com>
Health and Safety Executive <http://www.hse.gov.uk>
How Stuff Works <http://www.howstuffworks.com>
Institution of Agricultural Engineers <http://www.iagre.org>
Land-based Engineering <http://landbasedengineering.com>

Unit 359

Repair land-based synchromesh transmissions and clutches

| | |
|---------------|------------|
| UAN: | F/507/6997 |
| Level: | 3 |
| GLH: | 60 |

What is this unit about?

The purpose of this unit is to enable learners to understand and repair land-based synchromesh transmissions and clutches. These transmissions are fitted to a wide and varied range of land-based vehicles.

Learning outcomes

In this unit, learners will

1. understand land-based synchromesh transmissions and clutches
2. inspect, test and repair a land-based synchromesh transmission and clutch.

Scope of content

This section gives details of the scope of content to be covered in the teaching of the unit to ensure that all the learning outcomes can be achieved.

Learning outcome:

1. Understand land-based synchromesh transmissions and clutches

Topics

- 1.1 The function and working principles of land-based synchromesh transmissions
- 1.2 The function and working principles of land-based clutches

Topic 1.1

Learners will understand the function and working principles of land-based synchromesh transmissions.

The topic will include

- relationship between power, torque and speed
- types of gears (spur, helical, bevel, etc.)
- basic transmission and driveline layout
- differentials and differential locking systems
- final drive systems (reduction ratios, types of final drive systems, etc.)
- four-wheel drive systems
- gearbox selectors (forks, rods, etc.)
- gearbox synchros (hubs, cones, etc.)
- methods of gear engagement (manual linkage, cable, etc.)
- gear ratios and overlaps (where multiple ranges are used)
- speed charts and number of gears in the working range
- transmission efficiency (input power versus output power)
- typical component failure, trouble-shooting and repairs.

Topic 1.2

Learners will understand the function and working principles of land-based clutches.

The topic will include

- main components (friction disc, pressure plate, thrust bearing, etc.)
- friction materials, wearing parts and clutch longevity
- methods of clutch engagement (manual, electro-hydraulic, etc.)
- importance of adjustment and correct operation
- typical component failure, trouble-shooting and repairs.

Learning outcome:

2. Inspect, test and repair a land-based synchromesh transmission and clutch

Topics

- 2.1 Inspect, test and repair a land-based synchromesh transmission
- 2.2 Inspect, test and repair a land-based clutch

Topic 2.1

Learners will inspect, test and repair a land-based synchromesh transmission. Activities will be carried out on a complex machine, typically a tractor or other land-based vehicle.

Activities will include

- inspect and test the operation of the transmission prior to disassembly (where required)
- disassemble the machine (as required), to enable access to the transmission components
- inspect the transmission components following disassembly
- diagnose faults
- carry out repairs and/or overhaul procedures
- reinstate the transmission and the machine
- carry out other checks and activities, as per the manufacturer's service schedules
- verify the integrity of the repair/overhaul
- recommend actions for future servicing or maintenance.

Topic 2.2

Learners will inspect, test and repair a land-based clutch. Activities will be carried out on a complex machine, typically a tractor or other land-based vehicle.

Activities will include

- inspect and test the operation of the clutch prior to disassembly (where required)
- disassemble the machine (as required), to enable access to the clutch components
- inspect the clutch components following disassembly
- diagnose faults
- carry out repairs and/or overhaul procedures
- reinstate the clutch and the machine
- carry out other checks and activities (including clutch adjustment), as per the manufacturer's service schedules
- verify the integrity of the repair/overhaul
- recommend actions for future servicing or maintenance.

Guidance for delivery

Centres are encouraged to introduce employers and product specialists from industry to provide interesting and relevant information to learners. It would be helpful for tutors and centres to maintain close contact with industry to ensure ongoing access to suitable and up-to-date equipment for learners to work on.

It is accepted that some formal lectures will be necessary at level 3 but for this unit it is essential that they are they are linked directly with interactive workshop lessons working on real equipment.

Suggested learning resources

Books

| | |
|--|----------|
| Farm Machinery, 6 th Edition Published by: Old Pond Publishing, 2016 ISBN: 9781910456064 | Bell, B |
| Farm Machinery, 12 th Edition Published by: Wiley-Blackwell, 1992 ISBN: 9780632031597 | Culpin C |
| Hillier's Fundamentals of Motor Vehicle Technology, 6 th Edition Published by: Nelson Thornes, 2012 ISBN: 9781408515181 | Calex UK |

Miscellaneous manufacturers' publications and manuals

Journals

Profi International

Websites

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| CDX Automotive (Light Vehicle / Heavy Vehicle) | http://www.cdxtextbook.com |
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| How Stuff Works | http://www.howstuffworks.com |
| Institution of Agricultural Engineers | http://www.iagre.org |
| Land-based Engineering | http://landbasedengineering.com |

| | |
|---------------|------------|
| UAN: | J/507/6998 |
| Level: | 3 |
| GLH: | 60 |

What is this unit about?

The purpose of this unit is to enable learners to understand and repair land-based powershift transmissions. This unit encompasses semi-powershift, full-powershift and dual-clutch transmissions. These transmissions are fitted to a wide and varied range of land-based vehicles, including tractors.

Learning outcomes

In this unit, learners will

1. understand land-based powershift transmissions
2. inspect, test and repair a land-based powershift transmission.

Scope of content

This section gives details of the scope of content to be covered in the teaching of the unit to ensure that all the learning outcomes can be achieved.

Learning outcome:

1. Understand land-based powershift transmissions

Topics

1.1 The function and working principles of land-based powershift transmissions

Topic 1.1

Learners will understand the function and working principles of land-based powershift transmissions.

The topic will include

- relationship between power, torque and speed
- types of gears (spur, helical, bevel, etc.)
- semi-powershift, full-powershift and dual-clutch transmission layout
- clutch-pack design and calibration
- electro-hydraulic clutch-pack engagement (powershift transmission systems, etc.)
- electro-magnetic clutch-pack engagement (dual-clutch transmission systems, etc.)
- operator controls (manual, electro-hydraulic, programmable, etc.)
- gear ratios and overlaps (where multiple ranges are used)
- speed charts and number of gears in the working range
- transmission efficiency (input power versus output power)
- operational advantages and disadvantages of semi-powershift, full-powershift and dual-clutch transmissions
- typical component failure, trouble-shooting and repairs.

Learning outcome:

2. Inspect, test and repair a land-based powershift transmission

Topics

2.1 Inspect, test and repair a land-based powershift transmission

Topic 2.1

Learners will inspect, test and repair a land-based powershift transmission. Activities will be carried out on a complex machine, typically a tractor or other land-based vehicle.

Activities will include

- inspect and test the operation of the transmission prior to disassembly (where required)
- disassemble the machine (as required), to enable access to the transmission components
- inspect the transmission components following disassembly
- diagnose faults (mechanical, hydraulic, electric, etc.)
- carry out repairs and/or overhaul procedures
- reinstate the transmission and the machine
- calibrate the clutch-pack and/or transmission, as per the manufacturer's service schedules
- carry out other checks, adjustments or activities, as per the manufacturer's service schedules
- verify the integrity of the repair/overhaul

- recommend actions for future servicing or maintenance.

Guidance for delivery

Centres are encouraged to introduce employers and product specialists from industry to provide interesting and relevant information to learners. It would be helpful for tutors and centres to maintain close contact with industry to ensure ongoing access to suitable and up-to-date equipment for learners to work on.

It is accepted that some formal lectures will be necessary at level 3 but for this unit it is essential that they are they are linked directly with interactive workshop lessons working on real equipment.

Suggested learning resources

Books

| | |
|--|----------|
| Farm Machinery, 6 th Edition Published by: Old Pond Publishing, 2016 ISBN: 9781910456064 | Bell, B |
| Farm Machinery, 12 th Edition Published by: Wiley-Blackwell, 1992 ISBN: 9780632031597 | Culpin C |
| Hillier's Fundamentals of Motor Vehicle Technology, 6 th Edition Published by: Nelson Thornes, 2012 ISBN: 9781408515181 | Calex UK |

Miscellaneous manufacturers' publications and manuals

Journals

Profi International

Websites

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| Institution of Agricultural Engineers | http://www.iagre.org |
| Land-based Engineering | http://landbasedengineering.com |

Unit 361

Repair land-based hydrostatic or hydro-mechanical (CVT) transmissions

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|---------------|------------|
| UAN: | L/507/6999 |
| Level: | 3 |
| GLH: | 60 |

What is this unit about?

The purpose of this unit is to enable learners to understand and repair land-based hydrostatic or hydro-mechanical (CVT) transmissions. These transmissions are fitted to a wide and varied range of land-based vehicles, including tractors, materials handlers and self-propelled equipment.

Learning outcomes

In this unit, learners will

1. understand land-based hydrostatic and hydro-mechanical (CVT) transmissions
2. inspect, test and repair a land-based hydrostatic or hydro-mechanical (CVT) transmission.

Scope of content

This section gives details of the scope of content to be covered in the teaching of the unit to ensure that all the learning outcomes can be achieved.

Learning outcome:

1. Understand land-based hydrostatic and hydro-mechanical (CVT) transmissions

Topics

1.1 The function and working principles of land-based hydrostatic transmissions

1.2 The function and working principles of land-based hydro-mechanical (CVT) transmissions

Topic 1.1

Learners will understand the function and working principles of land-based hydrostatic transmissions.

The topic will include

- relationship between power, torque and speed
- hydrostatic transmission layout
- hydrostatic transmission circuit diagrams
- hydrostatic pump characteristics (variable-displacement, piston-type, swash-plate, etc.)
- hydrostatic motor characteristics
- additional mechanical transmission components (high/low ranges, etc.)
- operator controls (manual, electro-hydraulic, programmable, etc.)
- transmission efficiency (input power versus output power)
- operational advantages and disadvantages of hydrostatic transmissions
- typical component failure, trouble-shooting and repairs.

Topic 1.2

Learners will understand the function and working principles of land-based hydro-mechanical (CVT) transmissions.

The topic will include

- relationship between power, torque and speed
- hydro-mechanical (CVT) transmission layout
- hydrostatic transmission circuit diagrams
- integrated planetary gear-sets/assemblies and mechanical drive components
- interaction between mechanical and hydrostatic components
- hydrostatic pump characteristics (variable-displacement, piston-type, swash-plate, etc.)
- hydrostatic motor characteristics
- additional mechanical transmission elements (high/low ranges, etc.)
- operator controls (electro-hydraulic, programmable, etc.)
- automatic control settings (optimum economy versus maximum power, etc.)
- transmission efficiency (input power versus output power)
- operational advantages and disadvantages of hydro-mechanical (CVT) transmissions
- typical component failure, trouble-shooting and repairs.

Learning outcome:

2. Inspect, test and repair a land-based hydrostatic or hydro-mechanical (CVT) transmission

Topics

2.1 Inspect, test and repair a land-based hydrostatic or hydro-mechanical (CVT) transmission

Topic 2.1

Learners will inspect, test and repair a land-based hydrostatic or hydro-mechanical (CVT) transmission. Activities will be carried out on a complex land-based machine or vehicle.

Activities will include

- inspect and test the operation of the transmission prior to disassembly (where required)
- disassemble the machine (as required), to enable access to the transmission components
- inspect the transmission components following disassembly
- diagnose faults (mechanical, hydraulic, electric, etc.)
- carry out repairs and/or overhaul procedures
- reinstate the transmission and the machine
- carry out other checks, adjustments and activities, as per the manufacturer's service schedules
- calibrate the transmission (if applicable), as per the manufacturer's service schedules
- verify the integrity of the repair/overhaul
- recommend actions for future servicing or maintenance.

Guidance for delivery

Centres are encouraged to introduce employers and product specialists from industry to provide interesting and relevant information to learners. It would be helpful for tutors and centres to maintain close contact with industry to ensure ongoing access to suitable and up-to-date equipment for learners to work on.

It is accepted that some formal lectures will be necessary at level 3 but for this unit it is essential that they are they are linked directly with interactive workshop lessons working on real equipment.

Suggested learning resources

Books

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|--|----------|
| Farm Machinery, 6 th Edition Published by: Old Pond Publishing, 2016 ISBN: 9781910456064 | Bell, B |
| Farm Machinery, 12 th Edition Published by: Wiley-Blackwell, 1992 ISBN: 9780632031597 | Culpin C |
| Hillier's Fundamentals of Motor Vehicle Technology, 6 th Edition Published by: Nelson Thornes, 2012 ISBN: 9781408515181 | Calex UK |

Miscellaneous manufacturers' publications and manuals

Journals

Profi International

Websites

| | |
|--|---|
| CDX Automotive (Light Vehicle / Heavy Vehicle) | http://www.cdxtetextbook.com |
| Health and Safety Executive | http://www.hse.gov.uk |
| How Stuff Works | http://www.howstuffworks.com |
| Institution of Agricultural Engineers | http://www.iagre.org |
| Land-based Engineering | http://landbasedengineering.com |

Appendix 1 Sources of general information

The following documents contain essential information for centres delivering City & Guilds qualifications. They should be referred to in conjunction with this handbook. To download the documents and to find other useful documents, go to the **Centres and Training Providers homepage** on www.cityandguilds.com.

City & Guilds Centre Manual

This document provides guidance for organisations wishing to become City & Guilds approved centres, as well as information for approved centres delivering City & Guilds qualifications. It covers the centre and qualification approval process as well as providing guidance on delivery, assessment and quality assurance for approved centres.

It also details the City & Guilds requirements for ongoing centre and qualification approval, and provides examples of best practice for centres. Specifically, the document includes sections on:

- the centre and qualification approval process
- assessment, internal quality assurance and examination roles at the centre
- registration and certification of candidates
- non-compliance and malpractice
- complaints and appeals
- equal opportunities
- data protection
- management systems
- maintaining records
- internal quality assurance
- external quality assurance.

Our Quality Assurance Requirements

This document explains the requirements for the delivery, assessment and awarding of our qualifications. All centres working with City & Guilds must adopt and implement these requirements across all of their qualification provision. Specifically, this document:

- specifies the quality assurance and control requirements that apply to all centres
- sets out the basis for securing high standards, for all our qualifications and/or assessments
- details the impact on centres of non-compliance

The **centre homepage** section of the City & Guilds website also contains useful information on

- **Walled Garden:** how to register and certificate candidates on line
- **Events:** dates and information on the latest Centre events
- **Online assessment:** how to register for e-assessments.

Useful contacts

UK learners

General qualification information

E: learnersupport@cityandguilds.com

International learners

General qualification information

E: intcg@cityandguilds.com

Centres

Exam entries, Certificates, Registrations/enrolment, Invoices, Missing or late exam materials, Nominal roll reports, Results

E: centresupport@cityandguilds.com

Single subject qualifications

Exam entries, Results, Certification, Missing or late exam materials, Incorrect exam papers, Forms request (BB, results entry), Exam date and time change

E: singlesubjects@cityandguilds.com

International awards

Results, Entries, Enrolments, Invoices, Missing or late exam materials, Nominal roll reports

E: intops@cityandguilds.com

Walled Garden

Re-issue of password or username, Technical problems, Entries, Results, e-assessment, Navigation, User/menu option, Problems

E: walledgarden@cityandguilds.com

Employer

Employer solutions, Mapping, Accreditation, Development Skills, Consultancy

E: business@cityandguilds.com

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About City & Guilds

As the UK's leading vocational education organisation, City & Guilds is leading the talent revolution by inspiring people to unlock their potential and develop their skills. City & Guilds is recognised and respected by employers across the world as a sign of quality and exceptional training.

City & Guilds Group

The City & Guilds Group is a leader in global skills development. Our purpose is to help people and organisations to develop their skills for personal and economic growth. Made up of City & Guilds, City & Guilds Kineo, The Oxford Group and ILM, we work with education providers, businesses and governments in over 100 countries.

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