BTEC Level 2

Specification

BTEC Firsts

Pearson BTEC Level 2 Certificate, BTEC Level 2 Extended Certificate and BTEC Level 2 Diploma in Land-based Technology

For first teaching September 2010

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Issue 3

Edexcel, BTEC and LCCI qualifications

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These qualifications were previously entitled:

Edexcel BTEC Level 2 Certificate in Land based Technolgy (QCF)

Edexcel BTEC Level 2 Extended Certificate in Land-based Technolgy (QCF)

Edexcel BTEC Level 2 Diploma in Land-based Technolgy (QCF)

The QNs remain the same.

This specification is Issue 3. Key changes are sidelined. We will inform centres of any changes to this issue. The latest issue can be found on the Pearson website: www.pearson.com

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Contents

BTEC First qualification titles covered by this specification

Pearson BTEC Level 2 Certificate in Land-based Technology

Pearson BTEC Level 2 Extended Certificate in Land-based Technology

Pearson BTEC Level 2 Diploma in Land-based Technology

These qualifications have been accredited to the national framework and are eligible for public funding as determined by the Department for Education (DfE) under Sections 96 of the Learning and Skills Act 2000.

The qualification titles listed above feature in the funding lists published annually by the DfE and the regularly updated website www.education.gov.uk. The Qualifications Number (QN) should be used by centres when they wish to seek public funding for their learners. Each unit within a qualification will also have a unit code.

The qualification and unit codes will appear on the learners' final certification documentation.

The QNs for the qualifications in this publication are:

Pearson BTEC Level 2 Certificate in Land-based Technology	501/0343/X
Pearson BTEC Level 2 Extended Certificate in Land-based Technology	501/0347/7
Pearson BTEC Level 2 Diploma in Land-based Technology	501/0311/8

These qualification titles will appear on learners' certificates. Learners need to be made aware of this when they are recruited by the centre and registered with Pearson.

What are BTEC Firsts?

BTEC First qualifications are undertaken in further education and sixth-form colleges, schools and other training providers, and have been since they were introduced in 1983. Their purpose, approaches to teaching, learning and assessment are established and understood by teaching professionals, employers and learners alike.

The BTEC First qualifications within this specification are:

Pearson BTEC Level 2 Certificate in Land-based Technology

Pearson BTEC Level 2 Extended Certificate in Land-based Technology

Pearson BTEC Level 2 Diploma in Land-based Technology.

But for clarity and continuity they are referred to generically as BTEC First qualifications, where appropriate, and maintain the same equivalences, benchmarks and other articulations (for example SCAAT points) as their predecessor qualifications. The following identifies the titling conventions and variations between the predecessor and new specifications.

Predecessor BTEC Firsts (accredited 2006)	BTEC Firsts (for delivery from September 2010)
Pearson Level 2 BTEC First Diploma	Pearson BTEC Level 2 Diploma
Pearson Level 2 BTEC First Certificate	Pearson BTEC Level 2 Extended Certificate
Not applicable	Pearson BTEC Level 2 Certificate

BTEC Firsts are Level 2 qualifications designed to provide specialist work-related qualifications in a range of sectors. They give learners the knowledge, understanding and skills that they need to prepare for employment. The qualifications also provide career development opportunities for those already in work. Consequently, they provide a course of study for full-time or part-time learners in schools, colleges and training centres.

BTEC Firsts provide much of the underpinning knowledge and understanding for the National Occupational Standards for the sector, where these are appropriate. They are supported by the relevant Standards Setting Body (SSB) or Sector Skills Council (SSC). A number of BTEC Firsts are recognised as Technical Certificates and form part of the Apprenticeship Framework. They attract achievement and attainment points that equate to similar-sized general qualifications.

On successful completion of a BTEC First qualification, learners can progress to or within employment and/or continue their study in the same, or related vocational area.

Total Qualification Time

For all regulated qualifications, Pearson specifies a total number of hours that it is expected the average learner will be required to undertake in order to complete and show achievement for the qualification: This is the Total Qualification Time (TQT).

Within this, Pearson will also identify the number of Guided Learning Hours (GLH) that we expect a centre delivering the qualification will need to provide. Guided learning means activities that directly or immediately involve tutors and assessors in teaching, supervising, and invigilating learners, such as lessons, tutorials, online instruction, supervised study giving feedback on performance.

In addition to guided learning, other required learning directed by tutors or assessors will include private study, preparation for assessent and undertaking assessment when not under supervision, such as preparatory reading, revision and independent research.

These qualifications also have a credit value, which is equal to one tenth of TQT. Pearson consults with users of these qualifications in assigning TQT and credit values.

This suite of BTEC Level 2 qualifications is available in the following sizes:

- Certificate – 150 TQT (15 credits, 90 GLH)
- Extended Certificate – 300 TQT (30 credits, 180 GLF)
- Diploma – 600 TQT (60 credits, 360 GLH)

Pearson BTEC Level 2 Certificate – 15 credits

The 15-credit BTEC Level 2 Certificate offers a specialist qualification that focuses on particular aspects of employment within the appropriate vocational sector. The BTEC Level 2 Certificate is a qualification which can extend a learner's programme of study and provide a vocational emphasis. The BTEC Level 2 Certificate is broadly equivalent to one GCSE.

The BTEC Level 2 Certificate is also suitable for more mature learners, who wish to follow a vocational programme of study as part of their continued professional development or who want to move to a different area of employment.

Pearson BTEC Level 2 Extended Certificate – 30 credits

The 30-credit BTEC Level 2 Extended Certificate extends the specialist work-related focus from the BTEC First Certificate and covers the key knowledge and practical skills required in the appropriate vocational sector. The BTEC Level 2 Extended Certificate offers flexibility and a choice of emphasis through the optional units. It is broadly equivalent to two GCSEs.

The BTEC Level 2 Extended Certificate offers an engaging programme for those who are clear about the area of employment that they wish to enter. These learners may wish to extend their programme through the study of a related GCSE, a complementary NVQ or another qualification. These learning programmes can be developed to allow learners to study complementary qualifications without duplication of content.

For adult learners the BTEC Level 2 Extended Certificate can extend their experience of work in a particular sector. It is a suitable qualification for those wishing to change career or move into a particular area of employment following a career break.

Pearson BTEC Level 2 Diploma – 60 credits

The 60-credit BTEC Level 2 Diploma extends the specialist work-related focus from the BTEC Level 2 Extended Certificate. There is potential for the qualification to prepare learners for employment in the appropriate vocational sector and it is suitable for those who have decided that they wish to enter a particular area of work. It is broadly equivalent to four GCSEs.

Some learners may wish to gain the qualification in order to enter a specialist area of employment or to progress to a Level 3 programme. Other learners may want to extend the specialism they studied on the BTEC Level 2 Certificate or the BTEC Level 2 Extended Certificate programme.

Key features of the BTEC Firsts in Land-based Technology

The BTEC Firsts in Land-based Technology have been developed to:

- provide education and training for learners interested in employment and/or further education in the environmental and land-based and/or associated sectors
- provide opportunities for employees who currently work in land-based engineering and service industries to achieve a nationally recognised, Level 2 vocationally-specific qualification
- give full-time learners the opportunity to enter employment in the environmental and land-based sector or to progress to vocational qualifications such as the Pearson BTEC Level 3 Nationals in Land-based Technology
- give learners the opportunity to develop a range of skills and techniques, personal skills and attributes essential for successful performance in working life.

Rationale for the BTEC Firsts in Land-based Technology

The BTEC Firsts in Land-based Technology have been developed to provide entry and progression into and within land-based engineering and service industries that fall within the environmental and land-based sector. Lantra, the Sector Skills Council for the environmental and land-based industries, has identified knowledge, understanding and technical skills that employers will need from learners entering the sector in the coming years. Pearson have included these in the development of the units that make up these qualifications.

These qualifications are part of a wide suite of environmental and land-based qualifications offered by Pearson and are designed primarily for 14 to 19 learners seeking employment and/or further learning in the sector. They are also available to other learners who may already have experience within the sector but seek a nationally recognised qualification as part of their career. The qualifications are aimed at those interested in service engineering and mechanisation roles. The qualifications are made up from discrete 5 and 10 credit units of learning that give learners explicit recognition of their learning in education and work. BTEC First qualifications are free to be delivered and assessed in a range of traditional and contemporary models such as full time, part-time and e-learning. Tutors are free to create innovative and creative assessments that fit local requirements whilst maintaining a national standard.

National Occupational Standards

BTEC Firsts are designed to provide much of the underpinning knowledge and understanding for the National Occupational Standards (NOS), as well as developing practical skills in preparation for work and possible achievement of NVQs in due course. NOS form the basis of National Vocational Qualifications (NVQs). BTEC Firsts do not purport to deliver occupational competence in the sector, which should be demonstrated in a work context.

Each unit in the specification identifies links to elements of the NOS.

The Pearson BTEC Level 2 Firsts in Land-based Technology relate to the following NOS:

Level 2 Land-based Engineering Operations.

Rules of combination for Pearson BTEC Level 2 First qualifications

The rules of combination specify the:

- total credit value of the qualification
- the minimum credit to be achieved at the level, or above, the level of the qualification
- the mandatory unit credit
- the optional unit credit
- the maximum credit that can come from other BTEC units in this qualification suite.

When combining units for a BTEC First qualification, it is the centre's responsibility to ensure that the following rules of combination are adhered to.

Pearson BTEC Level 2 Certificate

1 Qualification credit value: a minimum of 15.

2 Minimum credit to be achieved at, or above, the level of the qualification: 8.

Pearson BTEC Level 2 Extended Certificate

1 Qualification credit value: a minimum of 30.

2 Minimum credit to be achieved at, or above, the level of the qualification: 16.

Pearson BTEC Level 2 Diploma

1 Qualification credit value: a minimum of 60.

2 Minimum credit to be achieved at, or above, the level of the qualification: 31.

3 Mandatory unit credit: 40.

4 Optional unit credit: 20.

5 A maximum of 10 optional credits can come from other BTEC units to meet local needs.

Pearson BTEC Level 2 Certificate in Land-based Technology

The Pearson BTEC Level 2 Certificate in Land-based Technology is 15-credits and has 90-guided-learning-hours (GLH) that consists of optional units that provide for a combined total of 15 credits (where at least eight credits must be at Level 2 or above).

Pearson BTEC Level 2 Certificate in Land-based Technology			
Unit	**Optional units**	**Credit**	**Level**
1	Monitor and Maintain Health and Safety in a Land-based Engineering Work Area	10	2
2	Land-based Engineering Operations – Applying Mechanical Principles	5	2
3	Land-based Engineering Operations – Understand How to Use, Service and maintain Tools and Equipment	5	2
4	Land-based Engineering Operations – Material Preparation, Shaping and Assembling	10	2
5	Land-based Engineering Operations – Carry out Servicing and Maintenance on Land-based Equipment	10	2
6	Land-based Engineering Operations – Use Calculations	5	2
9	Land-based Engineering Operations – Perform Thermal Joining and Cutting Processes	10	2
10	Land-based Engineering Operations – Service and Repair Cooling and Lubrication Systems	5	2
11	Land-based Engineering Operations – Service and Repair Engines and Components	10	2
12	Service and Repair Clutches, Fluid Flywheels and Torque Convertors on Land-based Equipment	5	2
13	Service and Repair Mechanical Transmissions on Land-based Equipment	10	2
14	Service and Repair Braking Systems on Land-based Equipment	5	2
15	Service and Repair Wheeled and Tracked Steering Systems on Land-based Equipment	5	2
17	Service and Repair Land-based Cutting and Mowing Equipment	5	2
26	Introduction to Land-based Workshop Practice	10	2
27	Introduction to Land-based Machinery Operations	10	2

Pearson BTEC Level 2 Extended Certificate in Land-based Technology

The Pearson BTEC Level 2 Extended Certificate in Land-based Technology is 30-credits and has 180-guided-learning-hours (GLH) that consists of optional units that provide for a combined total of 30 credits (where at least 16 credits must be at Level 2 or above).

Pearson BTEC Level 2 Extended Certificate in Land-based Technology			
Unit	**Optional units**	**Credit**	**Level**
1	Monitor and Maintain Health and Safety in a Land-based Engineering Work Area	10	2
2	Land-based Engineering Operations – Applying Mechanical Principles	5	2
3	Land-based Engineering Operations – Understand How to Use, Service and Maintain Tools and Equipment	5	2
4	Land-based Engineering Operations – Material Preparation, Shaping and Assembling	10	2
5	Land-based Engineering Operations – Carry out Servicing and Maintenance on Land-based Equipment	10	2
6	Land-based Engineering Operations – Use Calculations	5	2
7	Understand and Follow Organisational Procedures within Land-based Engineering Establishments	5	2
9	Land-based Engineering Operations – Perform Thermal Joining and Cutting Processes	10	2
10	Land-based Engineering Operations – Service and Repair Cooling and Lubrication Systems	5	2
11	Land-based Engineering Operations – Service and Repair Engines and Components	10	2
12	Service and Repair Clutches, Fluid Flywheels and Torque Convertors on Land-based Equipment	5	2
13	Service and Repair Mechanical Transmissions on Land-based Equipment	10	2
14	Service and Repair Braking Systems on Land-based Equipment	5	2
15	Service and Repair Wheeled and Tracked Steering Systems on Land-based Equipment	5	2
16	Service and Repair Tyres and Tracks on Land-based Equipment	5	2
17	Service and Repair Land-based Cutting and Mowing Equipment	5	2
18	Service and Repair Land-based Harvesting and Processing Equipment	10	2
19	Service and Repair Land-based Soil Preparation and Plant Establishment Equipment	10	2
20	Service and Repair Land-based Transport, Handling and Storage Equipment	10	2
21	Service and Repair Electrical Systems on Land-based Equipment	10	2
22	Service and Repair Hydraulic Systems and Components on Land-based Equipment	10	2
23	Service and Repair Pneumatic Systems and Components for Land-based Equipment	5	2
26	Introduction to Land-based Workshop Practice	10	2
27	Introduction to Land-based Machinery Operations	10	2

Pearson BTEC Level 2 Diploma in Land-based Technology

The Pearson BTEC Level 2 Diploma in Land-based Technology is 60-credits and has 360-guided-learning-hours (GLH) that consists of five mandatory units **plus** optional units that provide for a combined total of 60 credits (where at least 31 credits must be at Level 2 or above).

Pearson BTEC Level 2 Diploma in Land-based Technology			
Unit	**Mandatory units**	**Credit**	**Level**
1	Monitor and Maintain Health and Safety in a Land-based Engineering Work Area	10	2
2	Land-based Engineering Operations – Applying Mechanical Principles	5	2
3	Land-based Engineering Operations – Understand How to Use, Service and Maintain Tools and Equipment	5	2
4	Land-based Engineering Operations – Material Preparation, Shaping and Assembling	10	2
5	Land-based Engineering Operations – Carry out Servicing and Maintenance on Land-based Equipment	10	2
Unit	**Optional units**		
6	Land-based Engineering Operations – Use Calculations	5	2
7	Understand and Follow Organisational Procedures within Land-based Engineering Establishments	5	2
8	Provide Customer Care within Land-based Engineering Operations	5	2
9	Land-based Engineering Operations – Perform Thermal Joining and Cutting Processes	10	2
10	Land-based Engineering Operations – Service and Repair Cooling and Lubrication Systems	5	2
11	Land-based Engineering Operations – Service and Repair Engines and Components	10	2
12	Service and Repair Clutches, Fluid Flywheels and Torque Convertors on Land-based Equipment	5	2
13	Service and Repair Mechanical Transmissions on Land-based Equipment	10	2
14	Service and Repair Braking Systems on Land-based Equipment	5	2
15	Service and Repair Wheeled and Tracked Steering Systems on Land-based Equipment	5	2
16	Service and Repair Tyres and Tracks on Land-based Equipment	5	2
17	Service and Repair Land-based Cutting and Mowing Equipment	5	2
18	Service and Repair Land-based Harvesting and Processing Equipment	10	2
19	Service and Repair Land-based Soil Preparation and Plant Establishment Equipment	10	2
20	Service and Repair Land-based Transport, Handling and Storage Equipment	10	2
21	Service and Repair Electrical Systems on Land-based Equipment	10	2
22	Service and Repair Hydraulic Systems and Components on Land-based Equipment	10	2
23	Service and Repair Pneumatic Systems and Components for Land-based Equipment	5	2
24	Undertake Work-Related Experience in the Land-based Industries	10	2
25	Environmental and Land-based Business	10	2
26	Introduction to Land-based Workshop Practice	10	2
27	Introduction to Land-based Machinery Operations	10	2

Assessment and grading

In BTEC Firsts all units are internally assessed.

All assessment for BTEC First qualifications is criterion referenced, based on the achievement of all the specified learning outcomes.

Each unit within the qualification has specified assessment and grading criteria which are to be used for grading purposes. A summative unit grade can be awarded at pass, merit or distinction:

- to achieve a 'pass' a learner must have satisfied all the pass assessment criteria
- to achieve a 'merit' a learner must additionally have satisfied all the merit grading criteria
- to achieve a 'distinction' a learner must additionally have satisfied all the grading distinction criteria.

Grading domains

The assessment and grading criteria are developed in relation to grading domains which are exemplified by a number of indicative characteristics at the level of the qualification.

There are four BTEC First grading domains:

- application of knowledge and understanding
- development of practical and technical skills
- personal development for occupational roles
- application of generic skills.

Please refer to *Annexe B* which shows the merit and distinction indicative characteristics.

Guidance

The purpose of assessment is to ensure that effective learning has taken place to give learners the opportunity to:

- meet the assessment and grading criteria and
- achieve the learning outcomes within the units.

All the assignments created by centres should be reliable and fit-for-purpose, and should be built on the unit assessment and grading criteria. Assessment tasks and activities should enable learners to produce valid, sufficient and reliable evidence that relates directly to the specified criteria. Centres should enable learners to produce evidence in a variety of different forms including written reports, graphs, posters, along with projects, performance observation and time-constrained assessments.

Centres are encouraged to emphasise the practical application of the assessment and grading criteria, providing a realistic scenario for learners to adopt, and making maximum use of practical activities and work experience. The creation of assignments that are fit for purpose is vital to achievement and their importance cannot be over-emphasised.

The assessment and grading criteria must be clearly indicated on fit-for-purpose assignments. This gives learners focus and helps with internal verification and standardisation processes. It will also help to ensure that learner feedback is specific to the assessment and grading criteria.

When looking at the unit assessment and grading criteria grids and designing assignments, centres are encouraged to identify common topics and themes.

The units include guidance on appropriate Assessment methodology. A central feature of vocational assessment is that it allows for assessment to be:

- current, ie to reflect the most recent developments and issues
- local, ie to reflect the employment context of the delivering centre
- flexible to reflect learner needs, ie at a time and in a way that matches the learner's requirements so that they can demonstrate achievement.

Calculation of the qualification grade

Pass qualification grade

Learners who achieve the minimum eligible credit value specified by the rule of combination will achieve the qualification at pass grade (see *Rules of combination for Pearson BTEC Level 2 First qualifications*).

Qualification grades above pass grade

Learners will be awarded a merit or distinction or distinction* qualification grade by the aggregation of points gained through the successful achievement of individual units. The number of points available is dependent on the unit level and grade achieved, and the credit size of the unit (as shown in the 'points available for credits achieved at different Levels and unit grades' below).

Points available for credits achieved at different Levels and unit grades

The table below shows the **number of points scored per credit** at the unit level and grade.

Unit level	Points per credit		
	Pass	Merit	Distinction
Level 1	3	4	5
Level 2	**5**	**6**	**7**
Level 3	7	8	9

Learners who achieve the correct number of points within the ranges shown in the 'qualification grade' table will achieve the qualification merit or distinction or distinction* grade.

Qualification grade

Qualification	Points range above pass grade		
	Merit	Distinction	Distinction*
BTEC Level 2 Certificate	85-94	95-99	100 and above
BTEC Level 2 Extended Certificate	170-189	190-199	200 and above
BTEC Level 2 Diploma	340-379	380-399	400 and above

Please refer to *Annexe G* for examples of calculation of qualification grade above pass grade.

Quality assurance of centres

Pearson's qualification specifications set out the standard to be achieved by each learner in order to be awarded the qualification. This is covered in the statement of learning outcomes, and assessment and grading criteria in each unit. Further guidance on delivery and assessment is given in the *Essential guidance for tutors* section in each unit. This section is designed to provide additional guidance and amplification related to the unit to support tutors, deliverers and assessors and to provide for a coherence of understanding and a consistency of delivery and assessment.

Approval

Centres that have not previously offered BTEC qualifications will first need to apply for, and be granted, centre approval before they can apply for approval to offer the programme.

When a centre applies for approval to offer a BTEC qualification they are required to enter into an approvals agreement.

The approvals agreement is a formal commitment by the head or principal of a centre to meet all the requirements of the specification and any linked codes or regulations. Sanctions and tariffs may be applied if centres do not comply with the agreement. Ultimately, this could result in the suspension of certification or withdrawal of approval.

Centres will be allowed 'accelerated approval' for a new programme where the centre already has approval for a programme that is being replaced by the new programme.

The key principles of quality assurance are that:

- a centre delivering BTEC programmes must be an approved centre and must have approval for programmes or groups of programmes that it is operating
- the centre agrees as part of gaining approval to abide by specific terms and conditions around the effective delivery and quality assurance of assessment; it must abide by these conditions throughout the period of delivery
- Pearson makes available to approved centres a range of materials and opportunities intended to exemplify the processes required for effective assessment and examples of effective standards. Approved centres must use the materials and services to ensure that all staff delivering BTEC qualifications keep up-to-date with the guidance on assessment
- an approved centre must follow agreed protocols for standardisation of assessors and verifiers; planning, monitoring and recording of assessment processes; and for dealing with special circumstances, appeals and malpractice.

The approach of quality assured assessment is made through a partnership between an approved centre and Pearson. Pearson is committed to ensuring that it follows best practice and employs appropriate technology to support quality assurance processes where practicable. Therefore, the specific arrangements for working with centres will vary. Pearson seeks to ensure that the quality assurance processes that it uses do not place undue bureaucratic processes on centres and works to support centres in providing robust quality assurance processes.

Pearson monitors and supports centres in the effective operation of assessment and quality assurance. The methods which it uses to do this for these BTEC First and National programmes:

- ensuring that all centres have completed appropriate declarations at the time of approval, undertaking approval visits to centres where necessary

- requiring all centres to appoint a Lead Internal Verifier for designated groups of programmes and to ensure that this person is trained and supported in carrying out that role
- requiring that the Lead Internal Verifier completes compulsory online standardisation related to assessment and verification decisions for the designated programme
- assessment sampling and verification, through requested samples of assessments, completed assessed learner work and associated documentation
- overarching review and assessment of a centre's strategy for assessing and quality assuring its BTEC programmes.

Pearson Quality Assurance Handbook

Centres should refer to the *Handbook for Quality Assurance for BTEC Qualifications*, issued annually, for detailed guidance.

An approved centre must make certification claims only when authorised by Pearson and strictly in accordance with requirements for reporting.

Centres that do not fully address and maintain rigorous approaches to quality assurance will be prevented from seeking certification for individual programmes or for all BTEC First and National programmes. Centres that do not comply with remedial action plans may have their approval to deliver qualifications removed.

Programme design and delivery

BTEC First qualifications consist of mandatory and optional units. Optional units are designed to provide a focus to the qualification and give more specialist opportunities in the sector.

In BTEC Firsts each unit has a number of *guided learning hours* and centres are advised to take this into account when planning the programme of study associated with this specification.

Mode of delivery

Pearson does not define the mode of study for BTEC Firsts. Centres are free to offer the qualifications using any mode of delivery (such as full time, part time, evening only, distance learning) that meets their learners' needs. Whichever mode of delivery is used, centres must ensure that learners have appropriate access to the resources identified in the specification and to the subject specialists delivering the units. This is particularly important for learners studying for the qualification through open or distance learning.

Learners studying for the qualification on a part-time basis bring with them a wealth of experience that should be utilised to maximum effect by tutors and assessors. The use of assessment evidence drawn from learners' work environments should be encouraged. Those planning the programme should aim to enhance the vocational nature of the qualification by:

- liaising with employers to ensure a course relevant to learners' specific needs
- accessing and using non-confidential data and documents from learners' workplaces
- including sponsoring employers in the delivery of the programme and, where appropriate, in the assessment
- linking with company-based/workplace training programmes
- making full use of the variety of experience of work and life that learners bring to the programme.

Resources

BTEC Firsts are designed to prepare learners for employment in specific occupational sectors. Physical resources need to support the delivery of the programme and the proper assessment of the learning outcomes and should, therefore, normally be of industry standard. Staff delivering programmes and conducting the assessments should be familiar with current practice and standards in the sector concerned. Centres will need to meet any specific resource requirements to gain approval from Pearson.

Where specific resources are required these have been indicated in individual units in the *Essential resources* sections.

Delivery approach

It is important that centres develop an approach to teaching and learning that supports the specialist vocational nature of BTEC First qualifications and the mode of delivery. Specifications give a balance of practical skill development and knowledge requirements, some of which can be theoretical in nature. Tutors and assessors need to ensure that appropriate links are made between theory and practical application and that the knowledge base is applied to the sector. This requires the development of relevant and up-to-date teaching materials that allow learners to apply their learning to actual events and activity within the sector. Maximum use should be made of the learner's experience.

An outline learning plan is included in every unit as guidance which demonstrates one way in planning the delivery and assessment of the unit. The outline learning plan can be used in conjunction with the programme of suggested assignments.

Where the qualification has been designated and approved as a Technical Certificate and forms part of an Apprenticeship scheme, particular care needs to be taken to build strong links between the learning and assessment for the BTEC First qualification and the related NVQs and Functional Skills that also contribute to the scheme.

Meeting local needs

Centres should note that the qualifications set out in this specification have been developed in consultation with centres and employers and the Sector Skills Councils or the Standards Setting Bodies for the relevant sector. Centres should make maximum use of the choice available to them within the optional units to meet the needs of their learners, and local skills and training needs.

In certain circumstances, units in this specification might not allow centres to meet a local need. In this situation, Pearson will ensure that the rules of combination allow centres to make use of units from other BTEC specifications in this suite. Centres are required to ensure that the coherence and purpose of the qualification is retained and the vocational focus is not diluted.

Limitations on variations from standard specifications

The flexibility to import standard units from other BTEC Firsts is limited to a total of 25 per cent of the qualification credit value (see *Rules of combination for Pearson BTEC Level 2 First qualifications*).

These units cannot be used at the expense of the mandatory units in any qualification.

Additional and specialist learning

Additional and specialist learning (ASL) consists of accredited qualifications at the same level as, or one level above, the Diploma course of study. The ASL may include BTEC qualifications which are also available to learners not following a Diploma course of study.

Qualifications for ASL must be selected from the ASL catalogue through the National Database of Accredited Qualifications (NDAQ). The catalogue includes qualifications which have the approval of the Diploma Development Partnership (DDP) and will expand over time as more qualifications are approved. To access the catalogue go to www.ndaq.org.uk and select 'Browse Diploma Qualifications'.

Further units may be added to qualifications within the catalogue and centres undertaking, or preparing to undertake, ASL should refer regularly to the Pearson website for information regarding additions.

Functional Skills

BTEC Firsts give learners opportunities to develop and apply Functional Skills.

Functional Skills are offered as stand-alone qualifications at Level 2. See individual units for opportunities to cover ICT, Mathematics and English Functional Skills.

Personal, learning and thinking skills

Opportunities are available to develop personal, learning and thinking skills (PLTS) within a sector-related context. PLTS are identified in brackets after the unit pass criteria to which they are associated and they are also mapped in *Annexe C*. Further opportunities for learners to demonstrate these skills may also be apparent as learners progress throughout their learning.

Access and recruitment

Pearson's policy regarding access to its qualifications is that:

- they should be available to everyone who is capable of reaching the required standards
- they should be free from any barriers that restrict access and progression
- there should be equal opportunities for all wishing to access the qualifications.

Centres are required to recruit learners to BTEC qualifications with integrity. This will include ensuring that applicants have appropriate information and advice about the qualifications and that the qualification will meet their needs. Centres should take appropriate steps to assess each applicant's potential and make a professional judgement about their ability to successfully complete the programme of study and achieve the qualification. This assessment will need to take account of the support available to the learner within the centre during their programme of study and any specific support that might be necessary to allow the learner to access the assessment for the qualification. Centres should consult Pearson's policy on learners with particular requirements.

Centres will need to review the entry profile of qualifications and/or experience held by applicants, considering whether this profile shows an ability to progress to a Level 2 qualification. For learners who have recently been in education, the profile is likely to include one of the following:

- a BTEC Level 1 qualification in an environmental and land-based subject or related vocational area
- a standard of literacy and numeracy supported by a general education equivalent to four GCSEs at grade D-G
- other related Level 1 qualifications
- related work experience.

More mature learners may present a more varied profile of achievement that is likely to include experience of paid and/or unpaid employment.

Restrictions on learner entry

Most BTEC First qualifications are for learners aged 14 years and over.

In particular sectors the restrictions on learner entry might also relate to any physical or legal barriers, for example people working in health, care or education are likely to be subject to police checks.

Pearson BTEC Level 2 Firsts are listed on the DfE funding lists Section 96 and Section 97.

Access arrangements and special considerations

Pearson's policy on access arrangements and special considerations for BTEC and Pearson NVQ qualifications aims to enhance access to the qualifications for learners with disabilities and other difficulties (as defined by the 1995 Disability Discrimination Act and the amendments to the Act) without compromising the assessment of skills, knowledge, understanding or competence.

Further details are given in the policy document *Access Arrangements and Special Considerations for BTEC and Pearson NVQ Qualifications*, which can be found on the Pearson website (www.pearson.com). This policy replaces the previous Pearson policy (Assessment of Vocationally Related Qualification: Regulations and Guidance Relating to Learners with Special Requirements, 2002) concerning learners with particular requirements.

Recognition of Prior Learning

Recognition of Prior Learning (RPL) is a method of assessment (leading to the award of credit) that considers whether a learner can demonstrate that they can meet the assessment requirements for a unit through knowledge, understanding or skills they already possess and so do not need to develop through a course of learning.

Pearson encourages centres to recognise learners' previous achievements and experiences whether at work, home and at leisure, as well as in the classroom. RPL provides a route for the recognition of the achievements resulting from continuous learning.

RPL enables recognition of achievement from a range of activities using any valid Assessment methodology. Provided that the assessment requirements of a given unit or qualification have been met, the use of RPL is acceptable for accrediting a unit, units or a whole qualification. Evidence of learning must be sufficient, reliable and valid.

Unit format

All units in Pearson BTEC Level 2 First qualifications have a standard format. The unit format is designed to give guidance on the requirements of the qualification for learners, tutors, assessors and those responsible for monitoring national standards.

Each unit has the following sections.

Unit title

The unit title will appear on the learner's Notification of Performance (NOP).

Level

All units and qualifications will have a level assigned to them, which represents the level of achievement. There are nine levels of achievement, from Entry Level to Level 8. The level of the unit has been informed by the level descriptors and, where appropriate, the National Occupational Standards (NOS) and/or other sector/professional benchmarks.

Credit value

In BTEC First qualifications each unit consists of a credit value; learners will be awarded credits for the successful completion of whole units.

A credit value specifies the number of credits that will be awarded to a learner who has achieved all the learning outcomes of the unit.

Guided learning hours

Guided learning hours for the unit as defined in page 3.

Aim and purpose

The aim provides a clear summary of the purpose of the unit and is a succinct statement that summarises the learning outcomes of the unit.

Unit introduction

The unit introduction gives the reader an appreciation of the unit in the vocational setting of the qualification, as well as highlighting the focus of the unit. It gives the reader a snapshot of the unit and the key knowledge, skills and understanding gained while studying the unit. The unit introduction also highlights any links to the appropriate vocational sector by describing how the unit relates to that sector.

Learning outcomes

Learning outcomes state exactly what a learner should 'know, understand or be able to do' as a result of completing the unit.

Unit content

The unit content identifies the breadth of knowledge, skills and understanding needed to design and deliver a programme of learning to achieve each of the learning outcomes. This is informed by the underpinning knowledge and understanding requirements of the related NOS. The content provides the range of subject material for the programme of learning and specifies the skills, knowledge and understanding required for achievement of the pass, merit and distinction grading criteria.

Each learning outcome is stated in full and then the key phrases or concepts related to that learning outcome are listed in italics followed by the subsequent range of related topics.

Relationship between content and assessment criteria

Learners must have the opportunity within the delivery of the unit to cover all the unit content.

It is not a requirement of the unit specification that all the content is assessed. However, the indicative content will need to be covered in a programme of learning in order for learners to be able to meet the standard determined in the assessment and grading criteria. The merit and distinction grading criteria enable learners to achieve higher levels of performance in their acquisition of knowledge, understanding and skills.

Content structure and terminology

The information below shows how the unit content is structured and gives the terminology used to explain the different components within the content.

- Learning outcome: this is shown in bold at the beginning of each section of content.
- Italicised sub-heading: it contains a key phrase or concept. This is content which must be covered in the delivery of the unit. Colons mark the end of an italicised sub-heading.
- Elements of content: the elements are in plain text and amplify the sub-heading. The elements must be covered in the delivery of the unit. Semi-colons mark the end of an element.
- Brackets contain amplification of elements of content which must be covered in the delivery of the unit.
- 'eg' is a list of examples, used for indicative amplification of an element, (that is, the content specified in this amplification could be covered or could be replaced by other, similar material).

Assessment and grading grid

Each grading grid gives the assessment and grading criteria used to determine the evidence that each learner must produce in order to receive a pass, merit or distinction grade. It is important to note that the merit and distinction grading criteria require a qualitative improvement in a learner's evidence and not simply the production of more evidence at the same level.

Essential guidance for tutors

This section gives tutors additional guidance and amplification to aid understanding and a consistent level of delivery and assessment. It is divided into the following sections.

- *Delivery* – explains the content's relationship with the learning outcomes and offers guidance about possible approaches to delivery. This section is based on the more usual delivery modes but is not intended to rule out alternative approaches.
- *Outline learning plan* – the outline learning plan has been included in every unit as guidance and demonstrates one way in planning the delivery and assessment of a unit. The outline learning plan can be used in conjunction with the programme of suggested assignments.
- *Assessment* – gives amplification about the nature and type of evidence that learners need to produce in order to pass the unit or achieve the higher grades. This section should be read in conjunction with the grading criteria.
- *Suggested programme of assignments* – the table shows how the suggested assignments match and cover the assessment grading criteria.
- *Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications* – sets out links with other units within the qualification. These links can be used to ensure that learners make connections between units, resulting in a coherent programme of learning. The links show opportunities for integration of learning, delivery and assessment.
- *Essential resources* – identifies any specialist resources needed to allow learners to generate the evidence required for each unit. The centre will be asked to ensure that any requirements are in place when it seeks approval from Pearson to offer the qualification.
- *Employer engagement and vocational contexts* – gives a short list of agencies, networks and other useful contacts for employer engagement and for sources of vocational contexts.
- *Indicative reading for learners* – gives a list of learner resource material that benchmarks the level of study.

Units

Unit 1: Monitor and Maintain Health and Safety in a Land-based Engineering Work Area

Unit code: R/601/5311

Level 2: BTEC First

Credit value: 10

Guided learning hours: 60

Aim and purpose

The aim and purpose of this unit is to provide the learner with the knowledge and skills to monitor and maintain health and safety within a land-based engineering work environment.

Unit introduction

The health, safety and welfare of everyone, either working in or coming into contact with land-based engineering, is an essential requirement of the land-based engineering workshop and those employed in it.

In this unit learners will develop the knowledge and skills needed to apply health and safety in the land-based engineering workshop. The responsibilities of employees and employers to keep up-to-date with changes in relevant legislative requirements will be stressed throughout.

Learning outcomes

On completion of this unit a learner should:

1 Be able to monitor and maintain health and safety within a land-based engineering work area

2 Know how to monitor and maintain health and safety within the work area.

Unit content

1 Be able to monitor and maintain health and safety within a land-based engineering work area

Safe, clean and tidy working: selection and appropriate use, care and maintenance of personal protective equipment (PPE); safe manual and assisted movement of loads

Workplace responsibilities: key responsibilities and requirements of employees in relation to health and safely; reporting and recording of hazards in and around the workplace; following health and safety policies and procedures in and around the workplace

2 Know how to monitor and maintain health and safety within the work area

Definitions: health; safety; welfare; accident; injury; hazard; risk; incident

Responsibilities of employer and employee: current relevant legislation eg Health and Safety at Work Act 1974; requirements of legislation; communication, reporting and recording of health and safety matters; consequences of unsafe behaviour and practices in and around the workplace; health and safety precautions to be observed in the workplace to avoid risk to a third party

PPE: provision, selection, use and maintenance of appropriate PPE

Hazards and risks: procedures used to prevent and respond to risks and hazards in the workplace eg fire, explosion, dust and airborne particles, fumes and gasses, corrosives, solvents, irritants, electricity, stored energy; fire extinguishers (solid materials, flammable liquids, flammable gases, electrical); application of fire extinguishers

Procedures: workplace procedures in place to prevent and respond to risks and hazards; actions to be taken in the event of an emergency to minimise personal and third party injury risk (shutdown of electricity, presence of gas cylinders and/or equipment, evacuation procedures, the use of alarms, the use of barriers, the use of warning signs); first aid procedures on/off-site; health and safety recognised training and competencies (processes, products, activities, tools, equipment)

Precautions and actions: appropriate precautions and actions to be taken to prevent and/or avoid health and safety and environmental risks eg containment and removal of leaks and spillages, cleaning the work area, disposal of waste material, cleaning contaminated equipment, removing fumes, dust, hazardous gasses and vapours, working in elevated conditions, working in confined conditions, handling/storage of pressurised and/or bottled gases, releasing stored energy, secure objects in danger of falling, climatic conditions; safe manual and assisted movement of loads (lifting, jacking, supporting, securing)

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria					
To achieve a pass grade the evidence must show that the learner is able to:		**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**		**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**	
P1	work safely, cleanly and tidily at all times, complying with health and safety and other relevant regulations and guidelines [TW, EP, SM]	**M1**	describe safe, clean and tidy working in different land-based engineering applications	**D1**	explain the implementation of risk assessment and accident prevention in a given land-based engineering workplace.
P2	carry out main responsibilities of an employee in relation to health and safety in the workplace [TW, EP, SM]				
P3	follow procedures to both prevent and deal with hazards and risks in the workplace [TW, EP, SM]				
P4	outline the responsibilities of an employer and employee in relation to health and safety in the workplace [IE, CT, RL]	**M2**	explain health and safety monitoring and maintenance in a given land-based engineering workplace.		
P5	describe the procedures used to prevent and deal with risks and hazards in the workplace				
P6	describe processes, products, activities, tools and equipment that require recognised training and competence to prevent personal injury and harm to others				

Assessment and grading criteria			
To achieve a pass grade the evidence must show that the learner is able to:		**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P7	describe how to safely move, raise and support loads manually and with the aid of equipment		
P8	identify the different types of fire extinguishers found in the workplace and state their application.		

PLTS: This summary references where applicable, in the square brackets, the elements of the personal, learning and thinking skills applicable in the pass criteria. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

All centres must comply with the requirements of relevant, current legislation and associated codes of practice for example the *Prevention of Accidents to Children in Agriculture Regulations 1998*. Learners must be made aware of, and have access to, relevant health and safety legislation and know the importance of the use of risk assessments appropriate to each situation. Appropriate risk assessments must precede all practical machinery activities and learners must work in a safe manner at all times when using equipment or working with machinery. Learners must be supervised at all times and tutors must not ask learners to undertake tasks that are beyond their physical capabilities.

Delivery of this unit will involve practical and written assessments, visits to suitable collections and would link to work experience placements.

Tutors delivering this unit have opportunities to use as wide a range of techniques as possible. Lectures, discussions, seminar presentations, site visits, supervised health, safety and welfare practicals, research using the internet and/or library resources and the use of personal and/or industrial experience would all be relevant.

Work placements should be monitored regularly in order to ensure the quality of the learning experience. It would be beneficial if learners and supervisors were made aware of the requirements of this unit before any work-related activities so that naturally occurring evidence can be collected at the time. For example, learners may have the opportunity to carry out risk assessments and assessors should complete observation records and/or witness statements to confirm learner achievement. Guidance on the use of observation records and witness statements is provided on the Pearson website.

Whichever delivery methods are used, it is essential that tutors stress the impact of health, safety and welfare on employers and employees.

Tutors should consider integrating the delivery, private study and assessment for this unit with other relevant units and assessment instruments learners are taking as part of their programme of study.

The two learning outcomes are directly linked. These are likely to be delivered through formal lectures, discussion, site visits and independent learner investigation. Tutors could concentrate delivery around certain land-based technology businesses or facilities, for example a college's own engineering workshops. The HSE is an excellent source of case study materials and legislative information and this should be the primary source of information for the tutor. Visiting expert speakers could add to the relevance of the subject for learners. For example, health and safety advisers or workshop managers could talk about their work, the situations they face and the methods they use.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan gives **an indication of the volume of learning it would take the average learner** to achieve the learning outcomes. It is **indicative and is one way of achieving the credit value.**

Learning time should address all learning (including assessment) relevant to the learning outcomes, regardless of where, when and how the learning has taken place.

Topic and suggested assignments/activities and/assessment
Introduction and overview of the unit.
Assignment 1: Safe Working in the Workplace (P1, P2, P3, M1) Tutor introduces the assignment.
Clean, safe and tidy working, use of PPE.
Safe working practices and procedures.
Employee responsibilities and requirements in the workplace.
Assignment 2: Health and Safety Monitoring and Maintenance (P4, P5, P6, P7, P8, M2, D1) Tutor introduces the assignment.
Health and safety policies and practices.
Hazards and risks to health in a selected land-based engineering situation and operations.
Risk assessments and reporting procedures: introduce risk assessments Produce a risk assessment for a land-based engineering workshop activity.
PPE and safety equipment to be used in a workshop.
Monitoring and maintenance process.
Unit review.

Assessment

For P1, P2 and P3, learners must demonstrate safe working. Where possible, to ensure fairness of assessment, the size and complexity of the task should be the same for all learners. P1, P2 and P3 could be assessed by the tutor during practical sessions. If this format is used then suitable evidence from guided learning activities would be observation records completed by learners and tutor.

P4 requires learners to provide information on the key health and safety responsibilities of employee and employer within a selected land-based engineering business. Evidence could take the form of a pictorial presentation with notes (possibly using appropriate software), or a project.

For P5 and P7, learners are required to provide information on the hazard and risk procedures within a land-based engineering workshop. Learners could work in groups to produce a breakdown on the processes, which could be in the context of a given situation. Tutors should identify the situation and operation or agree it with learners. Where possible, to ensure fairness of assessment, the size and complexity of the tasks should be the same for all learners.

For P6, learners must describe recognised training and competence required in respect of processes, products, activities, tools and equipment. Evidence could link to that produced for P4.

P8 requires learners to identify and state the use of different types of fire extinguishers within the workplace. Evidence could link to that produced for P4.

For M1, learners must describe safe, clean and tidy working in different land-based engineering applications. This is likely to be assessed during practical activities and could be an extension of the observed evidence produced for P1, P2 and P3.

For M2, Learners must explain health and safety monitoring and maintenance in a given land-based engineering workplace. This is likely to be an extension of the information provided for P4, P5 and P7. Tutors should identify the workplace or agree this through discussions with learners. The workplace may be the same as that used for other grading criteria. Where possible, to ensure fairness of assessment the size and the complexity of the tasks should be the same for all learners. Evidence could link to that produced for P4.

For D1 learners must explain the implementation of risk assessment and accident prevention in a given land-based engineering workplace. To do this, learners must be able to consider risk assessments used in a given workplace and how useful they are in reducing accidents. Tutors should identify the workplace or agree it through discussion with learners. The workplace may be the same as that used to provide evidence for other grading criteria.

Programme of suggested assignments

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Pearson assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2, P3, M1	Safe Working in the Workplace	You have currently just started a new position as an engineering fitter in a land-based engineering organisation. You must demonstrate safe working.	Practical observation.
P4, P5, P6, P7, P8, M2, D1	Health and Safety Monitoring and Maintenance	One of your first tasks is to have monitor and maintain health and safety in the workplace. Your boss asks you to undertake an investigation covering the roles and responsibilities of employers and employees, current health and safety procedures employed, recognised training available and the correct movement of loads and use of fire extinguishers.	Report. Project.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC land-based sector suite. This unit links to all units contained within this specification and has particular links with:

Level 2	Level 3
LEO1 Recognise and reduce hazards in the land-based engineering work area	Understanding Health, Safety and Welfare in the Land-based Engineering Workplace

Employer engagement and vocational contexts

This unit focuses on the health and safety knowledge learners require when carrying out work in a workshop. It will also give learners knowledge of health and safety to undertake work experience placements. The unit will enable them to identify workplace risks and hazards, and their own legal obligations regarding health and safety in the workplace. Centres are encouraged to develop links with local Environmental Health Officers.

Indicative reading for learners

Textbooks

Health and Safety Executive – *An Introduction to Health and Safety* (HSE, 2003) ISBN 0717626857

Health and Safety Executive – *Essentials of Health and Safety at Work* (HSE, 2006) ISBN 0717661792

Health and Safety Executive – *Farmwise: Your Guide to Health and Safety* (HSE, 1995) ISBN 0717608395

Health and Safety Executive – *Managing Health and Safety: Five Steps to Success* (HSE, 2003) ISBN 0717621707

Hughes P and Ferrett E – *Introduction to Health and Safety at Work, 2nd Edition* (Butterworth-Heinemann, 2005) ISBN 0750666234

Websites

www.bagma.com	British Agricultural and Garden Machinery Association
www.businesslink.gov.uk	Business Link
www.defra.gov.uk	Department for Environment, Food and Rural Affairs
www.hse.gov.uk	Health and Safety Executive
www.iagre.org	Institution of Agricultural Engineers

Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit:

Skill	When learners are …
Independent enquirers	exploring the responsibilities of an employer and employee in relation to health and safety in the workplace
Creative thinkers	connecting own and other's ideas and experiences of preventative safety strategies
Team workers	working safely with others
Self-managers	carrying out the main employee responsibilities in relation to health and safety
Effective participators	discussing safety issues of concern.

Although PLTS opportunities are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are …
Reflective learners	assessing employer and employee responsibilities, identifying opportunities and achievements.

Unit 2: Land-based Engineering Operations – Applying Mechanical Principles

Unit code: L/600/3433

Level 2: BTEC First

Credit value: 5

Guided learning hours: 30

Aim and purpose

The aim of this unit is to provide the learner with the knowledge, and skills required to apply mechanical engineering principles within Land-based engineering operations.

Unit introduction

The majority of land-based businesses use some form of machinery and/or motor vehicles. These are often used in growing and production processes or in maintenance of an estate and/or facilities. They help businesses to be efficient in their growing and production processes, keeping costs within reason.

Many land-based businesses have limited access to immediate specialist help. As a result it is important that employees have a working knowledge of the operating principles of the machines they use.

This unit covers the application of mechanical principles to machines commonly found in land-based businesses, including tractors, rough terrain and utility vehicles, and other land-based mechanical equipment. These principles are commonly applied to transmissions, braking and suspension systems and rotational devices such as blades on mowing and harvesting equipment. Learners will develop the skills required to remove and refit components, along with the basic maintenance and inspection requirements that operators must complete before using such machines.

Health and safety is an integral topic and of paramount importance, not only while the learner or employee is working with machines, but also in any associated workshop facility or working environment. Learners will consider the safety of those working with or coming into contact with machinery.

Learning outcomes

On completion of this unit a learner should:

1 Be able to apply mechanical engineering principles

2 Know how to apply mechanical engineering principles.

Unit content

1 Be able to apply mechanical engineering principles

Removal and refit of components to suit application and manufacturers specification: power transmission components eg bearings, clutches and belts; component securing and locking devices eg hardware and chemical, interference fit

Remove and refit using recognised mechanical principles: leverage, pressure, impact, shock loading, expansion and contraction

Test and verification of power transmission and securing devices: torque setting; alignment; rolling resistance; slip; clearance fit; chemical bonding

Set linkages and selected components: to gain maximum mechanical advantage hydraulic and pneumatic ram sizes, lift linkages

Health and safety procedures: personal protective equipment (PPE); risk assessment; employee responsibilities; employer responsibilities; personnel cleaning requirements and facilities

Legislation: current relevant statutes and regulations eg Health and Safety at Work Act 1974 (HASAWA), Control of Substances Hazardous to Health 1989 (COSHH), Manual Handling Operations Regulations (1992), Provision and Use of Work Equipment Regulations 1998 (PUWER)

2 Know how to apply mechanical engineering principles

The application, installation and maintenance of bearings to include: needle, roller, taper roller, ball, floating, self-aligning, sealed, self-lubricating, thrust and shell bearings; plain bushes and washers

The use of specialist tools to install and maintain components: eg torque wrenches, feeler gauges

Checking clearances: rolling resistance, measurement; using lead wire, plastigauge, engineers blue

The principles of transmitting drive through a range of power transmission systems: shafts, belts, pulleys (fixed and variable), chains and sprockets, gears, universal and constant velocity joints, flexible drive, couplings

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 remove and refit components to suit application and manufacturers specification	**M1** explain how to maintain selected bearings and mechanical assemblies	**D1** identify common maintenance problems with bearings and mechanical assemblies.
P2 test and verify power transmission and securing devices [SM]		
P3 check components and machines for static and dynamic balance and stability		
P4 set linkages and select components to gain optimal mechanical advantage		
P5 describe the application, installation and maintenance of bearings	**M2** compare the maintenance requirements of selected bearings and mechanical assemblies.	
P6 describe the use of specialist tools to install and maintain components [IE, CT]		
P7 describe the construction, characteristics and fitting methods of seals		
P8 describe how directional rotation, reciprocating movement, timing and balance are achieved.		

PLTS: This summary references where applicable, in the square brackets, the elements of the personal, learning and thinking skills applicable in the pass criteria. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key			
	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

All centres must comply with the requirements of relevant, current legislation and codes of practice for example the Health and Safety Executives *Prevention of Accidents to Children in Agriculture Regulations 1998*. Learners must be made aware of, and have access to, relevant health and safety legislation and know the importance of the use of risk assessments appropriate to each situation. Appropriate risk assessments must precede all practical machinery activities and learners must work in a safe manner at all times when using equipment or working with machinery. Learners must be supervised at all times and tutors must not ask learners to undertake tasks that are beyond their physical capabilities.

Delivery of this unit will involve practical and written assessments, visits to suitable organisations and will link to work experience placements.

Tutors have the opportunity to use as wide a range of techniques as possible. Lectures, discussions, seminar presentations, site visits, supervised tractor and/or land-based machinery operation practicals, internet and library-based research and the use of personal and/or industrial experience would all be suitable.

Work placements should be monitored regularly in order to ensure the quality of the learning experience. It would be beneficial if learners and supervisors were made aware of the requirements of this unit before commencing any work-related activities, so that naturally occurring evidence can be collected at the time. For example, learners may have the opportunity to operate tractors or land-based machines. Assessors should complete observation records and/or witness statements to confirm assessment evidence and criteria achieved. Guidance on the use of observation records and witness statements is provided on the Pearson website.

Whichever delivery methods are used, it is essential that tutors stress the importance of health and safety, environmental issues and the need to manage the resource using legal methods.

Tutors should consider integrating the delivery, private study and assessment relating to this unit with other relevant units and assessment instruments learners may be taking as part of their programme of study.

Learners will need to know how to apply mechanical engineering principles. This will involve the disassembly and assembly of components and the safe use of relevant hand and power tools used in the maintenance and repair of land-based machinery. The unit is likely to be delivered using formal lecture, discussion, supervised land-based workshop practicals and independent learner research, with an emphasis on practical skills. Visiting speakers could add to the relevance of the subject for learners. For example, a mechanic working with land-based machinery could talk about their work and the tools they use to maintain and repair machinery.

Health and safety issues relating to workshop situations must be stressed and reinforced regularly, and risk assessments must be undertaken before practical activities. Adequate PPE must be provided and used following the production of suitable risk assessments.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan gives **an indication of the volume of learning it would take the average learner** to achieve the learning outcomes. It is **indicative and is one way of achieving the credit value.**

Learning time should address all learning (including assessment) relevant to the learning outcomes, regardless of where, when and how the learning has taken place.

Topic and suggested assignments/activities and/assessment
Introduction and overview of unit: discussion of prior knowledge.
Theory session: mechanical principles and their application in engineering.
Assignment 1: Practical Testing, Maintenance and Repair Tasks (P1, P2, P3, P4, M1) Tutor introduces the assignment.
Theory session: Applying mechanical principles to transmit power.
Assignment 2: Mechanical Assemblies Used in Power Transmission (P5, P6, P7, P8, M2, D1) Tutor introduces the assignment.
Demonstration and learner investigation: power transmission devices and securing devices.
Practical: power transmission assemblies – testing, maintenance and repair
Theory session and demonstration: bearings and seals.
Theory session and demonstration: rotation, timing and balance; reciprocal motion.
Practical session: Bearings; disassembly, maintenance and repair; re-assembly.
Assignment and self-study.
Unit review and evaluation.

Assessment

For P1, learners must remove and refit components to suit the given application and manufacturers' specification. Tutors should identify three different tasks and given objectives. Learners could be assessed directly by the tutor whilst undertaking practical activities. If this format is used suitable evidence from guided activities would be observation records completed by the tutor and accompanied by appropriate work logs or other relevant learner notes. If assessed during a placement, witness statements should be provided by a suitable representative and verified by the tutor.

For P2, learners must test and verify power transmission and securing devices. Tutors should identify the tasks and given objectives. Learners could be assessed directly by the tutor whilst undertaking practical activities, which could be integrated with activities for P1. Evidence may be in the same format as described for P1.

P3 requires learners to check components and machines for static and dynamic balance and stability. Tutors should identify the tasks and given objectives. Observation records to confirm the practical activities undertaken and learner achievement should be completed.

For P4, learners must set linkages and select components to gain mechanical advantage. This could be assessed directly by the tutor during practical activities. This could be assessed at the same time as P1 and evidence may be in the same format as for P1.

For P5, learners must describe the application, installation and maintenance of bearings. Evidence may be linked directly to tasks being undertaken for other criteria in this unit. It may be in the same format as for P1 or in a written format such as a pictorial presentation with notes (possibly using appropriate software or OHPs), an annotated poster or leaflet.

For P6, learners must describe the use of specialist tools to install and maintain components. Evidence may be linked directly to tasks being undertaken for other criteria in this unit. It may be in the same format as for P1 or in a written format such as a pictorial presentation with notes (possibly using appropriate software or OHPs), an annotated poster or leaflet.

For P7, learners must describe the construction, characteristics and fitting methods of seals. Evidence may be linked directly to tasks being undertaken for other criteria in this unit. It may be in the same format as for P1 or in a written format such as a pictorial presentation with notes (possibly using appropriate software or OHPs), an annotated poster or leaflet.

For P8, learners must describe how directional rotation, reciprocating movement, timing and balance are achieved. Evidence may be linked directly to tasks being undertaken for other criteria in this unit. It may be in the same format as for P1 or in a written format such as a pictorial presentation with notes (possibly using appropriate software or OHPs), an annotated poster or leaflet.

M1 requires learners to explain how to maintain selected bearings and mechanical assemblies. Evidence may be linked directly to tasks being undertaken for other criteria in this unit. It may be in the same format as for P1 or in a written format such as a pictorial presentation with notes (possibly using appropriate software or OHPs), an annotated poster or leaflet.

For M2, learners must compare the maintenance requirements of selected bearings and mechanical assemblies. Tutors should identify the selected bearing or agree it with learners. Evidence may be linked directly to tasks being undertaken for other criteria in this unit. It may be in the same format as for P1 or in a written format such as a pictorial presentation with notes (possibly using appropriate software or OHPs), an annotated poster or leaflet.

For D1, learners must identify common maintenance problems with bearings and mechanical assemblies. Evidence may be linked directly to tasks being undertaken for other criteria in this unit. It may be in the same format as for P1 or in a written format such as a pictorial presentation with notes (possibly using appropriate software or OHPs), an annotated poster or leaflet.

Programme of suggested assignments

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Pearson assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2, P3, P4, M1	Practical Testing, Maintenance and Repair Tasks	You are a fitter in an agricultural workshop and have been given three different tasks to inspect, maintain and repair power transmission assemblies. As part of your on job assessment, you need to explain their use and the work carried out.	Practical assessment. Observation records.
P5, P6, P7, P8, M2, D1	Mechanical Assemblies Used in Power Transmission	You are also asked to describe the assemblies and the tasks carried out, comparing them for ease of maintenance and identifying common problems.	Verbal questioning in the workplace and witness statement/or written assignment and/or presentation.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC land-based sector suite. This unit links to most units in this specification and has particular links with:

Level 2	Level 3
LEO4 Core land-based engineering principles – Mechanical principles	Understanding and Servicing Mechanical Power Transmission Systems

Essential resources

Learners need supervised access to workshop tools and land-based machinery such as tractors, tractor mounted powered and non-powered implements.

Sufficient equipment should be available so learners can experience a range of sizes and manufacturers' models.

Access to resources should be sufficient to allow learners to develop their practical ability and confidence.

Equipment consumables required include lubricants and replacement parts such as bearings, shells and drive belts.

Employer engagement and vocational contexts

It is essential that this unit is delivered in an applied and vocational context. Work-related experience will also be important. Centres are encouraged to develop links with local businesses, manufacturers and machinery dealers, who can support the breadth and application of this unit. Employers can provide real-work practical exercises and guest speakers and experts to support the learning experience.

Indicative reading for learners

Textbooks

Agate E – *Toolcare, A Maintenance and Workshop Manual* (British Trust for Conservation Volunteers, 2000) ISBN 0946752249

Bell B – *Farm Machinery* (Old Pond Publishing, 2005) ISBN 1903366682

Culpin C – *Farm Machinery, 12th Edition* (Blackwell Scientific, 1992) ISBN 063203159X

HSE – *Essentials of Health and Safety at Work* (HSE Books, 2006) ISBN 0717661792

Shippen J – *Basic Farm Machinery* (Butterworth-Heinemann, 1980) ISBN 0080249124

Journals

Farmers Weekly

Profi

Websites

www.hse.gov.uk	Health and Safety Executive
www.howstuffworks.com	HowStuffWorks

Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit:

Skill	When learners are …
Independent enquirers	testing and verifying power transmission and securing devices checking components and machines for static and dynamic balance and stability
Creative thinkers	setting linkages and selecting components to gain optimal mechanical advantage
Self-managers	removing and refitting components to suit application and manufacturers' specifications testing and verifying power transmission and securing devices checking components and machines for static and dynamic balance and stability setting linkages and select components to gain optimal mechanical advantage.

Although PLTS opportunities are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are …
Team workers	removing and refitting components to suit application and manufacturers' specifications checking components and machines for static and dynamic balance and stability setting linkages and select components to gain optimal mechanical advantage.

Functional Skills – Level 2

Skill	When learners are …
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	describing the application, installation and maintenance of bearings describing the use of specialist tools to install and maintain components describing the construction, characteristics and fitting methods of seals describing how directional rotation, reciprocating movement, timing and balance are achieved.

Unit 3: Land-based Engineering Operations – Understand How to Use, Service and Maintain Tools and Equipment

Unit code: R/600/3434

Level 2: BTEC First

Credit value: 5

Guided learning hours: 30

Aim and purpose

The aim of this unit is to provide the learner with the knowledge, understanding and skills required to select, use and maintain tools and equipment used within Land-based engineering operations.

Unit introduction

The majority of land-based businesses have some form of workshop associated with them. These facilities are generally used to maintain and repair land-based machinery and installations. They help businesses keep their equipment and installations available as needed, reducing down time and costs.

The size and complexity of the work carried out in these workshop facilities depends on the skill of the employees and the type of equipment and facilities available.

This unit covers the basic work requirements within land-based workshops. Learners will study how to use hand and power tools and equipment commonly found in a land-based setting safely. The associated skills will be integrated with the development and use of basic maintenance and repair techniques.

Health and safety is an integral topic and of paramount importance, not just while the learner or employee is working within the workshop. Learners will need to consider the safety of those working with, or coming into contact with, the equipment or installations being maintained and/or repaired.

Learning outcomes

On completion of this unit a learner should:

1 Be able to select, use, service and maintain tools and equipment safely

2 Know how to select, use and maintain tools and equipment appropriate to the task.

Unit content

1 Be able to select, use, service and maintain tools and equipment safely

Selection and safe use of: hand, air and electric power tools; fixed and portable equipment; taps and dies; reamers; drill bits; measuring and marking equipment; specialist and test equipment eg dismantling/reassembling, tools for fabrication, supporting, clamping, compressing, extracting, lifting and slinging equipment; correct use of each type of tool listed; safe methods of use; tool storage and maintenance; tool transportation; health and safety, personal protective equipment (PPE) eg footwear, personal clothing protection, barrier cream, gloves, eye protection, ear defenders, chemicals protection (apron)

Hand tools to include: spanners, socket sets, screwdrivers, Allan keys, pliers, hammers; hand tools for measuring, marking out and cutting eg rules, squares, centre punches, hacksaws

Power tools: for drilling, grinding, cutting; 110V and cordless tools

Units/sizes: metric and imperial

2 Know how to select, use and maintain tools and equipment appropriate to the task

Compare and contrast: hand tools; power tools; fixed and portable equipment; operational techniques and maintenance of tools eg hand tools, power tools, fixed and portable equipment, drill bits, chisel, reamers, measuring tools, engine testing, work securing devices; Portable Appliance Testing (PAT)

Health and safety procedures: PPE; risk assessment; employee responsibilities; employer responsibilities; personnel cleaning requirements and facilities

Legislation: current relevant statutes and regulations eg Health and Safety at Work Act 1974 (HASAWA), Control of Substances Hazardous to Health 1989 (COSHH), Manual Handling Operations Regulations (1992), Provision and Use of Work Equipment Regulations 1998 (PUWER)

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria					
To achieve a pass grade the evidence must show that the learner is able to:		**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**		**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**	
P1	identify, select and safely use tools and equipment [IE, RL, SM]	**M1**	explain how to use tools and equipment safely for a given task	**D1**	justify the choice of appropriate hand or power tools and equipment for a given task.
P2	compare tools and equipment available to undertake relevant tasks [RL]	**M2**	compare the use, service and maintenance requirements of a range of tools and equipment		
P3	describe the operational techniques and maintenance of tools				
P4	describe the range of tools for thread identification and maintenance				
P5	identify the different power supply requirements for power tools [IE]	**M3**	explain the importance of the correct procedures when using and servicing power tools.		
P6	describe how to isolate mains electrical equipment and how to charge portable tool packs.				

PLTS: This summary references where applicable, in the square brackets, the elements of the personal, learning and thinking skills applicable in the pass criteria. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

All centres must comply with the requirements of relevant, current legislation and associated codes of practice for example the *Prevention of Accidents to Children in Agriculture Regulations 1998*. Learners must be made aware of, and have access to, relevant health and safety legislation and know the importance of the use of risk assessments appropriate to each situation. Appropriate risk assessments must precede all practical machinery activities and learners must work in a safe manner at all times when using equipment or working with machinery. Learners must be supervised at all times and tutors must not ask learners undertake tasks that are beyond their physical capabilities.

Delivery of this unit will involve practical sessions, classroom-based sessions, visits to suitable workshops and will link to work experience placements.

Tutors have the opportunity to use as wide a range of techniques as possible. Lectures, discussions, seminar presentations, site visits, supervised practicals, internet and library-based research and the use of personal and/or industrial experience would all be suitable.

Where used to support delivery of this unit, work placements should be monitored regularly in order to ensure the quality of the learning experience. It would be beneficial if learners and supervisors were made aware of the requirements of this unit before any work-related activities, so that naturally occurring evidence can be collected at the time. For example, learners may have the opportunity to service of tractors or land-based machines and they should be encouraged to ask for observation records and/or witness statements to be provided as evidence. Guidance on the use of observation records and witness statements is provided on the Pearson website.

Learners will be required to identify, select, and use commonly found hand and power tools used in the maintenance and repair of land-based machinery and installations safely. Visiting expert speakers could add to the relevance of the subject for learners. For example, a mechanic working with land-based machinery could talk about their work and the tools they use to maintain and repair appropriate machinery.

Whichever delivery methods are used, it is essential that tutors stress the importance of health and safety, environmental issues and the need to comply with current legislation. Adequate PPE must be provided and used following the production of suitable risk assessments. Tutors should not ask learners to undertake tasks that are beyond their physical capabilities.

Tutors should consider integrating the delivery, private study and assessment relating to this unit with any other relevant units and assessment instruments learners may also be taking as part of their programme of study. When identifying suitable tasks for learners to undertake, tutors must remember that this is a level 2 unit and are referred to the relevant Level 2 National Occupational Standards in the land-based industries for guidance.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan gives **an indication of the volume of learning it would take the average learner** to achieve the learning outcomes. It is **indicative and is one way of achieving the credit value.**

Learning time should address all learning (including assessment) relevant to the learning outcomes, regardless of where, when and how the learning has taken place.

Topic and suggested assignments/activities and/assessment
Introduction and review of unit: testing of previous knowledge.
Theory session: health and safety in the workshop, legislation.
Group activity: workshop, tools and equipment familiarization.
Assignment 1: Workshop Tools and Equipment (P1, P2, P3, P4, M1, M2, D1) Tutor introduces the assignment.
Theory session: hand tools for measuring, marking out, cutting and filing.
Workshop practical: marking out, cutting and filing.
Theory session: safe lifting and use of slings.
Practical session: safe lifting, use of slings, supports and clamping.
Theory session: nuts, bolts and locking devices.
Workshop practical: nuts, bolts and locking devices.
Theory session and demonstration: power tools- cutting, grinding and drilling.
Workshop practical: power tools- cutting, grinding and drilling.
Theory session and demonstration: waste product disposal.
Theory session: test equipment.
Practical session: test equipment.
Theory session and demonstration: threads and thread cutting and maintenance.
Practical session: thread and thread cutting and maintenance.
Theory session: tool and equipment storage; stores.
Group activity: investigate a workshop.
Theory session and demonstration: equipment for the workshop.
Theory session and demonstration: miscellaneous tools and equipment.
Assessment/observations: workshop practical exercises.
Assignment and self-study.
Assignment 2: Power Tool Safety (P5, P6, M3) Tutor introduces the assignment.
Theory session: electrical safety, power supply requirements for different power tools.
Theory session: isolating mains electrical equipment and charging portable tool packs.
Practical/demonstrations: charging portable tool packs.
Assessment completion.
Unit review.

Assessment

For P1, learners must identify, select and use tools and equipment safely. Learners should undertake four tasks providing experience of a range of tools, equipment and techniques. Safe working methods and the use of personal protective equipment (PPE) are essential parts of the assessment. P1 could be assessed directly by the tutor during practical activities. If this format is used then suitable evidence from guided activities would be observation records completed by learners and the tutor, and accompanied by appropriate worklogs or other relevant learner notes. If assessed during a placement, witness statements should be provided by a suitable representative and verified by the tutor.

For P2, learners must compare tools and equipment available to undertake relevant tasks. These could be the same tools and equipment as used in P1, and learners should compare at least four. Comparisons may be based on power, precision, level of operator skill required, maintenance requirements, cost, and other relevant factors, agreed before the starting the task. This could be assessed at the same time as P1 and evidence could be in the same format, or using a written report, table or oral presentation.

For P3, learners must describe the operational techniques and maintenance of at least four different tools. Again, these could be the same tools and equipment as used in P1 and P2. This could be assessed at the same time as P2 and evidence could be in the same format.

For P4, learners must describe the range of tools for thread identification and maintenance. P4 could be assessed directly by the tutor during practical activities. If this format is used then suitable evidence from guided activities would be observation records completed by learners and the tutor, and accompanied by appropriate worklogs or other relevant learner notes. If assessed during a placement, witness statements should be provided by a suitable representative and verified by the tutor. Alternatively, evidence could take the form of a pictorial presentation with notes (possibly using appropriate software or an overhead projector), an annotated poster or a written assignment.

P5 requires learners to identify the different power supply requirements for power tools. P5 could be assessed directly by the tutor during practical activities. If this format is used then suitable evidence from guided activities would be observation records completed by learners and the tutor, and accompanied by appropriate worklogs or other relevant learner notes. This could also be assessed using a verbal or written report, poster or leaflet.

P6 requires learners to describe how to isolate mains electrical equipment and how to charge portable tool packs. This could be assessed directly by the tutor during practical activities and be the same equipment as used in P1. Evidence could be in the same format as for P4.

For M1, learners are required to explain how to use hand and/or power tools to maintain or repair land-based machinery or installations safely to meet given objectives. Evidence may be linked directly to tasks being undertaken for other criteria in this unit. It may be in the same format as for P1 or in a written format such as a pictorial presentation with notes (possibly using appropriate software or OHPs), an annotated poster or leaflet.

For M2, learners are required to compare the use, service and maintenance requirements of a range of tools and equipment. This should include at least four tools/items of equipment. Evidence may be linked directly to tasks being undertaken for other criteria in this unit. It may be in the same format as for P1 or in a written format such as a pictorial presentation with notes (possibly using appropriate software or OHPs), an annotated poster or leaflet.

For M3, learners are required to explain the importance of following the correct procedures when using and servicing a selected power tool. This may be linked to P5 and P6 and presented in the same format.

For D1, learners are required to justify their choice of appropriate hand or power tools and equipment for a given task. Tutors should identify the tasks and given objectives before learners start the task. Evidence may be linked directly to tasks being undertaken for other criteria in this unit. This could be assessed by a written or verbal report or presentation.

Programme of suggested assignments

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Pearson assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2, P3, P4, M1, M2, D1	Workshop tools and Equipment	You are an experienced fitter in an agricultural workshop and have been asked to help a new member of staff. You need to carry out four tasks to demonstrate how to select and use workshop tools and equipment safely. For one given task, select a tool and justify your choice. You have also been asked to write a guidance booklet for the new staff member, which explains how to use tools and equipment safely, describes their maintenance, and compares the use, service and maintenance of tools and equipment available for particular tasks. You should include a description of tools for thread identification and maintenance.	Practical assessment. Guidance booklet.
P5, P6, M3	Power Tool Safety	Create a poster for display in the workshop, which reminds staff of the different power supply requirements of power tools, how to isolate mains electrical equipment and charge portable tool packs, and the importance of correct procedures when using and servicing power tools.	Annotated poster.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC land-based sector suite. This unit links to most units contained within this specification and has particular links with:

Level 2	Level 3
LEO5 Core land-based engineering principles – tools and equipment	Land-based Engineering Operations – Service and Repair Engines and Components

Essential resources

Learners will need regular and routine supervised access to land-based engineering workshops and work areas. Workshops need to be well resourced with tools, both hand and powered, and equipment. Access to resources should be sufficient to enable all learners to have adequate opportunity to develop their practical ability and confidence over a period of time. Learners need access to a range of equipment to repair as well as the consumable items needed for fitting and maintenance projects. It is vital that there is adequate PPE as well as first aid facilities. Workshop facilities should have the appropriate procedures for storing and disposing of chemicals, paints and waste products in line with legislation.

Tutors delivering this unit should be competent and experienced in the use of workshop tools and in machinery maintenance/repair. Ideally, they should have recent industrial experience or show evidence of regular contact with the industry and/or technical updating.

Employer engagement and vocational contexts

Centres are encouraged to supply the range of equipment required for this unit, and local industry, contractors or the centre's estate department may be able to supply up-to-date equipment requiring maintenance. This will put an emphasis on using 'live' equipment rather than working through simulated scenarios. Visits to commercial workshops may enhance learner understanding of safe working practices, teamwork and workshop organisation. Work experience opportunities may help learners' to develop their skills being assessed for this unit.

Indicative reading for learners

Textbooks

Bell B – *Farm Machinery* (Old Pond Publishing, 2005) ISBN 1903366682

Bell B— Farm Workshop (Farming Press, 1992) ISBN 0852362374

Culpin C – *Farm Machinery* (Blackwell Science, 1992) ISBN 063203159X

HSE— Essentials of Health and Safety at Work (HSE Books, 2006) ISBN 0717661792

Kiubick R – *How to Set Up Your Farm Workshop* (Motorbooks International, 2007) ISBN 0760325490

Moore V – *Farm Workshop and Maintenance* (Oxford, Blackwell Scientific, 1992) ISBN 0632025387

Journals

Farmers Weekly

Profi

Websites

www.fwi.co.uk/machinery	Farmers Weekly Interactive
www.hse.gov.uk	Health and Safety Executive

Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit:

Skill	When learners are …
Independent enquirers	identifying, selecting and using tools and equipment safely identifying the different power supply requirements for power tools
Reflective learners	identifying, selecting and using tools and equipment safely comparing the tools and equipment available to undertake relevant tasks
Self-managers	identifying, selecting and using tools and equipment safely.

Although PLTS opportunities are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are …
Reflective learners	describing the operational techniques and maintenance of tools describing the range of tools for thread identification and maintenance
Team workers	identifying, selecting and safely using tools and equipment.

Functional Skills – Level 2

Skill	When learners are …
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	Describing the tools and equipment available to undertake relevant tasks describing the operational techniques and maintenance of tools
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	using manufacturers' handbooks
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	producing a report comparing tools and equipment

Unit 4: Land-based Engineering Operations – Material Preparation, Shaping and Assembling

Unit code: F/600/3431

Level 2: BTEC First

Credit value: 10

Guided learning hours: 60

Aim and purpose

The aim of this unit is to provide the learner with the knowledge and skills required to perform materials preparation, shaping and fixing.

Unit introduction

Engineering materials are used in land-based engineering operations in repair and maintenance activities so that machinery and equipment keep working effectively. Land-based engineers need to identify materials that are both compatible for the activity and suitable for the continuing success of repairs and modifications. Often materials are specified on engineering drawings, in maintenance schedules and repair processes by manufacturers and machinery dealers. Engineering technicians are expected to interpret such information and identify standards and abbreviations to select appropriate items which are fit for purpose.

Learners will prepare materials for use and carry out shaping and forming activities before assembly using a range of fixing and sealing devices. Learners will understand the properties and characteristics of materials to enable the application of heat treatment to alter material properties and prevent corrosion and contamination. Non-thermal joining and surface protection also play a part in assembly operations and learners will work confidently and apply good and safe working procedures to routine and non-routine tasks.

Learners will develop techniques for the dismantling and assembly of land-based machinery to gain access to components and sub-assemblies requiring repair or reworking. Reference to engineering drawings and exploded assembly drawings will help learners to carry out effective repairs on what can be very expensive equipment.

Learning outcomes

On completion of this unit a learner should:

1 Be able to perform material preparation, shaping and assembly operations

2 Know how to carry out material preparation, shaping and assembly operations.

Unit content

1 Be able to perform material preparation, shaping and assembly operations

Common materials: ferrous eg cast iron, low medium and high carbon steel, stainless steel; non-ferrous eg aluminium, brass, bronze, copper, lead; organic materials eg hard and softwoods, wood composites; thermo-plastic eg nylon, polytetrafluoroethylene, polythene, Perspex; thermo-setting eg Bakelite, Formica, melamine, epoxy resin, polyester resin

Material preparation and finishing: cleaning; de-greasing; de-scaling; hardening; tempering; annealing; polishing; corrosion proofing

Materials properties: tensile strength; hardness; toughness/brittleness; ductility/malleability

Profile materials: profile and process materials to given specifications and tolerances; to pattern; marking out; filing; thermal and non-thermal cutting; grinding; hot and cold bending; surface protection

Assembly and verification of components and sub-assemblies to given specifications: fastener types; hardware and chemical fixings; sealing components; orientation of components; pipe routing; pipe and cable fixing; component marking; alignment; timing; balancing; corrosion proofing; painting

2 Know how to carry out material preparation, shaping and assembly operations

Interpret engineering drawings: orthographic projection eg first angle, third angle; pictorial projection eg isometric, oblique, exploded view; standard symbols and abbreviations; scales; datum points; line types and representation; measurement eg linear, angular

Marking out: datum points; engineers blue; surface plates; templates; jigs; scribes; centre punches; squares; rules; callipers; error reduction techniques; patterns; waste reduction techniques; bend allowances

Fixing and sealing: mechanical fasteners eg nuts, bolts, screws, rivets, pins, circlips, snap rings; non mechanical fasteners eg chemical, adhesives (permanent, semi permanent); belt links; chain links; gaskets; O rings; lip seals; face-to-face seals; dynamic seals; thread tape (PTFE); jointing compound

Component dismantling and assembly techniques: cleanliness; mating surfaces; marking techniques; alignment; component protection (surface finish); limits fits and tolerances; pipe and hose routing; electrical cable and harness routing; securing (pipes, hoses, cables, harnesses); timing; balancing dynamic components and assemblies; bearing pre-load and end float; gear backlash; alignment aids eg splines, dowels, pins, mandrels, shimming; checking and adjusting alignment and run out; special tooling eg torque wrench, dial test indicator, spring balance

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria					
To achieve a pass grade the evidence must show that the learner is able to:		**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**		**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**	
P1	interpret information in relation to engineering tasks from engineering drawings, sketches and instructions [IE, RL]	**M1**	carry out checks to ensure marked out components meet the requirements of the drawing or pattern	**D1**	justify the work procedures, materials and processes used in the repair of land-based machine sub-assemblies.
P2	mark out profiles to given specifications [CT, TW, EP]				
P3	produce profiles and process materials to given specifications and tolerances [SM, TW, SM, EP]				
P4	assemble and verify components and sub-assemblies [RL, TW, SM, EP]				
P5	describe how to interpret an engineering drawing [RL]	**M2**	explain the importance of accuracy in preparation, shaping and assembly		
P6	describe the preparation techniques and tools used for marking out, cutting, shaping and finishing [RL]				
P7	describe hardware fastener types, their characteristics and applications [RL]	**M3**	recommend materials and methods for a given assembly situation.		
P8	identify the different materials and methods used to seal components and assemblies [IE, CT]				
P9	outline methods and techniques used to assemble components. [CT, RL, SM]				

PLTS: This summary references where applicable, in the square brackets, the elements of the personal, learning and thinking skills applicable in the pass criteria. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

All centres must comply with the requirements of relevant, current legislation and codes of practice for example the *Prevention of Accidents to Children in Agriculture Regulations 1998*. Learners must be made aware of, and have access to, relevant health and safety legislation and know the importance of the use of risk assessments appropriate to each situation. Appropriate risk assessments must precede all practical machinery activities and learners must work in a safe manner at all times when using equipment or working with machinery. Learners must be supervised at all times and tutors must not ask learners to undertake tasks that are beyond their physical capabilities.

Delivery is likely to be a mixture of classroom learning and supervised practical sessions in a workshop, visits to suitable engineering materials merchants and will link to work experience placements. Assessment is likely to be in the form of a portfolio of relevant documents bringing together recorded and authenticated evidence.

Where used to support delivery of this unit, work placements should be monitored regularly in order to ensure the quality of the learning experience. It would be beneficial if learners and supervisors were made aware of the requirements of this unit before undertaking any work-related activities, so that naturally occurring evidence could be collected at the time. For example, learners may have the opportunity to contribute to the preparation and profiling of materials for the repair of land-based machinery and assessors should complete observation records and/or witness statements to confirm learners achievement. Guidance on the use of observation records and witness statements is provided on the Pearson website.

Whichever delivery methods are used, it is essential that tutors stress the importance of the principles and application of health and safety guidance, good working practices, environmental issues and the need to comply with current legislation.

Tutors should consider integrating the delivery, private study and assessment relating to this unit with any other relevant units the learner may also be taking as part of their programme of study.

Learning outcome 1 is likely to be delivered using supervised land-based workshop practicals together with classroom-based activities, discussion and independent learner research. Learners will be introduced to the wide range of materials commonly used in land-based engineering maintenance and repair activities. They will be able to research the application of these materials on a range of machinery and equipment. Learners will need the opportunity to work with engineering materials, preparing raw material for use in particular situations that require shaping and assembly operations. Working to current engineering standards, components will be manufactured using hand fitting techniques involving marking out, cutting, bending and finishing.

Learning outcome 2 will support the practical activities of learning outcome 1, providing a sound theoretical base on which learners can form decisions about the processes needed in the preparation, shaping and assembly of land-based engineering materials. Current standards in engineering drawing will be studied so learners can read and understand the requirements for accuracy and compliance if repair activities are to be carried out effectively. Techniques for measuring and marking out will be detailed enabling learners to select appropriate procedures to shape and assemble components and sub-assemblies resulting in the production of the 'right part'. Learners will research the range of fixing, fastening and sealing devices now available to the modern engineer. The development of good working practices in dismantling and reassembling components will be emphasised.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan gives **an indication of the volume of learning it would take the average learner** to achieve the learning outcomes. It is **indicative and is one way of achieving the credit value.**

Learning time should address all learning (including assessment) relevant to the learning outcomes, regardless of where, when and how the learning has taken place.

Topic and suggested assignments/activities and/assessment
Unit introduction: tutor discusses unit content and assessment procedures.
Materials in common use: identify ferrous materials.
Learners research applications of ferrous materials in land-based machinery.
Materials in common use: identify non ferrous materials.
Learners research applications of non ferrous materials in land-based machinery.
Practical activity: skill development in materials preparation.
Discuss material properties for land-based machinery applications – ferrous and non-ferrous.
Practical activity: workshop tests to establish material properties.
Assignment 1: Workshop Processes (P5, P6, M2) Tutor to introduce brief.
Classroom session: preparation techniques and tools.
Classroom session: discussion of engineering drawing standards.
Practical: sketch simple components to scale.
Practical: convert sketches to orthographic and pictorial projections.
Assignment completion.
Assignment 2: Methods and Techniques (P7, P8, P9, M3, D1) Tutor to introduce brief.
Review and research fixing devices.
Review and research sealing devices.
Classroom session and demonstration: methods and techniques in assemblies.
Classroom activities: choosing methods and materials for different situations.
Assignment completion.
Assignment 3: Material Preparation, Shaping and Assembly (P1, P2, P3, P4, M1) Tutor to introduce brief.
Recap methods and procedures.
Practical activity: fabricate a range of components to given specifications and patterns by marking out, filing, thermal and non-thermal cutting, grinding, hot and cold bending.
Practical assessment activity.
Unit review.

Assessment

Assessment of P1, P2, P3 and P4 is likely to be linked. Learners are required to interpret drawings, mark out profiles, produce profiles and process materials and assemble and verify components. Learners could work from a given set of engineering drawings to select, prepare and rework raw materials to produce a component of at least three different but interconnecting parts. This could be a small clamp, extraction tool or alignment device that requires them to interpret information, mark out and produce profiles to given tolerances before assembly and testing. Tutors should identify the given objectives and tolerances in discussion with learners. Assessment may be through observation records completed by the tutor, and accompanied by appropriate worklogs or other relevant learner notes. If assessed during a work placement, witness statements should be provided by a suitable representative and verified by the tutor.

For P5, learners are required to describe how to interpret an engineering drawing. Evidence may be linked to the practical activities for P1, and could be obtained by direct questioning/discussion, or as a leaflet, poster, written or verbal report.

For P6, learners need to describe the preparation techniques and tools used for marking out, cutting, shaping and finishing. Evidence may be in the same format as for P5, and may be linked to the practical activities completed for P2 and P3.

For P7, learners need to describe at least six hardware fastener types, including mechanical and non-mechanical fasteners, their characteristics and applications. For P8, learners need to identify at least three different materials and methods used to seal components and assemblies. Evidence may be in the same format as for P5.

For P9, learners need to outline the major methods and techniques used to assemble components. Evidence may be in the same format as for P5.

Evidence for M1 could be linked to P1-P4, as learners devise means of checking the marked out components for accuracy and correct tolerance before cutting, shaping and finishing.
For M2, learners are required to explain the importance of accuracy in preparation, shaping and assembly. Evidence could be linked to P5 and P6 and presented in the same format.

For M3, learners could extend the evidence presented for P7, P8 and P9 to recommend the materials and methods for a specific assembly situation. This assembly scenario should be provided by the tutor.

For D1, learners are required to justify the work procedures, materials and processes used in the repair of land-based machine sub-assemblies. Learners could produce an evaluative report reviewing the materials used in the fabrication of components for land-based machines or sub-assemblies, with reference to their particular properties and characteristics. Tool inventories and assembly processes could be attached to show where particular tool requirements were essential to preparation, shaping or finishing operations and for the timing, balancing and alignment of parts. Learners could comment on the effectiveness of their chosen strategies and illustrate alternative processes or procedures.

Programme of suggested assignments

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Pearson assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P5, P6, M2	Workshop Processes	Having successfully completed your induction, you have been asked to help a new trainee. Produce some guidance notes describing how to interpret engineering drawings, the preparation tools and techniques used, and the importance of accuracy.	Guidance notes.
P7, P8, P9, M3, D1	Methods and Techniques	Your supervisor is pleased with your work, and has asked you to apply for a promotion. To support your application you have been asked to produce a report to cover types of fastener, materials and methods used to seal components, and methods and techniques used for assembly. For a given scenario, recommend and justify materials, methods and processes.	Report.
P1, P2, P3, P4, M1	Material Preparation, Shaping and Assembly	You have just been appointed to a position in a specialist engineering workshop. As part of your induction period you have been asked to select and prepare materials and marking out equipment and methods to produce three interconnected components of a sub-assembly from engineering drawings. You will need to carry out checks to ensure the marked out components meet the requirements of the drawings.	Practical assessment.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC land-based sector suite. This unit links with most units in this specification and has particular links with:

Level 2	Level 3
LEO6 Core land-based engineering principles – material preparation, shaping and assembling	Understand and Work with Land-based Repair Processes and Materials Technology

Essential resources

It is essential that learners have access to a range of engineering materials in a well equipped workshop situation that includes sufficient tooling and work areas.

A variety of finished components and sub-assemblies from land-based applications will provide relevance to this unit. There must be sufficient resources to learners to have the opportunity to develop practical skills over a period of time. It is vital that there is adequate PPE as well as first aid facilities.

Workshop facilities should have the appropriate procedures for storing and disposing of chemicals, paints and waste products in line with legislation.

Tutors delivering this unit should be competent and experienced in the use of workshop tools and machinery in maintenance/repair. Ideally, they should have recent industrial experience or show evidence of regular contact with the industry and/or technical updating.

Employer engagement and vocational contexts

This unit has a very practical focus and in this respect employer engagement place workshop skills and employers and manufacturers' requirements in context.

Work placement opportunities should be actively sought alongside visits by experienced practitioners to illustrate current uses of materials and processes. Learners could be encouraged to develop links with employers and arrange visits and demonstrations.

Indicative reading for learners

Textbooks

Bell B – *Farm Workshop, 2nd Edition* (Farming Press, 1992) ISBN 0852362374

Askerland D – *Science and Engineering of Materials* (Cengage Publishing, 2006) ISBN 0495244422

Sullivan M and Shackleford J – *Introduction to Materials Science for Engineers* (Prentice Hall, 2004) ISBN 0131276190

Tooley M – *BTEC First Engineering* (Newnes, 2006) ISBN 0750680601

Journals

Farm ideas

PROFI

Websites

www.hse.gov.uk	Health and Safety Executive

Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit:

Skill	When learners are …
Independent enquirers	researching material properties researching fasteners and sealing devices
Creative thinkers	marking out profiles identifying suitable materials outlining assembly techniques
Reflective learners	interpreting drawing information verifying component assembly describing techniques and processes
Team workers	producing profiles dismantling and assembling components
Self-managers	managing assessment workloads managing practical portfolios
Effective participators	producing components and sub-assemblies verifying components assembly.

Functional Skills – Level 2

Skill	When learners are …
ICT – Use ICT systems	
Select, interact with and use ICT systems independently for a complex task to meet a variety of needs	researching material properties and characteristics on the internet reviewing BS drawing symbols and abbreviations
Manage information storage to enable efficient retrieval	constructing and maintaining unit records and assessment planning submitting assessments
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	using websites such as those of the Health and Safety Executive and British Standards
ICT – Develop, present and communicate information	
Enter, develop and format information independently to suit its meaning and purpose including: • text and tables • images • numbers • records	recording practical work activities on worksheets or job cards using digital images to record activities
Bring together information to suit content and purpose	producing guidance notes for interpretation of engineering drawings
Present information in ways that are fit for purpose and audience	producing reports
Mathematics	
Understand routine and non-routine problems in a wide range of familiar and unfamiliar contexts and situations	measuring and marking out from datum points calculating material requirements applying error reduction techniques
Use appropriate checking procedures and evaluate their effectiveness at each stage	checking measurements and marking out prior to shaping and forming activities reviewing processes and procedures
Interpret and communicate solutions to practical problems in familiar and unfamiliar routine contexts and situations	working with engineering drawings and scales calculating and applying limits fits and tolerances
Draw conclusions and provide mathematical justifications	calculating and applying limits fits and tolerances justifying work processes and procedures managing waste material

Skill	When learners are …
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	participating in group discussion verbal assessment describing processes and procedures
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	using BS texts and abbreviations interpreting research information presented in a variety of formats justifying decisions taken during practical activities/assessments
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	producing reports presenting work sheets and job cards describing processes and procedures.

Unit 5: Land-based Engineering Operations – Carry out Servicing and Maintenance on Land-based Equipment

Unit code: F/600/3428

Level 2: BTEC First

Credit value: 10

Guided learning hours: 60

Aim and purpose

The aim of this unit is to provide the learner with the knowledge, understanding and skills required to carry out servicing and maintenance operations within Land-based engineering. This unit will introduce learners to the skills and knowledge in servicing and maintenance on land-based equipment and how these can be applied in practice. It is designed for learners in centre-based settings looking to progress into the sector or onto further/higher education.

Unit introduction

Mechanisation in the land-based sector enables the many and varied day-to-day operations to be carried out effectively and efficiently. However, the investment in machinery and equipment can, at the same time, be substantial. As with all investments, they need to be protected. This unit will enable learners to develop the skills need to service and maintain a range of land-based equipment.

There are many aspects to maintenance operations, including pre-delivery inspection, first services, interim services and major work, all of which are elated to the equipment's age and level of use. Many items need to be checked and replaced. This unit will help learners to understand maintenance and servicing procedures, access and use the range of information sources available effectively and select and use appropriate tools and equipment correctly. By learning the principles of service and maintenance operations learners will develop skills that can be applied to a wide range of vehicles and equipment, regardless of manufacturer or application.

At all times learners should be made aware of the need to work in a safe and efficient manner with due regard to current and relevant legislation,and to be aware of their actions in respect of themselves, customers and visitors to the organisations they work for.

Learning outcomes

On completion of this unit a learner should:

1 Be able to perform servicing and maintenance operations on land-based equipment

2 Know how to perform service and maintenance operations on land-based equipment.

Unit content

1 Be able to perform servicing and maintenance operations on Land-based equipment

Equipment assessment for maintenance: aural; visual; functional; measurements

Preparation for maintenance: work area definition; work area preparation; operational checks; cleanliness; damage protection; machine safety and security; waste disposal facilities; contamination prevention measures eg oil spills, disposal of consumables, disposal of contaminated parts

Inspection activity: manufacturers' specifications for service and maintenance eg logbooks, operator manuals, checklists, workshop manuals, service bulletins, specifications and volumes; machine history records; operational checks; unauthorised modification; leak detection; loose fitments; rubbing and chaffing; wear; fire hazards; guarding and interlocks

Service and maintenance activity and materials: filters eg air, fuel, oil, pollen; drive belts eg alternator, power steering, power take off, vee, poly-vee, toothed; spark plugs; injectors; lubricants and fluids eg engine oil, transmission oil, universal oil, automatic transmission fluid (ATF) brake fluid, anti-freeze; gaskets and seals; check, change and/or adjust oil and grease levels; check, change and/or adjust ignition components; check change and/or adjust wearing and consumable parts; belt and chain tension; running gaps and clearances; free play; cables and linkages

Adjustments: eg clearances, gaps, settings, alignment (lights, steering, bodywork, fittings), pressures, tension, speeds, levels, emissions, brakes, clutches, transmissions

Leak detection and elimination: fuel; air; oil; water; gasses; crop and product

Air evacuation: oil; fuel; heating; braking; hydraulic system; compliance and post-maintenance testing; acceleration/deceleration; power; pressure; flow; maximum speed; idle speed; engagement/disengagement; starting; leaks; cleanliness

Record and process information: eg job card, machine history record (fleet, company, customer), service records, report for customer

2 Know how to perform service and maintenance operations on land-based equipment

Reasons for service and maintenance: time elapsed, date elapsed, longevity, contamination; wear; legal conformity; residual value; breakdown

Types of maintenance: daily; weekly; monthly; annually; emergency; scheduled operating hours; pre-delivery; installation and commissioning; routine; non-routine

Service items construction and function: screens; suction filters; high pressure filters; centrifugal filters; oil bath filters; water traps; pre-cleaners; carbon filters; air filters; ventilation filters; assessment and preparation of machinery prior to service and maintenance; removal, dismantling, repair, reinstatement and adjustment of service items to manufacturers specifications: engine oil; fuel, transmission oils/fluids; brake fluid; coolants; high and low pressure filters; ventilation and breather filters, wet and dry air filters; check,change and/or adjust oil and grease levels; check, change and/or adjust ignition components; check, change and/or adjust wearing and consumable parts; belt and chain tension; running gaps and clearances; free play; cables and linkages

Compliance and post maintenance testing: acceleration/deceleration; power; pressure; flow; maximum speed; idle speed; engagement/disengagement; starting; leaks; cleanliness; job card; machine history record (fleet, company, customer)

Legislative compliance and unauthorised maintenance: Falling Object Protection (FOPS); Roll Over Protection (ROPS); emissions; noise; guarding; vibration

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria					
To achieve a pass grade the evidence must show that the learner is able to:		**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**		**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**	
P1	prepare equipment and the working area prior to service and maintenance operations [TW SM EP]	**M1**	report on service and maintenance findings	**D1**	propose and explain an ongoing maintenance plan for selected Land-based equipment.
P2	inspect equipment for conformity to manufacturer's specifications and take remedial actions [IE CT RL]				
P3	carry out service operations in line with manufacturer's schedules and standards [EP TW]				
P4	test, clean and reinstate the machine to operational condition [IE RL]				
P5	record and process information [SM]				
P6	outline reasons for service and maintenance operations [IE CT]	**M2**	explain the benefits of undertaking planned maintenance on land-based equipment		
P7	describe routine service and scheduled maintenance actions to be taken [CT RL]				
P8	describe and differentiate between the different types of filter, their construction, function and service requirements [RL]	**M3**	compare the service requirements of given land-based equipment.		

Assessment and grading criteria			
To achieve a pass grade the evidence must show that the learner is able to:		**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P9	describe how to assess and prepare machinery prior to service and maintenance operations [SM]		
P10	describe how to remove, dismantle, repair, reinstate and adjust service items [TW EP]		
P11	describe the methods used to carry out compliance tests on machinery related to the service work that has been performed. [IE CT RL EP]		

PLTS: This summary references where applicable, in the square brackets, the elements of the personal, learning and thinking skills applicable in the pass criteria. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key			
	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

All centres must comply with the requirements of relevant, current legislation and codes of practice for example the *Prevention of Accidents to Children in Agriculture Regulations 1998*. Learners must be made aware of, and have access to, relevant health and safety legislation and know the importance of the use of risk assessments appropriate to each situation. Appropriate risk assessments must precede all practical machinery activities and learners must work in a safe manner at all times when using equipment or working with machinery. Learners must be supervised at all times and tutors must not ask learners undertake tasks that are beyond their physical capabilities.

Tutors have the opportunity to use as wide a range of techniques as possible in the delivery of this unit. It is likely that there will be a high level of practical content, including supervised land-based workshop practicals, supplemented by classroom-based activities, discussions, seminar presentations, site visits, internet and library-research and the use of personal and/or industrial experience.

Where used to support delivery of this unit, work placements should be monitored regularly in order to ensure the quality of the learning experience. It would be beneficial if learners and supervisors were made aware of the requirements of this unit before to any work-related activities, so that naturally occurring evidence can be collected at the time. For example, learners may have the opportunity to contribute to the servicing and maintenance of land-based machinery and installations and they should be encouraged to ask for observation records and/or witness statements to be provided as evidence. Guidance on the use of observation records and witness statements is provided on the Pearson website.

Tutors should consider integrating the delivery, private study and assessment relating to this unit with any other relevant units and assessment instruments learners may also be taking as part of their programme of study.

Learning outcome 1 is likely to be delivered primarily through supervised land-based workshop practicals. Learners will need to be aware of how to use basic service and maintenance tools and techniques on land-based equipment safely. In particular, learners must be made aware of manufacturers' service and maintenance schedules and have sufficient supervised practical opportunities to undertake basic tasks related to them.

The need to apply good working practices will be reinforced as learners look at typical exercises in machinery maintenance and use the various sources of information and standards commonly found in Land-based workshops. Visiting expert speakers could add to the relevance of the subject for learners. For example, a mechanic working with land-based machinery could talk about their work and the service and maintenance operations they undertake, illustrating common practice in an industrial setting.

Learning outcome 2 will support the practical activity in learning outcome 1 by looking at the rationale for maintenance and the techniques that can be applied. Delivery will enable learners to review the different reasons for maintenance and how it is applied to Land-based equipment, and to examine the component parts that make up good engineering practice. Delivery methods should include the individual activities involved in service and maintenance tasks and the parts and consumable items that require replacement and/or renewal, those that require inspection and/or checking and those that require adjustment or setting up. It should also include post-maintenance issues and the need to check work done for conformity.

Legislation related to service and maintenance activities will be covered, in particular where unauthorised maintenance may have been carried out and the effect that this can have on the owner or operator. Finally, the need to maintain maintenance records will be embedded to ensure economic life cycle costs and inform fleet replacement policy. Visiting speakers or visits to fleet operators could place the relevance of good service and maintenance strategies in an industry context. Fleet managers can talk of their experiences in running land-based machinery and the need to have skilled operatives for both the functional and maintenance sides of their operation.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan gives **an indication of the volume of learning it would take the average learner** to achieve the learning outcomes. It is **indicative and is one way of achieving the credit value.**

Learning time should address all learning (including assessment) relevant to the learning outcomes, regardless of where, when and how the learning has taken place.

Topic and suggested assignments/activities and/assessment
Unit introduction and assessment schedule.
Assignment 1: Benefits of Service and Maintenance (P6, P7, M2) Introduction to the assignment
Classroom activity: review reasons for maintenance.
Theory session: define types of maintenance.
Case study exercise: benefits of planned servicing and maintenance.
Assessment completion.
Assignment 2: Service Requirements (P8, P9, P10, P11, M3, D1) Introduction to the assignment.
Theory session: preparation for maintenance, discuss work area and resource requirements.
Theory session: preparation for maintenance, discuss skill and material/consumables requirements.
Case study exercise: environmental protection, waste disposal and contamination controls.
Theory and practical: health and safety implications, PPE and work area, risk assessment activity.
Practical activity: investigate construction and function of service items.
Theory and demonstration: carry out servicing and maintenance.
Theory and demonstration: post-maintenance checks and tests.
Classroom activity: discuss maintenance legislation.
Assessment completion.
Assignment 3: Service and Maintenance Practical (P1, P2, P3, P4, P5, M1) Introduction to the assignment.
Practical sessions: inspection activity – inspect a rage of land-based machines using a range of information sources and record findings.
Practical sessions: maintenance activity – locate service items and identify requirements.
Practical sessions: adjustments – develop skills in carrying out adjustments and setting up service items.
Practical sessions: leak detection techniques and bleeding.
Practical sessions: carry out service and maintenance operations on a range of Land-based machinery.
Classroom session: discuss maintenance recording and life cycle costs.
Practical assessment completion and observation.
Unit review.

Assessment

Assessment of P1, P2, P3, P4 and P5 may be linked through the completion of practical activities. For P1, learners will be expected to identify the equipment, needed to carry out basic maintenance and servicing tasks and prepare this equipment together with a suitable work area in which to complete a variety of tasks.

For P2, learners are required to inspection of land-based equipment against manufacturer specifications, and to take any necessary remedial actions. For P3, learners need to carry out service operations on a piece of land-based equipment in line with manufacturer's specifications. For P4, learners must check their work by initiating a testing regime to ensure machinery is returned to correct operating conditions and for P5, record and process the information either manually or electronically. These criteria could be assessed directly by observation by the tutor during practical activities when learners are undertaking identified tasks and recording their activities. If this format is used suitable evidence from guided activities would be observation records completed by the learner and tutor and accompanied by appropriate work logs or other relevant learner notes. If assessed during a work placement, witness statements should be provided by a suitable representative and verified by the tutor. Guidance on the use of observation records and witness statements is provided on the Pearson website.

Assessment of P6 and P7 may be linked. For P6, learners are required to outline the reasons for service and maintenance operations and, for P7, to describe routine service and scheduled maintenance action. Evidence may be a poster, leaflet, booklet, written or verbal report or presentation.

For P8, learners need to describe and differentiate between the different types of filter shown in the unit content, including their construction, function and service requirements. Evidence may be in the same format as for P7, or may be presented as a comparison table.

Assessment of P9, P10 and P11 may be linked, and undertaken as an activity linked to the practical assessment for P1, P2, P3, P4 and P5. Learners are required to describe how to assess and prepare machinery, how to remove, dismantle, repair, reinstate and adjust service items and the methods used for compliance testing. Evidence may be generated through verbal questions and answers, or in the same format as for P7.

For M1, learners are required to report on service and maintenance findings, using information from the maintenance and tests carried out in P2, P3 and P4. This report may be written or verbal, but should be presented in appropriate language so the customer can understand the findings.

For M2, learners need to explain clearly the benefits of undertaking planned maintenance on Land-based equipment. This may be linked to evidence for P6 and P7 and presented in the same format.

For M3, learners are to compare the service requirements of given a minimum of three types of equipment land-based equipment. Evidence may be presented as a comparison table, written or verbal report.

For D1, learners are required to research, propose and explain a maintenance schedule for a selected piece of equipment and to show evidence of planning its completion. The piece of equipment could be selected by the tutor, or by learners, but should be agreed before the start of the task. Evidence may be linked directly to tasks being undertaken P1 – P6 and could be in the form of a checklist of tools and equipment, work processes and timeframes with accompanying notes.

Programme of suggested assignments

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Pearson assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2, P3, P4, P5, M1	Service and Maintenance Practical	In your role as a land-based service engineer, you need to prepare a work area and equipment, and then carry out service and maintenance activities. You will need to test, clean and reinstate the equipment, and record the activities completed. You are also to report your findings to the customer.	Practical assessment.
P6, P7, M2	Benefits of Service and Maintenance	Create a leaflet for customers which describes the reasons for service and maintenance, the types and timings of routine servicing, and the benefits of planned maintenance.	Leaflet.
P8, P9, P10, P11, M3, D1	Service Requirements	You have been asked to help support a work-based apprentice with their training. Create a short booklet which describes servicing and maintenance, including filter types, preparing machinery, carrying out servicing and compliance testing. Include a comparison table for three items of equipment, and a maintenance plan for one item.	Booklet.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC land-based sector suite. This unit links to most units in this specification and has particular links with:

Level 2	Level 3
LEO8 Core land-based engineering principles – servicing and maintenance	Land-based Engineering Operations – Service and Repair Engines and Components

Essential resources

Learners will need access to an equipped workshop. A range of Land-based machinery and equipment to repair is necessary as well as the consumable items needed for servicing and maintenance projects. There must be sufficient resources to allow learners the opportunity to develop practical skills over a period of time. It is vital that there is an adequate supply of PPE as well as first aid facilities.

Workshop facilities should have the appropriate procedures for storing and disposing of oils, chemicals, paints and contaminated parts in line with current best practice and legislation.

Tutors delivering this unit should be competent and experienced in the use of workshop tools and machinery maintenance/repair. Ideally, they should have recent industrial experience or show evidence of regular contact with the industry and/or technical updating.

Employer engagement and vocational contexts

This unit has a very practical focus and in this respect employer engagement will place servicing and maintenance skills and employers and manufacturers requirements in context.

Centres are encouraged to develop links with employers and arrange visits and demonstrations. Work placement opportunities should be actively sought alongside visits by experienced practitioners to illustrate current equipment, trends and practice in maintenance and service operations.

Indicative reading for learners

Textbooks

Bell B – *Farm Workshop, 2nd Edition* (Farming Press, 1992) ISBN 0852362374

Shippen J – *Basic Farm Machinery* (Butterworth-Heinemann, 1980) ISBN 00802491 16

Agate E – *Tool Care – A Maintenance and Workshop Manual* (British Trust for Conservation Volunteers, 2000) ISBN 0946752249

Journals

Farm Ideas

Farmers Guardian

Farmers Weekly

Profi International

Websites

www.defra.gov.uk	Department of Environment, Food and Rural Affairs
www.environment-agency.gov.uk	Environment Agency
www.hse.gov.uk	Health and Safety Executive
www.lantra.org.uk	Lantra Sector Skills Council

Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit:

Skill	When learners are …
Independent enquirers	inspecting land-based equipment testing land-based machinery describing service and maintenance operations
Creative thinkers	reviewing manufacturers specifications providing rationale for servicing operations initiating testing procedures
Reflective learners	reinstating machinery to manufacturers specifications differentiating components construction and operation carrying out post maintenance testing
Team workers	preparing equipment and working areas working to standards and schedules removing and replacing components
Self-managers	preparing for service and maintenance operations recording servicing activities describing service and maintenance operations
Effective participators	carrying out servicing operations replacing and adjusting service items compliance testing land-based machinery.

Functional Skills – Level 2

Skill	When learners are …
ICT – Use ICT systems	
Select, interact with and use ICT systems independently for a complex task to meet a variety of needs	researching manufacturers' specifications reviewing websites
Manage information storage to enable efficient retrieval	maintaining portfolio of evidence
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	obtaining information on current codes of practice
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	justifying maintenance operations
ICT – Develop, present and communicate information	
Enter, develop and format information independently to suit its meaning and purpose including: • text and tables • images • numbers • records	compiling and populating machine history records compiling written work for assessment maintaining a portfolio of practical evidence completing work records
Bring together information to suit content and purpose	preparing assignment submissions completing job cards and worksheets
Present information in ways that are fit for purpose and audience	submitting work for assessment completing machine condition reports
Mathematics	
Understand routine and non-routine problems in a wide range of familiar and unfamiliar contexts and situations	calculating volumes and quantities for maintenance operations predicting service intervals
Use appropriate checking procedures and evaluate their effectiveness at each stage	preparing costing information for service and maintenance activity comparing test results to specifications
Draw conclusions and provide mathematical justifications	justifying service costs within machine life cycle costs reporting on test results

Skill	When learners are …
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	working in groups to agree practical activities researching component costs negotiating session/assessment objectives
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	reviewing manufacturers' technical information to carry out service tasks using specifications and volume/quantities charts
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	compiling machine history records submitting work for assessment.

Unit 6: Land-based Engineering Operations – Use Calculations

Unit code: A/600/3430

Level 2: BTEC First

Credit value: 5

Guided learning hours: 30

Aim and purpose

The aim of this unit is to provide the learner with the knowledge and skills required to use calculations to support land-based engineering principles. This unit aims to introduce learners to the use of calculations in land-based engineering and how these can be applied in practice. It is designed for learners in centre-based settings looking to progress into the sector or onto further/higher education.

Unit introduction

In this unit learners will gain a sound understanding of many of the calculations used in land-based engineering operations. The skills acquired in this unit will readily transfer to other level 2 units and will also be a solid foundation for level 3 mathematics based units. This unit will enable learners to carry out tests in the workshop environment and check the accuracy of those tests using calculation methods.

Learning outcomes

On completion of this unit a learner should:

1 Be able to use calculations to support engineering principles

2 Know how to use calculations to support engineering principles.

Unit content

1 Be able to use calculations to support engineering principles

Transmissions: calculations to include reduction ratios as found in final drives, starter motors etc, Simple and compound ratios eg gearboxes, gear trains; calculation of speed from ratios and input and output speed; torque capacity of clutches including spring force, torque capacity, friction

Engines: measurements to include power, noise, fuel consumption, oil consumption; calculations including torque, torque reserve, compression ratio with regard to Boyle's Law

Hydraulics: calculations eg flow, pressure, load, lifting force, etc

Pneumatic: calculations eg flow, pressure etc

Machine performance: calculations eg velocity, acceleration, deceleration based on Newton's laws of Motion, calibration calculations to include application rate

Electrical performance: calculations eg current draw, resistance and power with regard to Ohm's Law; battery measurements eg specific gravity, electrolyte density, volts eg open circuit voltage, voltage drop under load

2 Know how to use calculations to support engineering principles

Calculations: units of measurement; conversion tables; mathematical formulae; measurements; how to use conversion factors for calculations eg conversion of non-SI units into SI units; use of conversion tables eg power ratings (BHP or KW); what they represent including ECE, DIN, SAE

General formulas: area, volume and circular calculations; the relationship between speed and torque; how to carry out measurement operations for land-based engineering operations

Underpinning principles: where relevant (Ohm's Law, Newton's Law of Motion, Boyle's Law, Pascal's Law)

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 use ratios and units of measurement to express values	**M1** explain how the results of calculation and measurement tasks may be checked to ensure accuracy	**D1** discuss how given measurements and calculations are used in land-based engineering operations.
P2 use conversion factors to convert measurement values from one unit of measurement to another [IE, CT, RL]		
P3 calculate and measure: ◊ areas ◊ weights ◊ volumes ◊ angles ◊ flow rates and speeds ◊ scaling		
P4 use physical and theoretical methods to establish measurements where relevant		
P5 verify by calculation the calibration of machinery and equipment [TW, SM, EP]		
P6 identify units of measurement used to express values	**M2** explain why calculated data may differ from measured results.	
P7 state how to use conversion tables		
P8 define the mathematical formulas for: ◊ area ◊ volume ◊ circumference		

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P9 state the relationship between speed and torque		
P10 describe how to calculate power, torque, force, consumption and application rates		
P11 describe the methods and equipment required to carry out a measuring task and the factors that can distort measurements		
P12 describe how to measure: ◊ speed ◊ velocity ◊ acceleration ◊ deceleration ◊ coefficient of friction.		

PLTS: This summary references where applicable, in the square brackets, the elements of the personal, learning and thinking skills applicable in the pass criteria. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key			
	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

Delivery of this unit will involve practical assessments, written assessment, visits to suitable collections and will link to industrial experience placements.

This unit should be delivered in a practical environment where applicable. Each calculation should derive from a hands on approach. Each aspect should be physically measured/investigated and then calculated during the same session. Tutors should avoid situations where practical takes place but the corresponding calculation theory is delivered some time in the future, this can lead to a disjointed learning process.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan gives **an indication of the volume of learning it would take the average learner** to achieve the learning outcomes. It is **indicative and is one way of achieving the credit value.**

Learning time should address all learning (including assessment) relevant to the learning outcomes, regardless of where, when and how the learning has taken place.

Topic and suggested assignments/activities and/assessment
Introduction to the unit, with examples of how calculations and measurements are important in land-based engineering.
Assignment 1: Measurements and Calculations (P1, P2, P3, P4, P5, P6, M1) Tutor introduces assignment.
Units of measurements: SI units and non-SI units.
Units of measurement: conversion factors.
Practical mathematical exercises to practice using conversion factors and units of measurement.
Theory session with practice: measuring and calculating areas, weights, volumes, angles, flow rates and speeds, scaling.
Measurements and calculations: practical activities designed to integrate the calculation and measurement of areas, weights, volumes, angles, flow rates, velocity and scaling.
Calibration practical and calculations.
Assignment 2: Using Calculations in Land-based Engineering (P7, P8, P9, P10, P11, P12, M2, D1) Tutor introduces assignment.
Theory and practice: calculating power, torque, force, consumption, application rates.
Practicals designed to integrate formulae relating to engines, power/torque, machine performance.
Practical session: using equipment and methods for measuring tasks.
Classroom activities: differences between measurement and calculations in land-based engineering.
Theory and practice: how to measure velocity, acceleration, deceleration, coefficient of friction.
Assessment completion.
Unit review.

Assessment

For those assessment criteria requiring calculations and/or measurement (P1, P2, P3, P4, P5) evidence may be a completed workbook, series of completed exercises or an in-class test. Learners should demonstrate their understanding of the calculations by showing their workings as well as the final answer. It will be beneficial if exercises/tasks are linked to the land-based engineering sector so learners recognise the vocational relevance and significance of the mathematical tasks they are carrying out.

For P1, learners need to demonstrate that they can choose the correct unit of measurement for particular values. Learners need to be aware that all values will need a correct unit except in the case of ratios.

For P2, learners must convert values from one unit into another and back again. Learners and tutors should always strive to use the correct SI unit in calculations. However, it may be of benefit to convert from kilopascal (KPa) to a unit that learners are more familiar with (Bar, psi, atm) for reasons of clarification of explanation only for example 101.3529 Kpa = 14.7psi

For P3, learners must use calculations/measurement as listed in the assessment and grading criteria grid. This could be linked to a practical investigation, and it would be beneficial for the calculations to be set in a land-based engineering context.

For P4, learners need use measurement equipment to establish correct measurements. Again, this should be practically based and can link to other units as necessary. For example, measurement of engine bore and stroke to calculate displacement would be appropriate.

P5 requires learners to verify calibration of machinery and equipment by using calculations. Learners are not required to undertake the calibration, but to check a calibration that has already been completed.

P6 requires learners to know which units are associated with which values. This could be linked to assessment of P1 or P3. Evidence could be an in-class test/examination or completion of a written assignment.

P7 requires learners to state how to use conversion tables. Evidence may be linked to that presented for P2, and may be in the form of a written assignment, test, question and answer session, poster or leaflet.

P8 requires learners to define the mathematical formulae for area, volume and circumference. Learners should know which formulae to use to work out the area, volume and circumference of different basic shapes as found in land-based engineering. Evidence may be presented in the same format as for P7.

P9 requires learners to know the relationship between speed and torque, which should include presentation of the appropriate formula together with a description of how an increase or decrease in speed affects torque. Evidence may be in the same format as for P7.

P10 requires learners to describe the formulae for power, torque, force, consumption and application rates. Evidence may be in the same format as for P7.

For P11, learners must describe the methods and equipment required to carry out a measuring task and the factors that can distort measurements. The measuring task may be chosen by the tutor or learner, but should be agreed before the start of the task and relate to the land-based engineering sector. Evidence may be in the same format as P7.

P12 requires learners to describe how to measure velocity, acceleration, deceleration and coefficient of friction. This should be in a land-based engineering context and could be based on any practical investigations that learners have carried out. Evidence may be a written or verbal report, poster or leaflet.

For M1, learners are required to explain how the results of measurement and calculation tasks can be checked for accuracy. This explanation should include examples and specific detail about how these checks can be used. Evidence may be in the same format as for P12.

M2 requires learners to explain why calculated data may differ from measured results, and can be linked to P5 and P11. Learners should also suggest how the discrepancy between calculations and measurements of the same operation can be reduced, ideally to zero. Evidence may be in the same format as P12.

For D1, learners are required to discuss how given measurements and calculations are used in land-based engineering operations. The types of measurement and calculation should be provided by the tutor, and should relate to a minimum of four of those identified in the pass criteria. This requires learners to demonstrate their understanding of the practical application of mathematical concepts. Evidence may be in the same format as for P12.

Programme of suggested assignments

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Pearson assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2, P3, P4, P5, P6, M1	Measurements and Calculations	You have been taken on by a land-based engineering workshop as a new trainee. In order to complete your probationary period you need to complete a workbook showing your ability to carry out measurements and calculations. Include notes which show how your results may be checked for accuracy.	Completed workbook.
P7, P8, P9, P10, P11, P12, M2, D1	Using Calculations in Land-based Engineering	To help those new staff working in the workshop, your supervisor has asked you to design two posters – one about measurement and one about calculations. Include an explanation of how calculations and measurements may differ, and how this can be resolved. The posters should show clearly a range of applications for calculations and measurements in land-based engineering.	Posters.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC land-based sector suite. This unit links to most units in this specification and has particular links with:

Level 2	Level 3
LEO7 Core land-based engineering principles – calculations	Mathematics for Engineering Technicians

Essential resources

Centres should be suitably equipped to enable learners to have access to a range of measuring equipment. This should include pressure and flow measuring equipment, together with general measurement devices associated with engineering such as DTIs, vernier callipers and micrometers. A dynamometer would also be useful to demonstrate how to measure engine power output and consumption at various loads.

Employer engagement and vocational contexts

Learners could be introduced to a variety of professionals from different companies and organisations such as product designers, component testers, etc to broaden their knowledge and make the learning experience interesting and contextualised. This could be through guest lecturers or off-site visits to different establishments. A visit focusing on the quality control procedures of a manufacturing firm and the measurement techniques used would also help learners to appreciate the vocational significance of the unit.

Indicative reading for learners

Textbooks

Taylor G, Fuller A and Greer A – *BTEC National Mathematics for Technicians, 3rd Edition* (Nelson Thornes, 2004) ISBN 0748779493

Twigg P – *Science for Motor Vehicle Engineers* (Butterworth-Heinemann, 1995) ISBN 034064527X

Journals

International Journal of Mechanical Sciences

Websites

www.ehow.com

Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit:

Skill	When learners are …
Independent enquirers	taking measurements, calculating
Creative thinkers	describing calculations
Reflective learners	using theoretical methods to establish measurements
Team workers	recording data
Self-managers	using conversion tables
Effective participators	carrying out calibration exercises.

Although PLTS opportunities are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are …
Independent enquirers	planning and carrying out research activities related to the unit evaluating and carrying out extended thinking
Creative thinkers	asking questions to extend their thinking during lectures and practical sessions trying out alternatives or new solutions
Reflective learners	identifying opportunities for their own achievements
Team workers	assisting in group activities
Self-managers	setting own targets for accurate completion of work asking for assistance
Effective participators	encouraging debate.

Functional Skills – Level 2

Skill	When learners are …
ICT – Use ICT systems	
Select, interact with and use ICT systems independently for a complex task to meet a variety of needs	designing tables to use in data recording
Use ICT to effectively plan work and evaluate the effectiveness of the ICT system they have used	
Manage information storage to enable efficient retrieval	
Follow and understand the need for safety and security practices	
Troubleshoot	
Mathematics	
Understand routine and non-routine problems in a wide range of familiar and unfamiliar contexts and situations	using formula to establish measurements
Identify the situation or problem and the mathematical methods needed to tackle it	
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	taking part in group discussions.
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	

Unit 7: Understand and Follow Organisational Procedures within Land-based Engineering Establishments

Unit code: F/600/3400

Level 2: BTEC First

Credit value: 5

Guided learning hours: 30

Aim and purpose

The aim of this unit is to provide the learner with the knowledge, and skills required to understand and follow organisational procedures required by the job role.

Unit introduction

The majority of land-based businesses have some form of workshop associated with them. These facilities are generally used for the maintenance and repair of land-based machinery and installations. They are important in helping businesses ensure their equipment and installations are available at the times that they are needed, reducing down time and costs.

The size and complexity of the work carried out in these workshop facilities depends on the skill of the employees and the type of equipment and facilities available.

This unit will cover the basic work requirements within land-based workshops. It covers the role and responsibilities of employees and the organisational systems and procedures found within the workplace. These include organization structure, communication, storage and retrieval of information, and the appropriate reporting and recording of information.

Learners will study the procedures within land-based engineering workshops for organising, planning, completing and the administration of work activities. These activities include-service and maintenance operations, pre-delivery inspections (PDI), machinery appraisal inspections, warranty systems and operations, parts searches, customer relations, technical reporting, use of timesheets and mileage claims.

Learning outcomes

On completion of this unit a learner should:

1 Be able to follow organisational procedures

2 Know the organisational procedures required by the job role.

Unit content

1 Be able to follow organisational procedures

Administration tasks and technical information in line with company and manufacturers' and suppliers' requirements: job cards, parts requisitions, service records, warranty records, service manuals, operators' manuals, service information and history, and diagnostic information

Customer and personal relationships: internal and external

Health and safety procedures: personal protective equipment (PPE); risk assessment; employee responsibilities; employer responsibilities; personnel cleaning requirements and facilities

2 Know the organisational procedures required by the job role

Procedures: environmental responsibilities including cleanliness, safe working practices, and safe waste disposal; human resource procedures; internal and external communications; quality standards; efficiency and effectiveness; customer confidentiality

Parts procedures: procurement; storage; retail and transport of parts; ordering procedures; parts location and identification and quality procedures

Internal and supplier documentation: timesheets; job cards; parts requisitions; unit records eg engine hours, mileage, service records; serial numbers; warranty and quality control

Legislation: current relevant statutes and regulations eg Health and Safety at Work Act 1974 (HASAWA), Control of Substances Hazardous to Health 1989 (COSHH), Manual Handling Operations Regulations (1992), Provision and Use of Work Equipment Regulations 1998 (PUWER)

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 follow organisational, departmental and task procedures required of the job role [SM]	**M1** compare the procedures to be followed to carryout a given task in two different workshops	**D1** suggest improvements to the procedures required for a given job role.
P2 complete administration tasks and record technical information **[SM]**		
P3 prepare and organise to carry out tasks required by the job role **[SM]**		
P4 locate, access, download, file and store electronic software and copy technical documentation [IE]		
P5 describe the structure of a given land-based organisation covering ◊ levels of responsibility and authority ◊ methods of communication ◊ organisational procedures [RL]	**M2** explain why the organisational and procedural requirements required for a given repair or maintenance task to be carried out are necessary.	
P6 describe the procurement, storage, retail and transport of parts [RL]		
P7 describe how to complete and process internal and supplier documentation. [RL]		

PLTS: This summary references where applicable, in the square brackets, the elements of the personal, learning and thinking skills applicable in the pass criteria. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

All centres must comply with the requirements of relevant, current legislation and codes of practice eg the *Prevention of Accidents to Children in Agriculture Regulations 1998*. Learners must be made aware of, and have access to, relevant health and safety legislation and know the importance of the use of risk assessments appropriate to each situation. Appropriate risk assessments must precede all practical machinery activities and learners must work in a safe manner at all times when using equipment or working with machinery. Learners must be supervised at all times and tutors must not ask learners to undertake tasks that are beyond their physical capabilities.

Delivery of this unit will involve practical assessments, written assessment, visits to suitable collections and will link to industrial experience placements.

Tutors have the opportunity to use as wide a range of techniques as possible. Lectures, discussions, seminar presentations, site visits, supervised tractor and/or land-based machinery operation practicals, internet and library-based research and the use of personal and/or industrial experience would all be suitable. Delivery should stimulate, motivate, educate and enthuse learners.

Work placements should be monitored regularly in order to ensure the quality of the learning experience. It would be beneficial if learners and supervisors were made aware of the requirements of this unit before to any work-related activities, so that naturally occurring evidence can be collected at the time. For example, learners may have the opportunity to carry out workshop tasks and the supporting and associated procedures including parts procurement, and they should be encouraged to ask for observation records and/or witness statements to be provided as evidence. Guidance on the use of observation records and witness statements is provided on the Pearson website.

Learners will be required to know, understand and to be able to follow organisational procedures within land-based engineering establishments. The unit is likely to be delivered using formal lectures, discussion, supervised land-based workshop practicals and independent learner research, with an emphasis on the development of practical skills. Visiting expert speakers could add to the relevance of the subject for learners. For example, mechanics working with land-based machinery could talk about their work procedures and the recording systems that they use.

Learners would benefit from visiting other workshops and engineering establishments to enable a range of possible procedures.

Health and safety issues relating to workshop situations must be stressed and reinforced regularly, and risk assessments must be undertaken before practical activities. Adequate PPE must be provided and used following the production of suitable risk assessments.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan gives **an indication of the volume of learning it would take the average learner** to achieve the learning outcomes. It is **indicative and is one way of achieving the credit value.**

Learning time should address all learning (including assessment) relevant to the learning outcomes, regardless of where, when and how the learning has taken place.

Topic and suggested assignments/activities and/assessment
Introduction and review of unit; testing of previous knowledge.
Theory session: administration tasks in the workshop.
Assignment 1: Using Workshop Procedures (P1, P2, P3, P4) Tutor introduces the assignment brief.
Group demonstration and investigation- workshop procedures.
Assignment 2: Workshop Organisation and Procedures (P5, P6, P7, M1, M2, D1) Tutor introduces the assignment brief.
Theory session: health and safety and environmental considerations.
Workshop Visit and/or speakers: workshop procedures.
Practical Workshop sessions: tasks and associated procedures.
Theory and practical session: communication.
Theory session: the customer: the internal and external customer customer relations.
Theory and practical: parts management.
Theory session: record keeping.
Assignment and self study.
Unit review.

Assessment

For P1, learners must follow organisational, departmental and task procedures required of the job role. Tutors should identify two workshop repair/maintenance tasks and objectives. Where possible, the size and complexity of these should be the same for each learner to ensure fairness of assessment. The tasks selected should ensure good coverage of the systems and procedures available. Safe working methods and the use of personal protective equipment (PPE) are essential parts of the assessment. P1 could be assessed directly by the tutor during practical activities. If this format is used then suitable evidence from guided activities would be observation records completed by learners and the tutor, and accompanied by appropriate worklogs or other relevant learner notes. If assessed during a work placement, witness statements should be provided by a suitable representative and verified by the tutor.

For P2, learners must complete given administration tasks and record technical information. These could be linked to the two tasks as for P1. Where possible, these should be the same for each learner to ensure fairness of assessment. This could be assessed at the same time as P1 and in the same format.

In P3, learners are required to prepare and organise to carry out the tasks required by the job role. These could be for the same tasks as for P1. Where possible, these should be the same for each learner to ensure fairness of assessment. This could be assessed at the same time as P1 and in the same format.

P4 requires learners to locate, access, download, file and store electronic software and copy technical documentation. These could be for the same task as for P1 or a task identified by the tutor. Where possible, the selection of these should be the same for each learner to ensure fairness of assessment. This could be assessed at the same time as P1 and in the same format.

P5 requires learners to describe the structure of a given land-based organisation, covering levels of responsibility and authority and methods of communication as well as organisational procedures. P5 could be assessed directly by the tutor during practical activities. If this format is used then suitable evidence from guided activities would be observation records completed by learners and the tutor, and accompanied by appropriate worklogs or other relevant learner notes. If assessed during work placement, witness

statements should be provided by a suitable representative and verified by the tutor.

Alternatively, evidence could take the form of a pictorial presentation with notes (possibly using appropriate software or an overhead projector), an annotated poster or a written assignment.

P6 requires learners to describe the procurement, storage, retail and transport of parts. This could be assessed in the same way as for P5.

For P7, learners must describe how to complete and process internal and supplier documentation. This could be assessed in the same way as for P5.

M1 requires learners to compare the procedures to be followed to carry out a given task in two different workshops. This will require a visit to another workshop/land-based repair establishment and/or visiting speakers and/or video presentations. Evidence may be linked directly to tasks being undertaken for other criteria in this unit. It could be in the same format as for P1 or in a written format such as a pictorial presentation with notes (possibly using appropriate software or OHPs), an annotated poster or leaflet.

M2 requires learners to explain why the organisational and procedural requirements required for a given repair or maintenance task are necessary. This could develop P5, P6, P7 and be carried out and assessed at the same time and in the same manner.

In D1, learners are required to suggest improvements to the procedures required for a given job role. This could develop M2 and be assessed at the same time. Evidence may be linked directly to tasks being undertaken for other criteria in this unit. It may be in the same format as described for P1 or in a written format such as a pictorial presentation with notes (possibly using appropriate software or OHPs), an annotated poster or leaflet.

Programme of suggested assignments

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Pearson assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2, P3, P4	Using Workshop Procedures	You are a newly appointed fitter in an agricultural workshop. You are asked to carry out two tasks and follow organisational procedures, and complete all necessary supporting tasks, associated documentation and records.	Practical Assessment.
P5, P6, P7, M1, M2, D1	Workshop Organisation and Procedures	Additionally, describe workshop organisation and procedures, explaining their purpose, and suggesting improvements, making comparison to alternative systems.	Verbal questioning in the workplace and/or written assignment and/or presentation.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC land-based sector suite. This unit links to most units in this specification and has particular links with:

Level 2	Level 3
LEO2 Organisational procedures in land-based engineering	Undertake and Review Work-related Experience in the Land-based Industries

Essential resources

Learners will need regular and routine supervised access to land-based engineering workshops and work areas. Workshops need to be well resourced with tools, both hand and powered, and equipment. Access to resources should be sufficient to allow all learners adequate opportunity to develop their practical ability and confidence over a period of time.

Learners will need to access a range of equipment to repair as well as the consumable items needed for fitting and maintenance projects.

Workshops need to have a wide range of good organizational procedures and provide the opportunity for learners to deal with customers.

Workshop facilities should have the appropriate procedures for storing and disposing of chemicals, paints and waste products in line with legislation.

It is vital that there is adequate PPE as well as first aid facilities.

Tutors delivering this unit should be competent and experienced in the use of workshop tools, machinery maintenance/repair and the supporting systems and procedures. Ideally, they should have recent industrial experience or show evidence of regular contact with the industry and/or technical updating.

Employer engagement and vocational contexts

Centres are encouraged to supply the range of equipment required for this unit and local industry, contractors or the centre estate department may be able to supply up-to-date equipment requiring maintenance and/or repair. This will put an emphasis on using 'live' equipment rather than working through simulated scenarios. Visits to commercial workshops may enhance learner's understanding of safe working practices, teamwork and workshop organisation. Work experience opportunities may enable learner's skills prior to this unit being assessed for this unit.

Indicative reading for learners

Textbooks

Bell B – *Farm Machinery* (Old Pond Publishing, 2005) ISBN 1903366682

Bell B – *Farm Workshop* (Farming Press, 1992) ISBN 0852362374

Farmers Weekly – *Farm Workshop and Maintenance* (Crosby Lockwood, 1979) ISBN 0258971339

Gillespie A – *Business in Action* (Hodder Arnold, 2002) ISBN 0340848200

HSE- Essentials of Health and Safety at Work (HSE Books, 2006) ISBN 0717661792

Kiubick R – *How to Set Up Your Farm Workshop* (Motorbooks International, 2007) ISBN 0760325490

Marcouse I – *A-Z Business Studies Handbook* (Philip Allan, 6th rev. edition, 2009) ISBN 0340987294

Moore V – *Farm Workshop and Maintenance* (WileyBlackwell, 3rd rev. edition, 1992) ISBN 0632025387

Shippen J – *Basic Farm Machinery* (Butterworth-Heinemann, 1980) ISBN 0080249124

Journals

Farmers Weekly

Profi

Websites

www.bagma.com	British Agricultural and Garden Machinery Association
www.fwi.co.uk/machinery	Farmers Weekly Interactive
www.hse.gov.uk	Health and Safety Executive

Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit:

Skill	When learners are …
Independent enquirers	locating, accessing, downloading, filing and storing electronic software and copying technical documentation
Reflective learners	describing the structure of a given land-based organisation covering: levels of responsibility and authority methods of communication organisational procedures describing the procurement, storage, retail and transport of parts describing how to complete and process internal and supplier documentation
Self-managers	following organisational, departmental and task procedures required of the job role completing the following administration tasks and recording technical information preparing and organising to carry out tasks required by the job role.

Although PLTS opportunities are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are …
Independent enquirers	describing the structure of a given land-based organisation covering levels of responsibility and authority methods of communication organisational procedures
Team workers	following organisational, departmental and task procedures required of the job role preparing and organising to carry out tasks required by the job role.

Functional Skills – Level 2

Skill	When learners are …
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	locating, accessing, downloading, filing and storing electronic software and copying technical documentation
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	locating, accessing, downloading, filing and storing electronic software and copying technical documentation
ICT – Develop, present and communicate information	
Enter, develop and format information independently to suit its meaning and purpose including: • text and tables • images • numbers • records	completing administration tasks and recording technical information
Bring together information to suit content and purpose	
Present information in ways that are fit for purpose and audience	
Evaluate the selection and use of ICT tools and facilities used to present information	
Select and use ICT to communicate and exchange information safely, responsibly and effectively including storage of messages and contact lists	
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	describing the structure of a given land-based organisation covering Levels of responsibility and authority Methods of communication organisational procedures describing the procurement, storage, retail and transport of parts describing how to complete and process internal and supplier documentation
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	completing the following administration tasks and recording technical information.

Unit 8: Provide Customer Care within Land-based Engineering Operations

Unit code: Y/600/3435

Level 2: BTEC First

Credit value: 5

Guided learning hours: 30

Aim and purpose

The aim of this unit is to provide the learner with the knowledge, understanding and skills required to provide customer care to customers using Land-based engineering services. This unit aims to introduce learners to customer care skills and knowledge in land-based engineering and how these can be applied in practice. It is designed for learners in centre-based settings looking to progress into the sector or onto further/higher education.

Unit introduction

Customer service is the most visible part of any company and, subsequently, is the most vital and integral to a successful business. To many organisations however customer service is one of the most challenging and neglected areas of management, including those with modern call centres. For customers the quality of customer service determines whether to buy and, particularly, whether to remain a customer.

This unit looks at how customer service fits into the workplace and how, as employees, customer service is important in daily dealings with members of the public and customers.

Learners will develop the knowledge and skills needed to understand and apply of the foundations on which appropriate customer service in land-based engineering businesses are built. Throughout the unit it will be stressed that it is the responsibility of employees and employers to keep up-to-date with changes in the relevant legislation.

Learning outcomes

On completion of this unit a learner should:

1 Be able to apply customer care principles

2 Know how to apply customer care principles.

Unit content

1 Be able to apply customer care principles

Customer service: customer needs and customer expectations eg meeting timescales, customer experience, customer feedback, customer loyalty, customer satisfaction, customer rights, customer relationship, personal appearance, business image

2 Know how to apply customer care principles

Customer service legislation: current relevant statutes and regulations eg Sale of Goods Act 1979, Supply of Goods and Services Act 1982, Trade Descriptions Act 1968, Consumer Credit Act 1974, Consumer Protection Act 1987, Consumer Protection (Distance Selling) Regulations 2000, Data Protection Act 1998, Disability Discrimination Act 1995, Sex Discrimination Act 1975, Race Relations Act 1976 (as amended) Health and Safety at Work Act 1974

Customer/Staff behaviour: positive and negative behaviour, both customer and business eg aggressiveness, politeness, why customer care is important and the components that contribute to customer satisfaction and dissatisfaction; written or verbal updating, taking and passing on messages, supplying information, confirmation of actions, being assertive or compliant

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria					
To achieve a pass grade the evidence must show that the learner is able to:		**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**		**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**	
P1	project the appropriate level of professionalism, personal appearance, conduct and behaviour [TW]	**M1**	evaluate own performance in customer service recommending appropriate areas for improvement	**D1**	explain the customer service policies in place for a selected business, and make recommendations for improvement.
P2	communicate information to customers using appropriate methods [TW, IE, EP]				
P3	describe the importance of meeting customers' expectations				
P4	respect the customer and corporate confidentiality				
P5	describe how to promote a positive image of yourself, colleagues, the organisation and it's products and/or services [CT, RL]	**M2**	describe how legislation, policies and procedures support the customer service process.		
P6	describe how to communicate with the customer politely, respectfully and effectively				
P7	describe how to recognise positive and negative behaviour traits in customers				
P8	state the limits of your authority and responsibility when dealing with customers				
P9	state the reasons why customer and corporate confidentiality must be respected.				

PLTS: This summary references where applicable, in the square brackets, the elements of the personal, learning and thinking skills applicable in the pass criteria. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

Delivery of this unit will involve practical assessments, written assessment, visits to suitable collections and will link to industrial experience placements.

Tutors have the opportunity to use as wide a range of techniques as possible. Lectures, discussions, seminar presentations, site visits, supervised tractor and/or land-based machinery operation practicals, internet and library-based research and the use of personal and/or industrial experience would all be suitable. Delivery should stimulate, motivate, educate and enthuse learners.

Work placements should be monitored regularly in order to ensure the quality of the learning experience. It would be beneficial if learners and supervisors were made aware of the requirements of this unit before any work-related activities, so that naturally occurring evidence can be collected at the time. For example, learners may have the opportunity to demonstrate customer care and they should be encouraged to ask for observation records and/or witness statements to be provided as evidence. Guidance on the use of observation records and witness statements is provided on the Pearson website.

Tutors should consider integrating the delivery, private study and assessment relating to this unit with any other relevant units and assessment instruments the learner may also be taking as part of their programme of study.

Learning outcome 1 is likely to be delivered through a series of formal lectures, presentations, role play and customer service practicals. Visiting expert speakers could add to the relevance of the subject for learners. For example, a of customer service representative from a land-based machine manufacturer could talk about the company's procedures and how they apply customer service principles.

Learning outcome 2 is likely to be delivered through a series of formal lectures, role play, and customer service practicals. Learners should know about legislation relating to customer service and how and when to apply it, their roles and responsibilities, and why customer care is so important to a company's image.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan gives **an indication of the volume of learning it would take the average learner** to achieve the learning outcomes. It is **indicative and is one way of achieving the credit value.**

Learning time should address all learning (including assessment) relevant to the learning outcomes, regardless of where, when and how the learning has taken place.

Topic and suggested assignments/activities and/assessment
Introduction and overview of the unit.
Assignment 1: Customer Service (P1, P2, P4, M1) Tutor introduces the assignment brief.
Customers service needs, customer expectations.
Customer experience, customer feedback, customer loyalty, customer satisfaction, customer rights, note taking.
Customer relationship.

Topic and suggested assignments/activities and/assessment
Personal appearance.
Business image.
Assignment 2: Customer Services Application (P3, P5, P6, P7, P8, P9, M2, D1) Tutor introduces the assignment brief.
Legislation.
Customer/staff behaviour.
Importance of customer care.
Message retrieval and submission.
Components that contribute to customer satisfaction and dissatisfaction.
Unit review.

Assessment

For P1, P2, P3 and P4, learners must communicate effectively with customers and provide information on this. Learners are required to dress and look professional and respectable. This could best be assessed in a role-play scenario or workplace environment. Learners need to undertake these two tasks in a scenario setting or whilst on work placement. Where possible, to ensure fairness of assessment the size and the complexity of the tasks should be the same for all learners.

For P5, learners will describe what promotes a positive image, and what does not including the individual, colleagues, the organisation and its products and/or services. The business may be the same as that used to provide evidence for other assessment and grading criteria. Where possible, to ensure fairness of assessment the size and complexity of the tasks should be the same for all learners.

P6 requires learners to describe how to communicate effectively with the customer. Learner will be able to describe how important it is to be polite and respectful.

For P7, learners need to describe both positive and negative behaviour exhibited by customers. Learners must describe aggressiveness, sarcasm and politeness, and how these behaviours affect the customer and the image of the business.

For P8, learners need to describe the limit of their responsibilities and authority when dealing with customers within a chosen Land-based business. Learners will explain what they are authorised to do, and when they must pass a customer over to their line manager. The business may be the same as that used to provide evidence for other assessment and grading criteria. Where possible, to ensure fairness of assessment the size and complexity of the tasks should be the same for all learners.

For P9, learners must state why customer and corporate confidentiality must be respected. Evidence could be in the form of a leaflet or recorded question and answer session.

For M1, requires learners to evaluate their own performance in providing customer service and make recommendations for improvement where necessary. Where possible, the size and complexity of the task should be the same for each learner to ensure fairness of assessment. Evidence may be in the form of a project assignment or through recorded questioning and answering and linked to evidence produced for P1, P2, P3 and/or P4.

M2 requires learners to explain how selected regulations affect customer service working practices in a given land-based engineering business. Tutors should identify the workplace and the regulations, or agree them through discussions with learners. The workplace may be the same as that used for other assessment and grading criteria. Where possible, to ensure fairness of assessment the size and the complexity of the tasks should be the same for all learners.

For D1, learners explain the customer service policies of a selected land-based engineering business and

make recommendations for improvements. Tutors should identify the business or agree it through discussion with learners. The business may be the same as that used to provide evidence for other assessment and grading criteria. Where possible, to ensure fairness of assessment the size and the complexity of the tasks should be the same for all learners

Programme of suggested assignments

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Pearson assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2, P4, M1	Customer Service	You currently work on the customer service desk of a Land-based technology company. Three customers are going to approach you. The first will be polite and want advice on who to contact regarding a demonstration of equipment on his farm. The second will be aggressive and annoyed and want a refund for a piece of equipment he has been sold. The third will be indecisive and want a part for his tractor, but is not sure what part he wants, or how to go about ordering one. Prepare a report showing how you performed in these three scenarios, and explain where you could improve.	Practical assessment, observation, witness statement, evaluation report.
P3, P5, P6, P7, P8, P9, M2, D1	Customer Services Application	Describe how important it is for the company to meet customer expectations and how enquires should be dealt with confidentially. You must also describe the limit of your responsibilities and authority when dealing with customers. You must describe what is a positive personal image and why appropriate communication is important. You must describe positive and negative behaviour, and how you would recognise these. You must describe how legislation, policies and procedures affect the customer service process, and explain what policies are in place for a selected business, making recommendations for improvement.	Written report, presentation.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC land-based sector suite. This unit has particular links with:

Level 2	Level 3
LEO3 Customer care in land-based engineering	Undertake and Review Work-related Experience in the Land-based Industries

Employer engagement and vocational contexts

This unit focuses on the customer service skills learners will need when undertaking work whilst in work placement and also when in full-time or part-time work. The unit will enable learners to identify and understand their own legal obligations regarding customer service in the workplace. Centres are encouraged to develop links with their own customer service department. When learning about customer service, learners should be encouraged to work in groups and discuss the implications of good and bad customer service for their image of the company. Learners could develop and apply their knowledge by undertaking nationally recognised qualifications in customer service.

Indicative reading for learners

Textbooks

Gober M – *The Art of Giving Quality Service* (Mary Gober International) ISBN 0 9624563 0 6

Websites

www.bbc.co.uk	The BBC is the largest broadcasting organisation in the world. Its mission is to enrich people's lives with programmes that inform, educate and entertain.
www.equalityhumanrights.com	Equality and Human Rights Commission
www.ico.gov.uk	The Information Commissioner's Office is the UK's independent authority set up to uphold information rights in the public interest, promoting openness by public bodies and data privacy for individuals.
www.instituteofcustomerservice.com	The Institute of Customer Service is the professional body for customer service.
www.oft.gov.uk	The Office of Fair Trading is the UK's consumer and competition authority.

Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit:

Skill	When learners are …
Independent enquirers	communicating information to customers using appropriate methods
Creative thinkers	evaluating own performance in customer service recommending appropriate areas for improvement
Reflective learners	evaluating own performance in customer service recommending appropriate areas for improvement
Team workers	communicating information to customers using appropriate methods, projecting the appropriate level of professionalism, personal appearance and conduct
Effective participators	communicating information to customers using appropriate methods, evaluating own performance in customer service recommending appropriate areas of improvement.

Although PLTS opportunities are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are …
Independent enquirers	asking questions and identifying solutions to problems when undertaking customer service duties.
Creative thinkers	exploring possible answers to customer problems
Reflective learners	reflecting on own customer service experiences
Team workers	undertaking role play
Self-managers	managing own time in completing assignments and meeting deadlines
Effective participators	discussing customer service and personal and customer behaviour.

Functional Skills – Level 2

Skill	When learners are …
ICT – Use ICT systems	
Select, interact with and use ICT systems independently for a complex task to meet a variety of needs	presenting information on own performance
Use ICT to effectively plan work and evaluate the effectiveness of the ICT system they have used	
Manage information storage to enable efficient retrieval	handling customers' personal data and personal details
Follow and understand the need for safety and security practices	
Troubleshoot	
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	taking part in group discussions and role play
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	understanding the customer service policies and procedures of land-based engineering businesses.
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	

Unit 9: Land-based Engineering Operations – Perform Thermal Joining and Cutting Processes

Unit code: A/600/3427

Level 2: BTEC First

Credit value: 10

Guided learning hours: 60

Aim and purpose

The aim of this unit is to provide the learner with the knowledge and skills required for carrying out thermal joining and cutting processes within Land-based operations. This unit aims to introduce learners to the skills and knowledge in thermal joining and cutting processes and how these can be applied in practice. It is designed for learners in centre-based settings looking to progress into the sector or onto further/higher education.

Unit introduction

Land-based machinery and equipment is invariably built of metal components, often of heavy construction. The ability to cut and thermally join these is an important skill for any workshop operative. The size and complexity of the work carried out in t workshop facilities depends on the skill of the employees and the type of equipment and facilities available.

The majority of land-based businesses have some form of workshop associated with which are generally used for the maintenance and repair of land- based machinery and installations. They are important in helping businesses ensure their equipment and installations are available at the times that they are needed, reducing down time and costs.

This unit has been designed to cover the basic thermal joining and cutting process requirements within land-based workshops. Learners will learn how to use basic welding and cutting equipment commonly found in a land-based setting safely. The associated skills will be integrated with the development and use of basic maintenance and repair techniques.

Health and safety is integral and of paramount importance – not just while the learner or employee is working within the workshop. Learners will need to consider the safety of those working with, or coming into contact with, the equipment or installations being maintained and/or repaired.

Learning outcomes

On completion of this unit a learner should:

1 Be able to perform thermal joining and cutting

2 Know how to perform thermal joining and cutting techniques.

Unit content

1 Be able to perform thermal joining and cutting

Techniques: oxy-acetylene; manual metal arc (MMA); metal inert gas (MIG); soldering and bronze welding (brazing)

Metals: ferrous and non-ferrous metals and their suitability

Equipment: joining equipment, personal protective equipment (PPE)

Preparation: cleaning; material removal (abrasives, filing, grinding); fire prevention, spatter control; light control; joint preparation (marking out, preparation, positioning of materials); clamping; tacking; bevelling; positioning

Joints: butt; lap; fillet

Techniques: positioning; clamping; tacking; single run; multi-run; using the downhand technique

Health and safety: health and safety; risk assessment; safe working practices; PPE; environmental risk assessment; fumes; dust; heat; light and heat radiation; sparks and spatter; relevant current legislation and codes of practice

2 Know how to perform thermal joining and cutting techniques

Techniques: oxy-acetylene; manual metal arc (MMA); metal inert gas (MIG); soldering and bronze welding (brazing)

Identification methods for ferrous and non-ferrous metals: filing; sawing; spark test; nick break; 'scrape'; heat

Preparation: cleaning; material removal (abrasives, filing, grinding); fire prevention; spatter control; light control; joint preparation (marking out, preparation, positioning of materials); clamping; tacking; bevelling; positioning

Safe selection, preparation and use of equipment: setting pressures; amperage; voltages; selecting electrode sizes; nozzle sizes; wire speed; selection of fluxes for bronze welding and soldering; the properties and purpose of flux; the methods for removal of welding slag; the range of techniques necessary to prepare material prior to downhand welding; how to control distortion, weld and heat effects

Detection and correct identification of faults and their causes in welded joints: visual inspection; non-destruction and destruction testing; fault-undercutting, slag traps, penetration, cracking and leak testing

Precautions required when engaging in a thermal joining and cutting process: fumes; explosions; fire; sharp edges; airborne debris; personal injury

Oxy-acetylene gas heating and cutting: nozzles; pressures and settings; changing and connecting gas cylinders; fire prevention and safety

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria					
To achieve a pass grade the evidence must show that the learner is able to:		**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**		**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**	
P1	identify welding and thermal joining equipment [IE]	**M1**	plan, prepare and carry out thermal joining tasks to a high standard	**D1**	evaluate a simple welded joint to meet given objectives.
P2	identify ferrous and non-ferrous materials and their suitability [IE]				
P3	prepare workplace materials and equipment to carry out a thermal joining process [SM]				
P4	use the correct techniques to carry out thermal joining tasks [SM]				
P5	join ferrous or non-ferrous materials to the required quality and dimensions [SM]				
P6	identify faults in welded, bronze welded and soldered joints [SM]				
P7	inspect and maintain equipment and change consumables used in joining processes [SM]				
P8	safely set up and shut down equipment for oxy-acetylene gas heating, cutting and joining [SM]				

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P9 describe how to identify ferrous and non ferrous materials and their respective joining characteristics	**M2** compare a range of joining techniques and their use with different materials	**D2** select and justify the choice of basic welding equipment, materials and joining techniques to meet a given objective.
P10 describe material preparation and joining procedures		
P11 describe the techniques for joining ferrous and non-ferrous materials using gas or electric welding and soldering methods		
P12 describe how to select, prepare and set the relevant equipment to carry out welding and joining tasks	**M3** explain the importance of correct selection, preparation and setting of equipment used in welding and joining tasks.	
P13 describe how to detect and correctly identify faults and their causes in welded joints [CT]		
P14 describe the precautions required when engaging in a thermal joining and cutting process		
P15 describe how to safely set up equipment and use the correct techniques for oxy-acetylene gas heating, cutting and joining. [CT, RL]		

PLTS: This summary references where applicable, in the square brackets, the elements of the personal, learning and thinking skills applicable in the pass criteria. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key			
	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

All centres must comply with the requirements of relevant, current legislation and codes of practice eg the *Prevention of Accidents to Children in Agriculture Regulations 1998*. Learners must be made aware of, and have access to, relevant health and safety legislation and know the importance of the use of risk assessments appropriate to each situation. Appropriate risk assessments must precede all practical machinery activities and learners must work in a safe manner at all times when using equipment or working with machinery. Learners must be supervised at all times and tutors must not ask learners to undertake tasks that are beyond their physical capabilities.

Tutors have the opportunity to use as wide a range of delivery techniques as possible. It is likely that delivery will have a strong practical bias, with supervised workshop sessions. Lectures, discussions, seminar presentations, site visits, internet and library-based research and the use of personal and/or industrial experience would also be suitable delivery methods.

Where used to support delivery of this unit, work placements should be monitored regularly in order to ensure the quality of the learning experience. It would be beneficial if learners and supervisors were made aware of the requirements of this unit before any work-related activities, so that naturally occurring evidence can be collected at the time. For example, learners may have the opportunity to take part in welding activities and they should be encouraged to ask for observation records and/or witness statements to be provided as evidence. Guidance on the use of observation records and witness statements is provided on the Pearson website.

Learners will develop their knowledge about the safe use of basic welding and cutting equipment in the maintenance of land-based machinery and installations. Tutors are required to cover the four methods listed in the unit content but it is accepted that learners may not become proficient in all of these during the learning time available. Tutors can concentrate practical delivery on one of the systems and, if time and learner development allow, move on to the other methods. Learners should be given the background theory and practical demonstrations of all the systems. Visiting expert speakers could add to the relevance of the subject for learners. For example, a mechanic working with land-based machinery could talk about their work and the welding systems they use to maintain and repair appropriate machinery and installations.

Tutors should consider integrating the delivery, private study and assessment relating to this unit with any other relevant units and assessment instruments learner's may also be taking as part of their programme of study.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan gives **an indication of the volume of learning it would take the average learner** to achieve the learning outcomes. It is **indicative and is one way of achieving the credit value.**

Learning time should address all learning (including assessment) relevant to the learning outcomes, regardless of where, when and how the learning has taken place.

Topic and suggested assignments/activities and/assessment
Introduction and review of unit; testing of previous knowledge.
Theory session: health and safety; hazards and precautions.
Assignment 1: Thermal Joining Techniques (P9, P10, P11, M2) Tutor introduces the assignment brief.
Theory session: ferrous and non-ferrous metals: properties, joining characteristics and identification.
Theory and demonstration: material preparation and joining techniques.
Assessment completion.
Assignment 2: Preparation for Thermal Joining (P12, P13, P14, P15, M3, D2) Tutor introduces the assignment brief.
Theory and demonstration: selecting, preparing and setting up equipment, workshop precautions.
Practical sessions: selecting, preparing and setting up equipment.
Assessment completion.
Assignment 3: Thermal Joining (P1, P2, P3, P4, P5, P6, P7, P8, M1, D1) Tutor introduces the assignment brief.
Theory and demonstration – gas welding.
Workshop practicals: oxy-acetylene welding.
Theory and demonstration: oxy-acetylene heating and cutting.
Workshop practicals oxy-acetylene cutting.
Theory and demonstration session – manual metal arc welding.
Workshop practicals: manual metal arc welding.
Theory and demonstration session: metal inert gas welding.
Workshop practicals: metal inert gas welding.
Theory and demonstration: soldering and bronze welding.
Workshop practicals: soldering and bronze welding.
Theory and practical: fault identification.
Assignment completion and practical observation.
Unit review.

Assessment

P1 requires learners to identify welding and thermal joining equipment and could be assessed directly by the tutor during practical activities. If this format is used then suitable evidence from guided activities would be observation records completed by learners and the tutor, and accompanied by appropriate worklogs or other relevant learner notes. If assessed during a work placement, witness statements should be provided by a suitable representative and verified by the tutor.

Alternatively, evidence could take the form of a pictorial presentation with notes (possibly using appropriate software or an overhead projector), an annotated poster or a written assignment.

For P2, learners are required to identify ferrous and non-ferrous materials and their suitability for welding and joining. The tutor should provide examples of common ferrous and non-ferrous metals used in the construction of machinery and equipment. P2 could be assessed directly by the tutor during practical activities using verbal questioning techniques. Alternatively, it could be assessed in a classroom-based situation using pre selected examples of relevant material.

For P3, learners need to prepare the workplace, materials and equipment to carry out a thermal joining

process. P3 could be assessed directly by the tutor during practical activities. If this format is used then suitable evidence from guided activities would be observation records completed by learners and the tutor, and accompanied by appropriate worklogs or other relevant learner notes. If assessed during a work placement, witness statements should be provided by a suitable representative and verified by the tutor.

P4 requires learners to use the correct techniques to carry out a minimum of three thermal joining tasks. Safe working techniques and the use of personal protective equipment (PPE) must form part of this. Assessment and evidence could take the same form as for P3.

P5 requires learners to join ferrous or non-ferrous material to meet the required quality and dimensions. Learners will be expected to use at least four types of welding system. Tutors should identify the given objectives, which may include basic quality tolerances. Three types of join should be produced, each by four different techniques, all to an acceptable standard. Safe working techniques and the use of personal protective equipment (PPE) must form part of this. Assessment and evidence of this could take the same form as for P3.

In P6 learners are required to identify faults in thermal joints including welded, soldered and bronze welds. This could be carried out using the joints produced in P5 or using examples provided by the tutor to ensure coverage of thermal joining faults. Assessment and evidence of this could take the same form as for P1.

P7 requires learners to inspect and maintain equipment and replace consumables as necessary. P7 could be assessed directly by the tutor during practical activities. If this format is used then suitable evidence from guided activities would be observation records completed by learners and the tutor, and accompanied by appropriate worklogs or other relevant learner notes. If assessed during a work placement, witness statements should be provided by a suitable representative and verified by the tutor.

P8 requires learners to set up and shut down equipment for oxy-acetylene gas heating, cutting and joining safely. Safe work techniques and the use of personal protective equipment (PPE) must form part of this. Assessment and evidence of this could take the same form as for P3.

P9 requires learners to describe how to identify ferrous and non-ferrous material and their respective joining characteristics. This could be combined with the assessment for P2. P9 could be assessed directly by the tutor during practical activities, or through completion of a written or verbal assignment. Evidence for this could be provided in the same form as for P1.

For P10, learners are required to describe material preparation and joining procedures prior to tasks being carried out. Assessment could be carried out at the same time as P3, or it could be linked to P9. P10 could be assessed directly by the tutor during practical activities, or through completion of a written or verbal assignment. Evidences could be in the same form as for P1.

P11 requires learners to describe the techniques for joining ferrous and non-ferrous materials using gas and electric welding and soldering techniques. Assessment could be carried out at the same time as P4, or in a written or verbal report linked to P10. Assessment and evidence for this could be provided in the same form as for P1.

P12 requires learners to describe how to select, prepare and set the relevant equipment to carry out welding and joining tasks. Assessment could be carried out at the same time as P3 and evidence provided in the same manner, or through a written or verbal report, poster, leaflet or presentation.

P13 requires learners to describe how to detect and identify faults and their causes correctly in welded joints. Assessment may be linked to P6, or in the same format as for P12.

For P14, learners must describe the precautions required when engaging in a thermal joining and cutting process. Assessment could be carried out at the same time as P3, or as a separate assignment with evidence in the same form as for P12.

P15 requires learners to describe how to set up equipment and use the correct techniques for oxy-acetylene gas heating, cutting and joining safely. This could be assessed in conjunction with P8. Assessment and evidence for this could be provided in the same form as for P1.

For M1, learners must plan, prepare and carry out thermal joining tasks to a high standard. Assessment could be directly linked to the relevant pass criteria, with learners demonstrating their ability to plan the tasks and prepare and carry out thermal joining to a high standard. A minimum of three joining tasks should be included, with assessment taking the same form as for P3.

M2 requires learners to compare a range of joining techniques and their use with different materials. Assessment could be in the same form as for P1.

For M3, learners are required to explain the importance of correct selection, preparation and setting of equipment. This is likely to be linked to evidence presented for P12, P13, P14 and P15 and presented in the same format.

For D1, learners are required to evaluate a simple welded joint to meet given objectives. This may be a joint produced from their own work, or one provided by the tutor. D1 could be assessed during practical activities or within the workplace. Alternatively, assessment could be carried out using a pre selected example of a completed welded joint. Suitable evidence from guided activities would be observation records completed by learners and the tutor, and accompanied by appropriate worklogs or other relevant learner notes. If assessed during a work placement, witness statements should be provided by a suitable representative and verified by the tutor.

For D2, learners need to select and justify their choice of basic welding equipment, materials and joining techniques to meet a given objective. Evidence may be a written or report, completed case study or presentation.

Programme of suggested assignments

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Pearson assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2, P3, P4, P5, P6, P7, P8, M1, D1	Thermal Joining	You are a trainee fitter in an agricultural workshop. You are required to produce three different types of weld using four different techniques to a standard acceptable by the workshop manager. As part of your training you are also required to identify faults in welded and soldered joints, and to evaluate your own work against the objectives set.	Practical Assessment.
P9, P10, P11, M2	Thermal Joining Techniques	Your manager is very pleased with your work, and has asked you to prepare a poster for display in the workshop. This should include how to identify different materials, material preparation and a comparison of the range of joining techniques.	Annotated poster.
P12, P13, P14, P15, M3, D2	Preparation for Thermal Joining	Having now completed your training, you are helping to support a new trainee. Prepare some guidance notes that include how to set up for welding and oxy-acetylene gas cutting, the precautions to take, and how to detect and identify faults in welded joints.	Written guidance notes.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC land-based sector suite. This unit has particular links with:

Level 2	Level 3
LEO9 Core land-based engineering principles – Thermal joining processes	Land-based Engineering Operations – Perform Thermal Joining Processes

Essential resources

Learners will need supervised access to workshop facilities containing a sufficiently diverse range of materials and equipment to meet the unit requirements. Health and safety considerations and effective learning require that there are sufficient facilities allow for one welding station per learner. Learners should also have access to sufficient library and internet facilities to enable research into techniques, materials, equipment and work examples. This unit requires vocationally-specific craft knowledge and appropriately qualified tutors to deliver it.

Employer engagement and vocational contexts

It is essential that this unit be delivered in an applied and vocational context. Work-based experience will also be important. The unit will be enhanced by contact with employers. Centres are encouraged to develop links with local businesses, manufacturers, machinery dealers and workshops, who can support the breadth and application of this unit. Employers can provide real-work practical exercises, and guest speakers and experts to support the learning experience.

Indicative reading for learners

Textbooks

Farnsworth S – *Welding for Dummies* (John Wiley and Sons, 2010) ISBN 0470455969

Finch R – *Welder's Handbook: A Guide to Plasma Cutting, Oxyacetylene, ARC, MIG and TIG Welding, Revised Edition* (HP Books, 2007) ISBN 1557885133

Flood C – *Fabrication Welding and Metal Joining Processes* (Butterworth-Heinemann, 1981) ISBN 0408004487

Gibson S and Smith A – *Basic Welding* (Thomson Learning, 1993) ISBN 0333578538

Gourd L – *Principles of Welding Technology, 3rd Edition* (Butterworth-Heinemann, 1995) ISBN 0340613998

Griffin I, Roden E and Briggs C – *Basic Arc Welding, 4th Edition* (Delmar, 1984) ISBN 0827321317

Griffin I, Roden E and Briggs C – *Basic Oxyacetylene Welding, 4th Edition* (Delmar, 1984) ISBN 0827321376

Health and Safety Executive – *Health and Safety in Arc Welding* (HSE Books, 2000) ISBN 0717618137

HSE – *Essentials of Health and Safety at Work* (HSE Books, 2006) ISBN 0717661794

Kenyon W – *Basic Welding and Fabrication, 2nd Edition* (Longman, 1987) ISBN 0582005361

Pearce A – *Farm and Workshop Welding, 2nd revised Edition* (Old Pond Publishing Ltd, 2007) ISBN 1905523300

Pritchard D – *Soldering, Brazing & Welding: A Manual of Techniques* (The Crowood Press, 2001) ISBN 1861263910

Websites

www.baba.org.uk	British Artist Blacksmiths Association
www.bagma.com	British Agricultural and Garden Machinery Association
www.gowelding.com	Go Welding
www.howstuffworks.com	HowStuffWorks
www.hse.gov.uk	Health and Safety Executive
www.roymech.co.uk	Welding Processes
www.twi.co.uk	The Welding Institute

Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit:

Skill	When learners are …
Independent enquirers	identifying welding and thermal joining equipment identifying ferrous and non-ferrous materials and their suitability
Creative thinkers	describing how to detect and identify faults and their causes correctly in welded joints
Reflective learners	identifying faults in welded, bronze welded and soldered joints
Self-managers	preparing workplace, materials and equipment to carryout a thermal joining process using the correct techniques to carry out thermal joining tasks joining ferrous or non-ferrous materials to the required quality and dimensions inspecting and maintaining equipment and changing consumables used in joining setting up and shutting down equipment for oxy-acetylene gas heating, cutting and joining safely.

Although PLTS opportunities are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are …
Reflective learners	describing how to identify ferrous and non-ferrous materials describing how to select, prepare and setup the relevant equipment to carryout welding and joining tasks.

Functional Skills – Level 2

Skill	When learners are …
ICT – Develop, present and communicate information	
Enter, develop and format information independently to suit its meaning and purpose including: • text and tables • images • numbers • records	
Bring together information to suit content and purpose	producing a report comparing a range of joining techniques
Present information in ways that are fit for purpose and audience	giving presentation to peers
Evaluate the selection and use of ICT tools and facilities used to present information	
Select and use ICT to communicate and exchange information safely, responsibly and effectively including storage of messages and contact lists	
Draw conclusions and provide mathematical justifications	
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	describing how to identify ferrous and non-ferrous materials describing how to select, prepare and set the relevant equipment to carryout welding and joining tasks describing the precautions required when engaging in a thermal joining and cutting process
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	producing a report comparing a range of joining techniques.

Unit 10: Land-based Engineering Operations – Service and Repair Cooling and Lubrication Systems

Unit code: T/600/3426

Level 2: BTEC First

Credit value: 5

Guided learning hours: 30

Aim and purpose

The aim of this unit is to provide the learner with the knowledge and skills required when working with cooling and lubrication systems within Land-based engineering.

Unit introduction

Recent developments in engine design have led to improved in efficiency and performance. Manufacturers have developed the engine to meet the new emission tiers, whilst improving performance for a given size of engine further. As a result there have been developments relating to the cooling and lubrication systems used.

In this unit learners will develop the knowledge and skills needed to understand the construction and function of cooling and lubrication systems in compression ignition (CI) and spark ignition (SI) engines and to support the need for accurate fault diagnosis and repair of these systems.

An integral part of this unit will be interpreting data given in workshop manuals and the application of relevant health and safety regulations.

Learning outcomes

On completion of this unit a learner should:

1 Be able to perform service and repair operations on cooling and lubrication systems

2 Know the construction and function of cooling and lubrication systems and their components.

Unit content

1 Be able to perform service and repair operations on cooling and lubrication systems

Types of cooling and lubrication systems: air; liquid; splash; forced; two-stroke

Types of coolants and lubricants: anti-freeze and its dilution rates; oils

Drainage and replacement: taking samples; ensuring correct levels; flushing; materials to insulate hot and cold components

Service and repair: reasons for servicing and repair; use of manufacturers' service manuals and data; methods used to dismantle, repair and reinstate, cooling and lubrication systems and their components; tests used to check the integrity of service and repair activities: pressure, temperature, sensory, leaking component

2 Know the construction and function of cooling and lubrication systems and their components

Lubrication system: sump wet/dry; drip/gravity/immersion; splash self-lubricating; force fed; pump; pressure relief valve; filter; oil cooler; oil flow diagram; two-stroke; automatic greasing; common causes of system failure

Cooling system: air cooling systems eg fans, ducting, fins; liquid cooling systems, radiator, expansion tank, pressure cap, water pump, fan and belt, electric fan, thermostat, hoses, coolant circulation, anti-freeze; cab heater

Reasons for the control of temperature: expansion; contraction; vaporisation; efficiency; combustion; longevity; oil viscosity

Methods of temperature control: eg liquid, forced air, convection, conduction, radiation, heat sinks, insulation materials

Symptoms of insufficient cooling and lubrication: eg distortion, glazing, wear, seizure, hot spots, friction welding, scoring, cavitation

Causes of insufficient cooling and lubrication: eg obstruction, leaks, circulation, air locks, ambient temperature, system pressure overload

Characteristics and properties of the coolant and lubricant: lubricant; anti-friction; anti-wear; particulate suspension; anti-freeze; cooling; anti corrosion.

Test: sensory; pressure; input and output temperatures; leak; thermostats; fan speeds; flushing and bleeding procedures

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria					
To achieve a pass grade the evidence must show that the learner is able to:		**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**		**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**	
P1	identify different types of cooling and lubrication systems and their components [EP, SM, RL]	**M1**	report on service and repair findings	**D1**	explain common causes of component failure in cooling and lubrication systems and how these may be prevented.
P2	identify the different types of coolants and lubricants and select the appropriate product to comply with manufacturers specifications [EP, SM, RL]				
P3	perform operations requiring the drainage and replacement of lubricants and coolants [EP, TW, SM, IE]				
P4	prepare and test cooling and lubrication systems and their components [CT, IE, SM]				
P5	state the reasons and methods of the control of temperature in land-based engineering applications [IE, CT, SM, RL]	**M2**	explain the importance of cooling and lubrication systems in land-based engines.		
P6	describe the causes and symptoms of insufficient cooling and lubrication [IE, CT, SM, RL]				
P7	describe the fundamental operating principles of lubrication and cooling systems in engines [IE, CT, SM, RL]				
P8	state the reasons for lubrication and cooling systems in engines [IE, CT, SM, RL]				

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P9 describe how to dismantle, repair and reinstate cooling and lubrication systems. [IE, CT, SM, RL]		

PLTS: This summary references where applicable, in the square brackets, the elements of the personal, learning and thinking skills applicable in the pass criteria. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key			
	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

All centres must comply with the requirements of relevant, current legislation and associated codes of practice for example the *Prevention of Accidents to Children in Agriculture Regulations 1998*. Learners must be made aware of, and have access to, relevant health and safety legislation and know the importance of the use of risk assessments appropriate to each situation. Appropriate risk assessments must precede all practical machinery activities and learners must work in a safe manner at all times when using equipment or working with machinery. Learners must be supervised at all times and tutors must not ask learners to undertake tasks that are beyond their physical capabilities.

Tutors have the opportunity to use as wide a range of techniques as possible in the delivery of this unit. There is likely to be a practical bias, but lectures, discussions, seminar presentations, site visits, supervised tractor and/or land-based machinery operation practicals, internet and library-based research and the use of personal and/or industrial experience would all be suitable.

Where used to support delivery of this unit, work placements should be monitored regularly in order to ensure the quality of the learning experience. It would be beneficial if learners and supervisors were made aware of the requirements of this unit before any work-related activities, so that naturally occurring evidence can be collected at the time. For example, learners may have the opportunity to take part in servicing tractors or land-based machines and they should be encouraged to ask for observation records and/or witness statements to be provided as evidence. Guidance on the use of observation records and witness statements is provided on the Pearson website.

Tutors should consider integrating the delivery, private study and assessment relating to this unit with any other relevant units and assessment instruments the learner may also be taking as part of their programme of study.

Learning outcome 1 is likely to be delivered through a series of demonstrations, site visits, supervised land-based service and repair practicals and formal lectures. Learners will develop skills relating to the repair of mechanical transmission equipment. Visiting expert speakers could add to the relevance of the subject for learners. For example, a representative from a land-based machine manufacturer could talk about the company's products and how they are used.

Learning outcome 2 is likely to be delivered through formal lectures, discussion, site visits, demonstrations and independent learner research. Learners will become aware of the construction and function of cooling and lubrication systems. This is intended to be a wide ranging learning outcome. Tutors must cover the range listed in the unit content. However, they may wish to spend longer in delivering information relating to commonly used cooling and lubrication systems in the primary sector(s) being studied. Ideally, learners should have access to actual examples of components listed in the unit content. Visiting expert speakers could add to the relevance of the subject for learners. For example, a farm worker or forester could talk about their work and the engines they use. Visits to country shows where land-based machine manufacturers display their products could be useful.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan gives **an indication of the volume of learning it would take the average learner** to achieve the learning outcomes. It is **indicative and is one way of achieving the credit value.**

Learning time should address all learning (including assessment) relevant to the learning outcomes, regardless of where, when and how the learning has taken place.

Topic and suggested assignments/activities and/assessment
Introduction to the unit.
Assignment 1: Cooling and Lubrication Systems (P5, P6, P7, P8, P9, M2, D1) Introduction to the assignment.
Theory session: reasons for lubrication and cooling systems in engines, methods of temperature control in land-based engineering applications.
Theory session: operating principles of lubrication and cooling systems.
Practical session: identifying and examining components.
Demonstration: dismantling, repair, reinstating and testing.
Practical session: dismantling, repair, reinstating and testing.
Classroom-based activity: causes and symptoms of insufficient cooling and lubrication, avoiding and preventing problems.
Assessment completion.
Assignment 2: Service and Repair of Cooling and Lubrication Systems (P1, P2, P3, P4, M1) Introduction to the assignment.
Demonstration: drainage and replacement of lubricants and coolants.
Practical session: drainage and replacement of lubricants and coolants.
Theory and classroom activity: types of coolants and lubricants and their use.
Practical session: preparing and testing cooling and lubrication systems and components.
Practical assessment.
Unit review.

Assessment

For P1 and P2, learners need to identify different types of cooling systems, lubrication systems and their components and different types of coolants and lubricants and select the appropriate product to comply with manufacturers' specifications. Tutors should identify the systems or agree them through discussion with learners. Where possible, the systems should be those commonly used in the land-based industry sector that is the learner's primary area o interest. Evidence could be generated through practical assessment or a verbal or written report.

For P3 and P4, learners need to carry out maintenance on cooling and lubrication systems. This should include the draining and renewal of coolants and lubricants and the testing of systems and components. Tutors should identify the systems or agree them through discussion with learners. Where possible, the systems should be those commonly used in the land-based industry sector that is the learner's primary area of interest. Assessment may be through practical observation. If this format is used then suitable evidence would be observation records completed by learners and the tutor, and accompanied by appropriate worklogs or other relevant learner notes. If assessed during a work placement, witness statements should be provided by a suitable representative and verified by the tutor.

For P5, learners need to state the reasons for and methods of temperature control in land-based engineering applications. Evidence may be a written or verbal report, leaflet, booklet, poster or presentation.

For P6, learners are required to describe the symptoms and causes of insufficient cooling and lubrication. Evidence could link with and be presented in the same format as for P5.

For P7 and P8, learners are required to describe the operating principles of cooling and lubrication systems in engines and state the reasons for having lubrication and cooling systems in these engines. Tutors should identify the systems or agree them through discussion with learners. Where possible, the systems should be those commonly used in the land-based industry sector that is the learner's primary area of interest. Evidence may be in the same format as for P5.

For P9, learners need to describe how to dismantle, repair, reinstate and test cooling and lubrication systems. Tutors should identify the systems or agree them through discussion with learners. Where possible, the systems should be those commonly used in the land-based industry sector that is the learner's primary interest area. Evidence may be presented in the same format as for P5, or linked with the practical assessment in P3 and P4.

For M1, learners are required to report on service and repair findings, using information from the maintenance and tests carried out in P3 and P4. This report may be written or verbal, but should be presented in appropriate language so the customer can understand the findings.

M2 requires learners to explain the importance of cooling and lubrication systems in land-based engines. This could be an extension of evidence presented for P5, P6, P7 and P8 and may be presented in the same format.

D1 requires learners to explain common causes of component failure in cooling and lubrication systems and how these may be prevented. Evidence could be a case study, written or verbal report, poster, leaflet or through recorded questioning and answering.

Programme of suggested assignments

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Pearson assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2, P3, P4, M1	Service and Repair of Cooling and Lubrication Systems	You are working for a local agricultural dealership that repairs different types of Land-based machinery. As part of your role, you have been asked to carry out servicing and testing of cooling and lubrication systems, including coolant and lubricant selection, and report on your findings. Your manager will also ask you to identify different types of cooling and lubrication systems and their components as part of your regular performance reviews.	Practical Report, Job card, Work-logs.

Criteria covered	Assignment title	Scenario	Assessment method
P5, P6, P7, P8, P9, M2, D1	Cooling and Lubrication Systems	You are working for a local agricultural dealership that repairs land-based vehicles and have been asked to mentor a work placement student. Create some guidance notes for them which include the reasons for and methods of temperature control, causes and symptoms of insufficient cooling and lubrication, the importance of cooling and lubrication systems, their operating principles and how to dismantle, repair, reinstate and test them. Include a section which explains common causes of component failure and how these may be prevented.	Guidance notes.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC land-based sector suite. This unit links with many units within this specification and has particular links with:

Level 2	Level 3
LEO10 Core land-based engineering principles – cooling and lubrication	Understanding and Working with Land-based Vehicle Engine Technology

Essential resources

Learners will need access to a range of land-based vehicles with different types of mechanical transmission equipment to support their practical investigation. They will also need access to sufficient test and repair equipment and materials to enable accurate evaluation of land-based engines and components. Manufacturers' specifications will also be required. Tutors delivering this unit should be familiar with land-based engines and their components.

Employer engagement and vocational contexts

Learners could be introduced to a variety of professionals from different companies and organisations to broaden their knowledge and make the learning experience interesting and contextualised. This could be through either guest lectures, work placements or off-site visits to different establishments.

Textbooks

Bell B – *Farm Machinery, 5th Edition* (Old Pond Publishing, 2005) ISBN 1903366682

Hillier V, Coombes P and Rogers D – *Hillier's Fundamentals of Motor Vehicle Technology: Powertrain Electronics, 5th Edition* (Nelson Thornes, 2006) ISBN 0748780998

Whipp J and Brooks R – *Transmission, Chassis and Related Systems* (Vehicle Maintenance & Repair Series: Level 3), 3rd Edition (Thomson Learning, 2001) ISBN 186152806X

Websites

www.bagma.com	British Agricultural and Garden Machinery Association
www.defra.gov.uk	Department for Environment, Food and Rural Affairs
www.howstuffworks.com	HowStuffWorks
www.hse.gov.uk	Health and Safety Executive
www.iagre.org	Institution of Agricultural Engineers
www.lantra.co.uk	Lantra Sector Skills Council

Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit:

Skill	When learners are …
Independent enquirers	explaining the function of cooling and lubrication systems assessing risk
Creative thinkers	explaining the function of cooling and lubrication systems assessing risk explaining principles of operation
Reflective learners	discussing the correct selection of components describing methods of fault diagnosis
Team workers	carrying out maintenance and repair work diagnosing faults using a variety of sources
Self-managers	carrying out maintenance and repair work diagnosing faults using a variety of sources
Effective participators	diagnosing faults using a variety of sources.

Although PLTS opportunities are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are …
Independent enquirers	planning and carrying out research activities related to the unit evaluating and carrying out extended thinking
Creative thinkers	asking questions to extend their thinking during lectures and practical sessions adapting ideas as circumstances change eg repairs on a variety of machinery
Reflective learners	identifying opportunities for their own achievements setting goals for themselves eg time management reviewing progress in practical tasks and coursework
Team workers	working with others to carry out repair and maintenance tasks reaching clear agreements regarding who is carrying out which tasks during practical activities working together when diagnosing faults
Self-managers	dealing with pressures in an emergency situation managing time and resources during practical activities
Effective participators	discussing issues of concern relating to time management and resources during practical activities identifying improvements that could be implemented during practical tasks.

Functional Skills – Level 2

Skill	When learners are …
ICT – Use ICT systems	
Select, interact with and use ICT systems independently for a complex task to meet a variety of needs	completing their course work using ICT facilities using interactive materials for teaching and learning, researching subjects on the internet.
Use ICT to effectively plan work and evaluate the effectiveness of the ICT system they have used	
Manage information storage to enable efficient retrieval	
Follow and understand the need for safety and security practices	
Troubleshoot	
Mathematics	
Understand routine and non-routine problems in a wide range of familiar and unfamiliar contexts and situations	planning an activity and obtaining relevant information from relevant sources using this information to carry out multi-stage calculations to do with amounts or sizes, scales or proportion and using formulae. interpreting the results of calculations, presenting your findings and justifying your methods.
Identify the situation or problem and the mathematical methods needed to tackle it	
Select and apply a range of skills to find solutions	
Use appropriate checking procedures and evaluate their effectiveness at each stage	
Interpret and communicate solutions to practical problems in familiar and unfamiliar routine contexts and situations	
Draw conclusions and provide mathematical justifications	

Skill	When learners are …
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	reading material on the subject from a variety of sources for their assignment work. reading around subjects and producing clear and concise documents using correct engineering terminology presenting information to a group of people, ideally in a classroom situation with their peers.
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	

Unit 11: Land-based Engineering Operations – Service and Repair Engines and Components

Unit code: K/600/3424

Level 2: BTEC First

Credit value: 10

Guided learning hours: 60

Aim and purpose

The aim of this unit is to provide the learner with the knowledge and skills required to perform engine service and repair tasks on Land-based engineering equipment.

Unit introduction

Recent developments in engine design have led to much improvement in efficiency, performance and exhaust emissions. Manufacturers have developed the engine to meet the new emission tiers whilst improving performance for a given size of engine further. This has mainly been as a result of developments in the combustion process, the introduction of the common rail fuel system and monitoring of engine performance by a variety of electronic control units.

In this unit learners will develop the knowledge and skills needed to understand the features, construction, function and operation of compression ignition (CI) and spark ignition (SI) engines commonly used in land-based vehicles and support the need for accurate fault diagnosis and repair of land-based engines.

Learners will also develop an understanding of engine systems and their relationship to improved of efficiency, performance and exhaust emissions. An integral part of this unit to interpreting data given in workshop manuals and the application of relevant health and safety regulations.

Learning outcomes

On completion of this unit a learner should:

1 Be able to perform basic service and repair procedures on engines and their components

2 Know the construction, function and operation of two-stroke and four-stroke spark and compression ignition engines and their components.

Unit content

1 Be able to perform basic service and repair procedures on engines and their components

Engine types: two-stroke; four-stroke; spark ignition; compression ignition

Engine components: carburettors; spark plugs; injection pumps; fuel delivery pumps; injectors; governors; cold start aids; air filtration systems; exhaust systems; turbo; superchargers

Sub-assemblies: cylinder heads and valve train; pistons and rings; liner, wet and dry; engine timing; camshaft; balancer; crankshaft; spark ignition systems

Service and repair: two-stroke; four-stroke; spark ignition; compression ignition; causes of engine wear; manufacturers' specifications; reasons for following manufacturers' instructions eg safety, warranty; safe working practice in service and repair operations; correct use and storage of tools, equipment and materials; appropriate disposal of waste; reporting of findings to appropriate colleagues; record keeping; legislation and codes of practice requirements relevant to service and repair operations; own performance and identification of improvement

2 Know the construction, function and operation of two-stroke and four-stroke spark and compression ignition engines and their components

Engine types and their uses: two-stroke; four-stroke; spark ignition; compression ignition; their uses in different scenarios

Construction and operation of engine components: carburettors; spark plugs; injection pumps; fuel delivery pumps; injectors; governors; cold start aids; air filtration systems; exhaust systems; turbo; superchargers; principles of safe working practice (preparation, care, use, maintenance, storage, environmental considerations); relevant legislation and codes of practice eg Health and Safety at Work Act 1974; risk assessment; consequences of accidents to individuals, family, business, the national economy

Engine features: air cooled and water cooled; wet and dry liners; monoblock; naturally aspirated and pressure charged covering turbo compounding and supercharging; balancers and vibration suppression; differences between direct and indirect fuel injection systems; engine starting and stopping procedures

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria					
To achieve a pass grade the evidence must show that the learner is able to:		**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**		**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**	
P1	identify engine types and their components [EP, SM, RL]	**M1**	explain how to identify the signs of excessive engine wear and poor maintenance	**D1**	evaluate own performance in the service and repair of engines, recommending appropriate areas of improvement
P2	remove, dismantle, repair and reinstate ancillary engine components and sub-assemblies to manufacturers' specifications and standards [EP, TW, SM, IE]				
P3	describe the types, construction and operating principles of land-based engines [IE, CT, SM, RL]	**M2**	explain how the effectiveness of given components affects engine performance	**D2**	suggest a maintenance programme for a given land-based machine.
P4	describe the function and types of engine components [IE, CT, SM, RL]				
P5	describe engine features and their purpose within the engine construction [IE, CT, SM, RL]				
P6	describe how to remove, dismantle, repair and reinstate engines and components to manufacturers' specifications and standards (excluding fuel, induction and exhaust systems) [IE, CT, SM, RL]	**M3**	explain why servicing and maintenance are important for land-based engines.		
P7	describe engine starting and stopping procedures [IE, CT, SM, RL]				
P8	state the major differences between direct and indirect fuel injection systems. [IE, CT, RL, SM]				

PLTS: This summary references where applicable, in the square brackets, the elements of the personal, learning and thinking skills applicable in the pass criteria. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

All centres must comply with the requirements of relevant, current legislation and codes of practice eg the *Prevention of Accidents to Children in Agriculture Regulations 1998*. Learners must be made aware of, and have access to, relevant health and safety legislation and know the importance of the use of risk assessments appropriate to each situation. Appropriate risk assessments must precede all practical machinery activities and learners must work in a safe manner at all times when using equipment or working with machinery. Learners must be supervised at all times and tutors must not ask learners to undertake tasks that are beyond their physical capabilities.

Tutors have the opportunity to use as wide a range of techniques as possible in delivering this unit. Delivery is likely to have a strong practical bias, including demonstrations and the opportunity for supervised workshop practice. Lectures, discussions, seminar presentations, site visits, internet and library-based research and the use of personal and/or industrial experience would also be suitable. Visiting expert speakers could add to the relevance of the subject for learners. For example, a representative from a land-based machine manufacturer could talk about the company's products and how they are used.

Where used to support delivery of this unit, work placements should be monitored regularly in order to ensure the quality of the learning experience. It would be beneficial if learners and supervisors were made aware of the requirements of this unit before any work-related activities, so that naturally occurring evidence can be collected at the time. For example, learners may have the opportunity to take part in servicing tractors or land-based machines and they should be encouraged to ask for observation records and/or witness statements to be provided as evidence. Guidance on the use of observation records and witness statements is provided on the Pearson website.

Tutors should consider integrating the delivery, private study and assessment relating to this unit with any other relevant units and assessment instruments learners may also be taking as part of their programme of study.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan gives **an indication of the volume of learning it would take the average learner** to achieve the learning outcomes. It is **indicative and is one way of achieving the credit value.**

Learning time should address all learning (including assessment) relevant to the learning outcomes, regardless of where, when and how the learning has taken place.

Topic and suggested assignments/activities and/assessment
Introduction to the unit.
Assignment 1: Servicing and Repair (P1, P2, M1, D1) Introduction to the assignment.
Workshop sessions: identify engine types and their components.
Theory session and demonstrations: reasons and methods of servicing.
Workshop sessions: carrying out servicing and repair.

Topic and suggested assignments/activities and/assessment
Assessment: practical observations.
Assignment 2: Engine Components (P3, P4, P5, P8, M2) Introduction to the assignment.
Theory and demonstrations: types, construction and operating principles of land-based engines.
Classroom and workshop based activities: function and types of the engine components.
Theory session: engine features and their purpose, how components affect performance.
Theory and workshop session: fuel injection systems.
Assignment completion.
Assignment 3: Maintaining Land-based Engines (P6, P7, M3, D2) Introduction to the assignment.
Theory and practical sessions: reviewing how to remove, dismantle, repair and reinstate engines and/or components.
Theory session: engine starting and stopping procedures.
Classroom session: planning a maintenance programme.
Assignment completion.
Unit review.

Assessment

For P1, learners must identify engine types and the key components listed in the unit content. The engines chosen can be those that are commonly found in the land-based sector being studied. Evidence could be in the form of a verbal or written report, leaflet, poster or through recorded questioning and answering.

For P2, learners need to remove, dismantle, repair and reinstate three ancillary engine components, and remove, disassemble, assess for wear and reassemble three sub-assemblies. Evidence may be in the from of practical observation sheets or a log-book. If assessed during a work placement, witness statements should be provided by a suitable representative and verified by the tutor. Guidance on the use of observation records and witness statements is provided on the Pearson website.

Assessment of P3, P4 and P5 may be linked. Learners need to produce information describing the types, construction and operating principles of land-based engines (P3), the function and types of engine components and engine features and their purpose. Evidence may be in the same format as for P1.

For P6, learners need to produce information describing how to remove, dismantle, repair and reinstate engines and/or components. This may be linked to the practical assessment completed for P2, or may be a separate piece of work in the same format as P1.

For P7, learners need to produce information explaining engine starting and stopping procedures. Evidence may be in the same format as for P1.

For P8, learners need to state the major differences between direct and indirect fuel injection systems. Evidence may be in the same format as for P1.

M1 requires learners to explain how to identify the signs of excessive wear and poor maintenance. Evidence may be linked to P2 through recorded questions and answers, or completed separately in the same format as P1.

M2 requires learners to explain how the effectiveness of three engine components affects engine performance. The engine components should be selected by the tutor before the start of the task. Evidence may be linked to that for P3, P4 and P5 and be in the same format.

For M3, learners are required to explain the importance of servicing and maintenance for land-based

engines. Evidence may be a verbal or written report, project, presentation, poster, leaflet or case study.

For D1, learners need evaluate their performance when carrying out service and repair activities in terms of adhering to working rules, requirements and practical competence. They must recommend appropriate areas for improvement.

For D2, learners need to suggest a maintenance programme for a given land-based machine. The machine should be identified by the tutor before the start of the task.

Programme of suggested assignments

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Pearson assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2, M1, D1	Servicing and Repair	You are working for a local agricultural dealership that repairs different types of engines. Your supervisor is assessing your performance to decide whether to recommend you for promotion. You will need to identify a range of engines and components and carry out servicing and repair on land-based engines. Explain to your supervisor how to identify signs of excessive wear and poor maintenance, and evaluate the standard of your work.	Practical observation, Verbal report. QandA.
P3, P4, P5, P8, M2	Engine Components	Your supervisor is pleased with your work, and you have been promoted. One of your responsibilities is to train others, and you have been asked to produce a guidance booklet which includes the types, construction, operating principles and functions of land-based engines, and their components and features. Include the differences between direct and indirect fuel injection systems.	Written guidance booklet.
P6, P7, M3, D2	Maintaining Land-based Engines	As part of your new role you have been asked to produce an information leaflet to customers to help them improve the performance of their vehicles and understand the importance of servicing. This should include a description of how you service their vehicles, correct engine starting and stopping procedures, and an explanation of why servicing and maintenance are important. Include a suggested maintenance programme for a land-based vehicle.	Leaflet.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC land-based sector suite. This unit has particular links with:

Level 2	Level 3
LEO11 Service and repair engines on land-based equipment	Understanding and Working with Land-based Vehicle Engine Technology

Essential resources

Learners will need access to a range of land-based vehicles with different types of engines and simulation equipment to support their practical investigation. They will also need access to sufficient test and repair equipment and materials to enable accurate evaluation of land-based engines and components. Manufacturers' specifications should also be available. Tutors delivering this unit should be familiar with land-based engines and components.

Employer engagement and vocational contexts

Learners could be introduced to a variety of professionals from different companies and organisations to broaden their knowledge and make the learning experience interesting and contextualised. This could be through either guest lectures, work placements or off-site visits to different establishments.

Indicative reading for learners

Textbooks

Bell B – *Farm Machinery, 5th Edition* (Old Pond Publishing, 2005) ISBN 1903366682

Hillier V, Coombes P and Rogers D – *Hillier's Fundamentals of Motor Vehicle Technology: Powertrain Electronics, 5th Edition* (Nelson Thornes, 2006) ISBN 0748780998

Nunney M – *Light and Heavy Vehicle Technology, 4th Edition* (Butterworth-Heinemann, 2006) ISBN 0750680377

Whipp J and Brooks R – *Transmission, Chassis and Related Systems (Vehicle Maintenance & Repair Series: Level 3)*, 3rd Edition (Thomson Learning, 2001) ISBN 186152806X

Websites

www.bagma.com	British Agricultural and Garden Machinery Association
www.defra.gov.uk	Department for Environment, Food and Rural Affairs
www.howstuffworks.com	HowStuffWorks
www.hse.gov.uk	Health and Safety Executive
www.iagre.org	Institution of Agricultural Engineers
www.lantra.co.uk	Lantra Sector Skills Council

Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit:

Skill	When learners are …
Independent enquirers	explaining the function of land-based engine components assessing risk explaining principles of operation
Creative thinkers	explaining the function of land-based engines assessing risk explaining principles of operation discussing the correct selection of components
Reflective learners	discussing the correct selection of components describing methods of fault diagnosis
Team workers	carrying out maintenance and repair work diagnosing faults using a variety of sources
Self-managers	carrying out maintenance and repair work diagnosing faults using a variety of sources
Effective participators	diagnosing faults using a variety of sources.

Although PLTS opportunities are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are …
Independent enquirers	planning and carrying out research activities related to the unit evaluating and carrying out extended thinking
Creative thinkers	asking questions to extend their thinking during lectures and practical sessions adapting ideas as circumstances change eg repairs on a variety of machinery
Reflective learners	identifying opportunities for their own achievements setting goals for themselves eg time management reviewing progress in practical tasks and coursework
Team workers	working with others to carry out repair and maintenance tasks reaching clear agreements regarding who is carrying out which tasks during practical activities working together when diagnosing faults
Self-managers	dealing with pressures in an emergency situation managing time and resources during practical activities
Effective participators	discussing issues of concern relating to time management and resources during practical activities identifying improvements that could be implemented during practical tasks.

Functional Skills – Level 2

Skill	When learners are …
ICT – Use ICT systems	
Select, interact with and use ICT systems independently for a complex task to meet a variety of needs	completing their course work using ICT facilities using interactive materials for teaching and learning researching subjects on the internet.
Use ICT to effectively plan work and evaluate the effectiveness of the ICT system they have used	
Manage information storage to enable efficient retrieval	
Follow and understand the need for safety and security practices	
Troubleshoot	
Mathematics	
Understand routine and non-routine problems in a wide range of familiar and unfamiliar contexts and situations	planning an activity and obtaining relevant information from relevant sources. Using this information to carry out multi-stage calculations to do with amounts using formulae. interpreting the results of calculations, presenting your findings and justifying your methods.
Identify the situation or problem and the mathematical methods needed to tackle it	
Select and apply a range of skills to find solutions	
Use appropriate checking procedures and evaluate their effectiveness at each stage	
Interpret and communicate solutions to practical problems in familiar and unfamiliar routine contexts and situations	
Draw conclusions and provide mathematical justifications	

Skill	When learners are …
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	reading material on the subject from a variety of sources for their assignment work reading around subjects and producing clear and concise documents using correct engineering terminology presenting information to a group of people ideally in a classroom situation with their peers.
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	

Unit 12: Service and Repair Clutches, Fluid Flywheels and Torque Converters on Land-based Equipment

Unit code: H/600/3423

Level 2: BTEC First

Credit value: 5

Guided learning hours: 30

Aim and purpose

The aim of this unit is to provide the learner with the knowledge and skills required to service and repair clutches, flywheels and torque converters within Land-based equipment.

Unit introduction

An engine's power is transmitted to the place where the work is to be carried out by various means on land-based equipment. In nearly all transmission systems there needs to be a point at which the engagement and disengagement of the drive can be accommodated to either take up the drive or prevent overload of the system. This unit deals with the construction, function and maintenance of clutches, fluid flywheels and torque converters (fluid couplings) ie the devices that enables this to happen.

Learners will be introduced to the mechanical and hydraulic devices that accomplish these tasks. Learners will investigate friction clutches and will discover how they can be used to transmit all engine power or be set up to allow only a certain proportion of the power to be transmitted. Fluid flywheels and torque converters (fluid couplings) are also be introduced as possible alternatives to a mechanical system.

Learners will carry out service and repair operations on these devices. They will also study their construction and the principles of operation that enable them to be maintained in good working order and according to manufacturers' specifications.

Learning outcomes

On completion of this unit a learner should:

1 Be able to perform service and repair operations on clutches and associated devices

2 Know the construction, function and operation of clutches and associated devices.

Unit content

1 Be able to perform service and repair operations on clutches and associated devices

Transmission layouts and component location: manual transmission, fluid flywheel; torque converter shuttle; torque converter power-shift; conventional dry clutch; dual clutch; torque limiting/slip clutch; multi dry plate clutch

Access to transmission clutches and fluid couplings: vehicle security; vehicle stability; vehicle isolation; specialist ancillary systems eg air conditioning, front loader cab and control systems; vehicle jacking; transmission/engine alignment systems; splitting techniques; component protection; dust control measures

Clutch and flywheel removal and replacement: manufacturers' information; cleanliness and dust control measures; clamping load and safe release techniques; component protection; component assessment and measurements; serviceability; realignment for reassembly eg mandrels, spigot shaft, dummy shaft; reassembly procedures and setting up; run out measurement; finger height; release bearing reassembling machine; adjustment and free play; surface grinding and skimming

Fluid coupling removal and replacement: oil and spill prevention; draining points; cleanliness; component protection; component condition assessment; serviceability; realignment for reassembly; drive plates, drive rings; run out measurement and adjustment; refilling and oil levels

2 Know the construction, function and operation of clutches and associated devices

Clutch types: dry single and dual clutches; diaphragm; wet single and multi disc; torque limiting/slip; centrifugal; overrun; electro magnetic; cone

Clutch function and operation: make and break drive lines; take up drive; torque limiting; overload protection; coefficient of friction; anti vibration; shock/judder control

Fluid coupling function and operation: fluid flywheel, single and two stage torque converters; multi plate wet clutches

Condition assessment: test procedures; operational tests; sensory testing; stall tests; slip measurement/assessment; component measurement and manufacturers' specifications

Common causes of failure: overload; incorrect adjustment; operator misuse; wear and tear; contamination; corrosion; overheating

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria					
To achieve a pass grade the evidence must show that the learner is able to:		**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**		**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**	
P1	carry out stall tests and assess the slip point of torque limiting clutches [IE, TW, SM]	**M1**	assess a and-based machine transmission clutch system, report on its condition and suggest options for repair or replacement	**D1**	justify the choice of clutch or fluid coupling as fitted by the manufacturer for a selected machine.
P2	remove, dismantle, repair, and reinstate clutches and associated devices to manufacturer's specifications and standards [CT, TW, EP]				
P3	identify and report reasons for clutch, fluid flywheel/or torque converter failure [CT, RL]				
P4	describe the different types, construction, and functions of clutches, fluid flywheels and torque converters [IE, RL]	**M2**	compare the operation of manual dry clutches and fluid couplings as fitted to various land-based machinery.		
P5	explain the methods used to sequence clutch engagement and provide smooth drive take up [IE, SM]				
P6	explain how to remove, dismantle, repair, recondition and reinstate clutches, fluid flywheels and torque converters [RL]				

Assessment and grading criteria			
To achieve a pass grade the evidence must show that the learner is able to:		**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P7	describe how to assess clutch failure, wear and condition [RL]		
P8	identify the common causes and symptoms of clutch, fluid flywheel and torque converter failure. [IE, CT, EP]		

PLTS: This summary references where applicable, in the square brackets, the elements of the personal, learning and thinking skills applicable in the pass criteria. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

All centres must comply with the requirements of relevant, current legislation and codes of practice eg the *Prevention of Accidents to Children in Agriculture Regulations 1998*. Learners must be made aware of, and have access to, relevant health and safety legislation and know the importance of the use of risk assessments appropriate to each situation. Appropriate risk assessments must precede all practical machinery activities and learners must work in a safe manner at all times when using equipment or working with machinery. Learners must be supervised at all times and tutors must not ask learners to undertake tasks that are beyond their physical capabilities.

Delivery of this unit will involve practical assessments, written assessment, visits to suitable business organisations and will link to industrial experience placements. It is likely to be a mixture of classroom learning and supervised practical sessions in a workshop. Assessment is likely to be in the form of a portfolio collecting relevant recorded and authenticated evidence.

Tutors have the opportunity to use as wide a range of techniques as possible. Lectures, discussions, seminar presentations, site visits, supervised land-based workshop practicals, internet and library-based research and the use of personal and/or industrial experience would all be suitable. Delivery should stimulate, motivate, educate and enthuse learners.

Work placements should be monitored regularly in order to ensure the quality of the learning experience. It would be beneficial if learners and supervisors were made aware of the requirements of this unit before any work-related activities, so that naturally occurring evidence could be collected at the time. For example, learners may have the opportunity to contribute to the maintenance, servicing and repair of land-based machinery clutches and fluid couplings and they should be encouraged to ask for observation records and/or witness statements to be provided as evidence. Guidance on the use of observation records and witness statements is provided on the Pearson website.

Whichever delivery methods are used, it is essential that tutors stress the importance of the principles and application of health and safety guidance, good working practice, environmental protection issues and the need to manage the resource using legal methods. Although not specifically stated in the learning outcomes of the unit, these principles should be embedded at all stages of delivery and throughout all learning activities. Tutors must consider the safety of those working in, or coming into contact with the machinery and equipment to be serviced, maintained and/or repaired. Risk assessments must be undertaken before practical activities. Tutors should not ask learners to undertake tasks that are beyond their physical capabilities. As learners develop their skills, the tutor may encourage them to identify clutch and fluid coupling service and maintenance activities in real situations, selecting and using the necessary tools and equipment under supervision.

Learning outcome 1 deals with the practical aspects of working with clutches and fluid couplings. Learners should be encouraged to investigate the different types and applications utilised by machine manufacturers. Testing and fault diagnosis will be introduced through stall and slip testing and this can be extended into practical activities in clutch and fluid coupling repair or overhaul. This should include refurbishment options such as surface grinding or skimming of friction surfaces on flywheels and pressure plates.

Learning outcome 2 supports learning outcome 1 by examining the construction, function, manufacturers' applications and operation of clutches and fluid couplings. An introduction to the concept of friction should be included– in this way torque limiting devices can be investigated. Learners could carry out dismantling, condition assessment and reassembly procedures to given or manufacturers' specifications.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan gives **an indication of the volume of learning it would take the average learner** to achieve the learning outcomes. It is **indicative and is one way of achieving the credit value.**

Learning time should address all learning (including assessment) relevant to the learning outcomes, regardless of where, when and how the learning has taken place.

Topic and suggested assignments/activities and/assessment
Introduce unit and assessment schedule.
Investigate concepts of friction.
Assignment 1: Clutch Testing and Repairs (P1, P2, P3, P6, P7, P8, M1)
Practical activity: transmission type assessment and component location.
Practical activity: testing (stall and slip).
Practical activity: clutch removal and condition assessment.
Investigate component construction function and operation.
Practical activity: clutch reinstatement and adjustment.
Investigate fluid couplings: operational testing.
Practical activity: fluid flywheel/torque converter removal and assessment.
Practical activity: fluid flywheel/torque converter reinstatement and adjustment.
Assignment 2: Applications for Clutches and Fluid Couplings (P4, P5, M2, D1)
Investigate driveline protection clutches.
Dismantle, assess and reassemble driveline protection clutches.
Unit review.

Assessment

For P1, learners must carry out, under supervision, a series of tests to diagnose faults on clutches and fluid couplings. Typically stall and slip tests should be undertaken in controlled conditions with learners reporting their findings. This lends itself to an element of group working. If this method is used tutors should satisfy themselves of the individual's contribution to the process. It is accepted that all centres will not have the range and type of equipment available for real-life scenarios to be utilised, in which case tutors should simulate situations on machinery and equipment

P2, requires learners repairs a land-based machine clutch or fluid coupling. Again group working is possible and tutors should satisfy themselves of individual contributions. Evidence can also be gathered for P6 through observation supported by individual discussion and the completion of authenticated work records and descriptions of work processes undertaken

When assessing machine performance for P1, learners could point out reasons for the failure of clutches or fluid couplings through discussion or written report for P3 and by extending the discussion could provide evidence for P7 and P8. This criteria could be assessed directly by observation by the tutor during practical activities when learners are undertaking work placement. If this format is used suitable evidence from guided activities would be observation records completed by the learner and supervisor accompanied by appropriate work logs or other relevant learner notes. If assessed during a work placement, these witness

statements should be provided by a suitable representative and verified by the tutor. Guidance on the use of observation records and witness statements is provided on the Pearson website.

For P4 and P5, learners are expected to research the range of clutches and fluid couplings identified in the unit content describing their type, construction and the functions they carry out. They explain their operating principles and how, in the case of operator involvement, they are controlled and the sequencing of events as they are used. Evidence could be in the form of a written report, pictorial presentation and or posters

For M1, learners need to asses a land-based machine and, prior to dismantling for repair, report on its condition and suggest options for rectification. Where possible, the given objectives should be the same for each learner. However, it is appreciated that this may be difficult to organise for larger learner groups, in which case tutors should again try to ensure fairness of assessment for all learners

For M2, learners are expected to compare the operation of manual clutch systems with fluid couplings. Two of the devices used for P4 and P5 could be used with learners commenting on the advantages and disadvantages of devices used in similar circumstances on different machines by different manufacturers. Evidence could be in the form of a written report, pictorial presentation or posters

For D1, learners are required to evaluate the use of either clutch or fluid coupling to meet given objectives. Evidence may be linked directly to work being undertaken for other criteria in the Unit or tutors could ask learners to evaluate different applications.

Evidence could take the form of a reflective log attached to the research activities undertaken where learners describe the choice of clutch or fluid coupling in the context of its role in the machine's operating cycle. Tutors should identify the given objectives of the chosen machines in discussion with learners. Where possible, the size and complexity of these should be the same for each learner to ensure fairness of assessment. Evidence for D1 is likely to be diverse and wide ranging in nature. Observation and discussion will play a vital role and will require careful monitoring. Illustrated reports and searches will also provide documentary evidence within a portfolio.

Programme of suggested assignments

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Pearson assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2, P3, P6, P7, P8, M1	Clutch Testing and Repairs	A predominantly practical situation where learners test transmission clutches and fluid couplings, gain access to the components and carry out replacement or refurbishment before to reassembly. Learners should report their findings regarding failure and record their work processes	Naturally occurring evidence as learners work through either real or simulated clutch/fluid coupling failures. Observation. Job records Reports.
P4, P5, M2 D1	Applications for Clutches and Fluid Couplings	A research-based assignment involving learners in searches for information regarding clutch and fluid coupling types and applications. Learners are expected to comment on the range of applications, how they operate and where and why manufacturers use the devices	Written report. Posters. Pictorial presentation.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC land-based sector suite. This unit has particular links with:

Level 2	Level 3
LEO12 Service and repair clutches, fluid flywheels and torque convertors on land-based equipment	Land-based Engineering Operations – Service and Repair Engines and Components

Essential resources

Learners will need access to a equipped workshop. Learners will also need to access a range of Land-based machinery and equipment to investigate and repair as well as to the consumable items needed for clutch and fluid coupling repair projects. Access to a range of components that make up different types of clutches and fluid couplings will help learners gain a perspective on scale and application. There must be sufficient resources to give learners the opportunity to develop practical skills over a period of time. It is vital that there is an adequate supply of PPE as well as first aid facilities.

Workshop facilities should also have the appropriate procedures for storing and disposing of oils, chemicals and contaminated parts, and for the control and extraction of dust and contaminants from clutch and fluid coupling components in line with current best practice and legislation.

Tutors delivering this unit should be competent and experienced in the use of workshop tools and machinery maintenance/repair. Ideally, they should have recent industrial experience or show evidence of regular contact with the industry and/or technical updating.

Employer engagement and vocational contexts

The unit has a very practical focus and in this respect employer engagement will place servicing, repair and maintenance of clutches and fluid couplings in context.

Good employer links will also help secure a valuable resource for the benefit of learners. Work placement opportunities should be actively sought alongside visits by experienced practitioners to illustrate current equipment, trends and practice in clutch and fluid coupling maintenance and service operations. Learners could be encouraged to develop links with employers and arrange visits and demonstrations.

Indicative reading for learners

Textbooks

Bell B – *Farm Workshop, 2nd Edition* (Farming Press, 1992) ISBN 0852362374

Shippen J – *Basic Farm Machinery* (Butterworth-Heinemann, 1980) ISBN 00802491 16

Hillier V and Coombes P – *Hillier's Fundamentals of Motor Vehicle Technology, 5th Edition* (Nelson Thornes, 2004) ISBN 0748780823

Whipp J and Brooks R – *Transmission, Chassis and Related Systems* (Vehicle Maintenance & Repair Series: Level 3), 3rd Edition (Thomson Learning, 2001) ISBN 186152806X

Journals

Farm Ideas

Farmers Guardian

Farmers Weekly

Profi International

Websites

www.defra.gov.uk	DEFRA
www.environment-agency.gov.uk	Environment Agency
www.hse.gov.uk	Health and Safety Executive
www.lantra.org.uk	LANTRA

Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit:

Skill	When learners are …
Independent enquirers	carrying out system testing researching different systems researching operation of systems
Creative thinkers	dismantling machinery for repairs identifying reasons for failures
Reflective learners	reporting failures in systems describing applications and procedures describing causes of failure
Team workers	working in groups to establish faults identifying causes of failure working in groups to achieve repair objectives
Self-managers	organising machinery for repairs researching operational sequencing
Effective participators	dismantling and repairing systems discussing causes of failures.

Functional Skills – Level 2

Skill	When learners are …
ICT – Use ICT systems	
Select, interact with and use ICT systems independently for a complex task to meet a variety of needs	researching manufacturers' specifications reviewing websites
Manage information storage to enable efficient retrieval	maintaining a portfolio of evidence managing assessed work
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	obtaining information on transmission devices and applications
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	researching manufacturers' information justifying component selection
ICT – Develop, present and communicate information	
Enter, develop and format information independently to suit its meaning and purpose including: • text and tables • images • numbers • records	compiling written work for assessment maintaining a portfolio of practical evidence completing work records
Bring together information to suit content and purpose	preparing assignment submissions completing job cards and worksheets
Present information in ways that are fit for purpose and audience	submitting work for assessment completing component condition reports
Mathematics	
Understand routine and non-routine problems in a wide range of familiar and unfamiliar contexts and situations	calculating lever lengths measuring torque transmission
Identify the situation or problem and the mathematical methods needed to tackle it	calculating lever length and load interaction transposing formulae
Draw conclusions and provide mathematical justifications	reporting results of tests

Skill	When learners are …
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	working in groups to agree practical activities researching component operation negotiating session/assessment objectives
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	reviewing manufacturers' technical information to carry out service tasks using specifications to set up devices
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	submitting work for assessment recording work activities on job cards describing component operation.

Unit 13: Service and Repair Mechanical Transmissions on Land-based Equipment

Unit code: Y/600/3421

Level 2: BTEC First

Credit value: 10

Guided learning hours: 60

Aim and purpose

The aim of this unit is to provide the learner with the knowledge and skills required to service and repair mechanical transmission in Land-based equipment. This unit will introduce learners to how these can be applied in practice. It is designed for learners in centre-based settings looking to progress into the sector or onto further/higher education.

Unit introduction

The need to improve the efficiency and productivity of land-based vehicles has become more important as land-based businesses analyse their machinery costs. To improve land-based vehicle efficiency manufacturers have developed 'user friendly' transmission systems that can be complex in design but are reliable and effective in operation. Those employed in maintenance, fault diagnosis and repair of land-based vehicles must therefore have the knowledge and skills to undertake the repair a mechanical transmissions.

In this unit learners will develop the knowledge and skills needed to understand the types and characteristics of mechanical transmissions commonly used in land-based vehicles and to support the need for accurate fault diagnosis and repair of mechanical transmissions.

Learners will develop an understanding of mechanical transmissions and their relationship to the improved of efficiency and performance of land-based equipment. An integral part of the unit to interpreting data given in workshop manuals and the application of relevant health and safety regulations.

Learning outcomes

On completion of this unit a learner should:

1 Be able to perform service and repair operations on mechanical transmissions

2 Know the type and characteristics of transmission and gearboxes

3 Know how to remove and reinstate transmission

4 Know how to identify transmission faults.

Unit content

1 Be able to perform service and repair operations on mechanical transmissions

Service and repair: reasons for maintenance, servicing and repair; use of manufacturers' service manuals; methods used to maintain; methods used to check the integrity of maintenance, service and repair activities; health and safety; risk assessment; relevant current legislation

Types of mechanical transmission equipment: single and multi ratio transmissions; front and/or rear axle assemblies; belt drive assemblies; friction drive assemblies; drive shaft assemblies, PTO drives

2 Know the type and characteristics of transmission and gearboxes

Transmissions and gearboxes: sliding mesh; constant mesh; synchromesh; selectors and interlocks; differentials; differential locks; limited slip; range and reduction; front and/or rear drive axles; reduction units; forward and reverse shuttle; PTO drives; drive shaft assemblies; constant velocity joints; belt drive assemblies; friction drives; single and multi ratio transmissions

3 Know how to remove and reinstate transmission

Systems: two-wheel drive; four-wheel drive; power take-off; track laying

Transmission clutches: types eg dual, multi-plate oil immersed, fluid couplers; clutch operation

Gearboxes: types eg sliding mesh, constant mesh, synchromesh, semi automatic, powershift; gearbox operation

Final drives: types eg crown wheel and pinion, differential, differential locking, final reduction units

4 Know how to identify transmission faults

Faults in transmission equipment: methods used to identify faulty components eg regular and irregular noise; lock up; loss of drive; drag; over heating; vibration; jump out; non selection; use of manufacturers' service manuals; health and safety; risk assessment; relevant-current legislation

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 remove dismantle, repair and reinstate transmission assemblies and their components to manufacturers specifications and standards [EP, TW, SM, IE]	**M1** carry out risk assessments for repair activities on mechanical transmission equipment	**D1** evaluate selected mechanical transmission equipment in terms of cost and effectiveness
P2 identify and report faults in mechanical transmission assemblies and their components [EP, SM, RL]		
P3 describe the types, construction, characteristics and operating principles of transmissions and gearboxes [IE, CT, SM, RL]	**M2** justify applications of two and four-wheel drive mechanical transmission equipment in given situation	
P4 describe the drive path through a mechanical transmission and their components with the aid of the manufacturer's schematic drawings [IE, CT, SM, RL]		
P5 summarise the relationship between power, speed and torque and the influence on transmission layout and component size [IE, RL, SM]		

Assessment and grading criteria					
To achieve a pass grade the evidence must show that the learner is able to:		**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**		**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**	
P6	describe how to remove dismantle, repair and reinstate transmissions and their components [IE, CT, SM, RL]	**M3**	describe the tools and equipment required to carry out repair tasks to mechanical transmission equipment to meet given objectives and justify the choice	**D2**	explain the effect that a lack of maintenance has on the performance of mechanical transmission equipment.
P7	explain how to identify land-based equipment mechanical transmission faults. [IE, CT, SM, RL]	**M4**	identify the components which would be most likely to fail due to incorrect operator actions in mechanical transmission equipment.		

PLTS: This summary references where applicable, in the square brackets, the elements of the personal, learning and thinking skills applicable in the pass criteria. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

All centres must comply with the requirements of relevant, current legislation and associated codes of practice eg the *Prevention of Accidents to Children in Agriculture Regulations 1998*. Learners must be made aware of, and have access to, relevant health and safety legislation and know the importance of the use of risk assessments appropriate to each situation. Appropriate risk assessments must precede all practical machinery activities and learners must work in a safe manner at all times when using equipment or working with machinery. Learners must be supervised at all times and tutors must not ask learners to undertake tasks that are beyond their physical capabilities.

Delivery of this unit will involve practical assessments, written assessment, visits to suitable collections and will link to industrial experience placements.

Tutors have the opportunity to use as wide a range of techniques as possible. Lectures, discussions, seminar presentations, site visits, supervised tractor and/or land-based machinery operation practicals, internet and library-based research and the use of personal and/or industrial experience would all be suitable. Delivery should stimulate, motivate, educate and enthuse learners.

Work placements should be monitored regularly in order to ensure the quality of the learning experience. It would be beneficial if learners and supervisors were made aware of the requirements of this unit before any work-related activities, so that naturally occurring evidence can be collected at the time. For example, learners may have the opportunity to operate tractors or land-based machines and they should be encouraged to ask for observation records and/or witness statements to be provided as evidence. Guidance on the use of observation records and witness statements is provided on the Pearson website.

Tutors should consider integrating the delivery, private study and assessment relating to this unit with any other relevant units and assessment instruments learners may also be taking as part of their programme of study.

Learning outcome 1 is likely to be delivered through a series of demonstrations, site visits, supervised land-based service and repair practicals and formal lectures. Learners will develop skills relating to the repair of mechanical transmission equipment. Visiting expert speakers could add to the relevance of the subject for learners. For example, a representative from a land-based machine manufacturer could talk about the company's products and how they are used.

Learning outcomes 2, 3 and 4 are likely to be delivered by formal lecture, discussion, site visits and independent learner research. Learners will be able to explain how to remove and reinstate and identify faults in mechanical transmission equipment. This is intended to be a wide ranging learning outcome. Tutors must cover the range listed in the unit content. However they may wish to spend longer delivering information relating to commonly used mechanical transmission equipment in the primary sector(s) being studied. Ideally, learners should have access to actual examples of the transmissions listed in the unit content. Visiting expert speakers could add to the relevance of the subject for learners. For example, a farm worker or forester could talk about their work and the engines they use. Visits to country shows where land-based machine manufacturers display their products could be useful.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan gives **an indication of the volume of learning it would take the average learner** to achieve the learning outcomes. It is **indicative and is one way of achieving the credit value.**

Learning time should address all learning (including assessment) relevant to the learning outcomes, regardless of where, when and how the learning has taken place.

Topic and suggested assignments/activities and/assessment
Introduction to the unit.
Assignment 1: Perform Service and Repair Operations on Mechanical Transmissions (P1, P2, M1) Introduction to the assignment and learner- centred research.
Remove, dismantle, identify faults, repair and reinstate transmission assemblies and their components to manufacturers' specifications and standards.
Assignment 2: Types and Characteristics of Transmission and Gearboxes (P3, P4, P5, M2, D1) Introduction to the assignment and learner- centred research.
Describe the types, construction, characteristics and operating principles of transmissions and gearboxes.
Describe the drive path through a mechanical transmission and their components with the aid of the manufacturer's schematic drawings.
Assignment 3: Transmission Removal and Reinstatement (P6, M3) Introduction to the assignment and learner- centered research.
Assignment 4: Transmission Fault Identification (P7, M4, D2) Introduction to the assignment and learner-centered research.
Feedback on learning and assessment.
Unit review.

Assessment

For P1 and 2, learners need to remove, disassemble, identify faults, repair and reinstate mechanical transmission equipment or components. Tutors should identify the systems or agree them through discussion with learners. Where possible, to ensure fairness of assessment the size and complexity of the task should be the same for all learners. It is expected that, as a minimum, learners will provide evidence for two mechanical transmission assemblies or components, preferably those commonly used in the land-based industry sector that is their primary interest area of interest.

For P3 learners need to describe the types, construction characteristics and operating principles of mechanical transmission equipment. Where possible, the size and complexity of the task should be the same for each learner to ensure fairness of assessment. It is expected that, as a minimum, learners will provide evidence for two pieces of mechanical transmission equipment, preferably those commonly used in the land-based industry sector that is their primary areas of interest. Evidence may be in the form of a project assignment or through recorded questioning and answering.

For P4 and P5, learners need to produce information showing the path of drive through a mechanical transmission using manufacturer's drawings and summarising the relationship between speed, power and torque. Where possible, the size and complexity of the task should be the same for each learner to ensure fairness of assessment. Evidence may be in the form of a project assignment or through recorded questioning and answering.

For P6 learners need describing how to remove, dismantle, repair and reinstate mechanical transmission equipment and their components. Where possible, the size and complexity of the task should be the same for each learner to ensure fairness of assessment. Evidence may be in the form of a project assignment or through recorded questioning and answering.

For P7, learners need to explain how to identify faults in mechanical transmission equipment. Where possible, the size and complexity of the task should be the same for each learner to ensure fairness of assessment. It is expected that, as a minimum, learners will provide evidence for two pieces of mechanical transmission equipment, preferably those commonly used in the land-based industry sector that is their primary areas of interest. Evidence may be in the form of a project assignment or through recorded questioning and answering.

M1 requires learners to carry out risk assessments for repair activities on mechanical transmission equipment. Learners are expected to provide evidence for two different activities. Tutors should identify the activities or agree them through discussion with learners. The activities may be the same as those used to provide evidence for other assessment and grading criteria. Where possible, to ensure fairness of assessment the size and complexity of the tasks should be the same for all learners. Evidence should be in a format that is recognised within the industry and by the Health and Safety Executive.

M2 requires learners to justify the application of two- and- four wheel drive mechanical transmission equipment in given situations. Tutors should identify the machines or agree them through discussion with learners. Where possible, to ensure fairness of assessment the size and complexity of the task should be the same for all learners. Evidence may be in the form of a project assignment or through recorded questioning and answering

M3 requires learners to select the tools, equipment and materials required to carry out repair tasks to mechanical transmission equipment to meet given objectives and justify their choice. Tutors should identify the systems and objectives, or agree them through discussion with learners. The systems may be the same as those used to provide evidence for other assessment and grading criteria. Where possible, to ensure fairness of assessment the size and complexity of the tasks should be the same for all learners. Evidence must cover tasks relating to bearings, shafts, chains and belts and may be in the form of a project assignment or through recorded questioning and answering

M4 requires learners to identify the components which would be most likely to fail due to incorrect operator actions. Learners are expected to provide evidence for two types of mechanical transmission equipment. Evidence may be in the form of a project assignment or through recorded questioning and answering

For D1, learners must evaluate selected mechanical transmission equipment in terms of cost and effectiveness. Tutors should identify the systems or agree them in discussion with learners. The systems may be the same as those used to provide evidence for other assessment and grading criteria. Learners are expected to provide evidence for a minimum of two mechanical transmissions. Where possible, to ensure fairness of assessment the size and complexity of the task should be the same for all learners.

D2 requires learners to explain the effects that a lack of maintenance has on the performance of mechanical transmission equipment. Tutors should identify the systems or agree them in discussion with learners. The systems may be the same as those used to provide evidence for other assessment and grading criteria. Learners are expected to provide evidence for a minimum of two mechanical transmissions. Where possible, to ensure fairness of assessment the size and complexity of the task should be the same for all learners.

Programme of suggested assignments

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Pearson assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2, M1	Perform Service and Repair Operations on Mechanical Transmissions	You are working for a local agricultural dealership that repairs different types of engines. You should be able to remove dismantle, identify faults, repair and reinstate transmission assemblies and their components.	Practical. Report. Job card. Work logs.
P3, P4, P5, M2, D1	Types and Characteristics of Transmission and Gearboxes	You are working for a local agricultural dealership that repairs land-based vehicles. You will need to be able to describe the drive path through a transmission using manufacturer's schematic drawings and explain the relationship between speed, power and torque.	Assignment. Report. Presentation
P6, M3	Transmission Removal and Reinstatement	You are working for a local agricultural dealership that repairs land-based vehicles to assist your work you will need to remove and refit mechanical transmission equipment.	Assignment. Report. Presentation.
P7, M4, D2	Transmission Fault Identification	You are working for a local agricultural dealership that repairs land-based vehicles. You will need to be able to explain how to carry out fault finding on mechanical transmission equipment.	Assignment. Report. Presentation.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC land-based sector suite. This unit links with many units in this specification and has particular links with:

Level 2	Level 3
LEO13 Service and repair mechanical transmission on land-based equipment	Understanding and Servicing Mechanical Power Transmission Systems

Essential resources

Learners will need access to a range of land-based vehicles with different types of mechanical transmission equipment to support their practical investigation. They will also need access to sufficient test and repair equipment and materials to enable accurate evaluation of land-based engines and components.

Manufacturers' training videos, service manuals and test data will make a significant contribution to learners achievement. Tutors delivering this unit should be familiar with land-based engines and their components.

Employer engagement and vocational contexts

Learners could be introduced to a variety of professionals from different companies and organisations to broaden their knowledge and make the learning experience interesting and contextualised. This could be through either guest lectures, work placements or off-site visits to different establishments.

Indicative reading for learners

Textbooks

Bell B – *Farm Machinery, 5th Edition* (Old Pond Publishing, 2005) ISBN 1903366682

Hillier V, Coombes P and Rogers D – *Hillier's Fundamentals of Motor Vehicle Technology: Powertrain Electronics, 5th Edition* (Nelson Thornes, 2006) ISBN 0748780998

Whipp J and Brooks R – *Transmission, Chassis and Related Systems* (Vehicle Maintenance & Repair Series: Level 3), 3rd Edition (Thomson Learning, 2001) ISBN 186152806X

Websites

www.bagma.com	British Agricultural and Garden Machinery Association
www.defra.gov.uk	Department for Environment, Food and Rural Affairs
www.howstuffworks.com	HowStuffWorks
www.hse.gov.uk	Health and Safety Executive
www.iagre.org	Institution of Agricultural Engineers
www.lantra.co.uk	Lantra Sector Skills Council

Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit:

Skill	When learners are …
Independent enquirers	explaining the function of mechanical transmission equipment assessing risk explaining principles of operation
Creative thinkers	explaining the function of mechanical transmission equipment assessing risk explaining principles of operation discussing the correct selection of components
Reflective learners	discussing the correct selection of components describing methods of fault diagnosis
Team workers	carrying out maintenance and repair work diagnosing faults using a variety of sources
Self-managers	carrying out maintenance and repair work diagnosing faults using a variety of sources
Effective participators	diagnosing faults using a variety of sources.

Although PLTS opportunities are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are …
Independent enquirers	planning and carrying out research activities related to the unit evaluating and carrying out extended thinking
Creative thinkers	asking questions to extend their thinking during lectures and practical sessions adapting ideas as circumstances change eg repairs on a variety of machinery
Reflective learners	identifying opportunities for their own achievements setting goals for themselves eg time management reviewing progress in practical tasks and coursework
Team workers	working with others to carry out repair and maintenance tasks reaching clear agreements regarding who is carrying out which tasks during practical activities working together when diagnosing faults
Self-managers	dealing with pressures in an emergency situation managing time and resources during practical activities
Effective participators	discussing issues of concern relating to time management and resources during practical activities identifying improvements that could be implemented during practical tasks.

Functional Skills – Level 2

Skill	When learners are …
ICT – Use ICT systems	
Select, interact with and use ICT systems independently for a complex task to meet a variety of needs	completing their course work using ICT facilities using interactive materials for teaching and learning, researching subjects on the internet.
Use ICT to effectively plan work and evaluate the effectiveness of the ICT system they have used	
Manage information storage to enable efficient retrieval	
Follow and understand the need for safety and security practices	
Troubleshoot	
Mathematics	
Understand routine and non-routine problems in a wide range of familiar and unfamiliar contexts and situations	plan an activity and obtaining relevant information from relevant sources use this information to carry out multi-stage calculations to do with using formulae. interpreting the results of calculations, presenting findings and justifying your methods
Identify the situation or problem and the mathematical methods needed to tackle it	
Select and apply a range of skills to find solutions	
Use appropriate checking procedures and evaluate their effectiveness at each stage	
Interpret and communicate solutions to practical problems in familiar and unfamiliar routine contexts and situations	
Draw conclusions and provide mathematical justifications	
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	reading material on the subject from a variety of sources for their assignment work reading around subjects and producing clear and concise documents using correct engineering terminology presenting information to a group of people ideally in a classroom situation with their peers.
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	

Unit 14: Service and Repair Braking Systems on Land-based Equipment

Unit code: R/600/3420

Level 2: BTEC First

Credit value: 5

Guided learning hours: 30

Aim and purpose

This unit aims to introduce learners to the skills and knowledge in the service and repair of Land-based equipment braking systems and how these can be applied in practice. It is designed for learners in centre-based settings looking to progress into the sector or onto further/higher education.

Unit introduction

Technical advancements relating to land- based tractors, machines and transport equipment have increased the need for equipment to be serviced regularly and repaired to ensure is safe and capable of optimum performance.

Land-based equipment is becoming larger and heavier. Equipment is expected to travel at greater speeds and is subjected to increased loads over steep and undulating terrain.

In this unit learners will develop and improve their ability to understand why braking systems on land-based tractors and equipment need to be maintained according to manufacturer's recommendations and to recognise the need to replace or repair worn, missing or damaged components. Due to the vast range of equipment available to meet modern day requirements it would be impossible for learners to demonstrate an understanding of all the equipment. Learners will select from a range of equipment typical to their chosen area of study.

On completion of the unit, learners will have successfully demonstrated knowledge, understanding and an ability to perform specific tasks on their chosen range of equipment they must also be made aware of the need to follow future developments which are increasingly being introduced by manufacturers.

Due to the increased complexities and performance requirements of modern equipment there are increased risks of accidents and injuries. It is essential that, throughout the unit, all learners demonstrate safe working practices and conform to legislative requirement.

Learning outcomes

On completion of this unit a learner should:

1 Be able to perform service and repair operations on braking systems and their components

2 Know the construction, function and operation of braking systems

3 Know how to recognise faults in braking systems.

Unit content

1 Be able to perform service and repair operations on braking systems and their components

Service operations: daily checks and maintenance, pre-use checks for braking efficiency, balance, linkage checks and lubrication, periodic service and adjustments, oil level checks, park brake engagement

Systems: mechanical; hydraulic; pneumatic; hydro-pneumatic

Type: eg band brakes (static and/or hand-held equipment), disc brakes, drum brakes; independent; 2 wheel-drive; 4 wheel-drive; transmission; parking brakes/locks

Faults: eg spongy and/or soft pedal; pitting, scoring and excessive wear, contamination, uneven braking, binding, grabbing, glazing, fade, failure, vapour lock, glazing, vibration, noise, incorrect fluids, leaking seals

Repair operations: preparation of equipment, decontamination; relevant legislation and codes of practice; dismantling procedures and marking orientation of components; wear checks on components, manufacturers wear limits, replacement linings, shoes, discs, seals; hydraulic, mechanical, remote linkage repair, component replacement, adjustments; replacement fluids, air evacuation, brake balancing valve operations; removal, dismantling, repair and reinstatement of braking systems and their components (adjust, bleed, balance, test braking performance)

2 Know the construction, function and operation of braking systems

Construction: component layout; wet and dry brake systems, drum brakes, lining materials, leading and trailing shoes, drum, adjusters, return springs; disc brakes, disc materials, single and multi-disc packs, actuator linkages, pistons, seals; retarder devices and exhaust brakes, valves, linkages, solenoids

Function and operation: efficiency, loads, road legislations, construction and use regulations; independent operation, combination of exhaust, vehicle and trailer braking, effects of inadequate or faulty tyre and/or suspension systems, operation on gradients and uneven ground.

Systems: wet and dry disc, drum and band brakes; induction and exhaust brakes overrun brakes; independent braking; 2-wheel and 4-wheel braking; park brakes and locks; trailer braking

Effects: effects of heat on braking efficiency and brake components eg glazing, brake fade, wear/deterioration of braking surfaces, vapour lock; effects of incorrect braking relationships between towing vehicle and attachments (advance, fail safe devices, jack-knifing brake); how vehicle ballast, loading and weight transfer can influence braking performance

3 Know how to recognise faults in braking systems

Recognition of faults: eg grabbing, binding, glazing, fade, failure, vapour lock, spongy and/or soft pedal, uneven braking, vibration, noise, contamination, pitting, scoring and excessive wear, incorrect operating fluid, leaking seals

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria					
To achieve a pass grade the evidence must show that the learner is able to:		**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**		**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**	
P1	identify braking systems and their components [RL,CT]	**M1**	perform practical tasks with due consideration for health and safety, environmental and legal considerations and use	**D1**	perform practical tasks following manufacturers' service instructions, using specialised measuring and testing apparatus, having set up or calibrate the equipment, before obtaining and recording necessary measurements or data.
P2	perform tests, decontaminate, remove, dismantle, repair and reinstate braking systems to meet manufacturers/ technical and legislative compliance [SM, EP]				
P3	identify and report on braking system faults [RL, CT]				
P4	describe the construction and function of braking systems and their components [CT]	**M2**	describe situations and give examples of land-based equipment where the range of systems would be most suited		
P5	describe how to remove, dismantle, repair and reinstate braking systems and their components				
P6	describe the effects that heat can have on braking efficiency and brake components				
P7	summarise the effects of incorrect braking relationships between towing vehicle and attachments				
P8	describe how to recognise faults in braking systems.	**M3**	describe possible causes of braking system faults and explain how faults in braking systems could be minimised.		

PLTS: This summary references where applicable, in the square brackets, the elements of the personal, learning and thinking skills applicable in the pass criteria. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

All centres must comply with the requirements of relevant, current legislation and codes of practice eg the *Prevention of Accidents to Children in Agriculture Regulations 1998*. Learners must be made aware of, and have access to, relevant health and safety legislation and know the importance of the use of risk assessments appropriate to each situation. Appropriate risk assessments must precede all practical machinery activities and learners must work in a safe manner at all times when using equipment or working with machinery. Learners must be supervised at all times and tutors must not ask learners to undertake tasks that are beyond their physical capabilities.

Delivery of this unit will involve practical assessments, written assessment, visits to suitable collections and will link to industrial experience placements.

Tutors have the opportunity to use as wide a range of techniques as possible. Lectures, discussions, seminar presentations, site visits, supervised land-based braking system practical maintenance and repair operations, internet and library-based research and the use of personal and/or industrial experience would all be suitable. Delivery should stimulate, motivate, educate and enthuse learners.

Work placements should be monitored regularly in order to ensure the quality of the learning experience. It would be beneficial if learners and supervisors were made aware of the requirements of this unit before any work-related activities, so that naturally occurring evidence can be collected at the time. For example, learners may have the opportunity to operate and maintain tractor and land-based equipment braking systems and they should be encouraged to ask for observation records and/or witness statements to be provided as evidence. Guidance on the use of observation records and witness statements is provided on the Pearson website.

Tutors should consider integrating the delivery, private study and assessment relating to this unit with any other relevant units and assessment instruments learners may also be taking as part of their programme of study.

Learning outcome 1 could be delivered through demonstrations, visits and by a series of supervised practical maintenance and repair sessions backed up by lectures to cover technical and safety aspects. Due to the vast range of land-based vehicles and equipment available to cover braking systems, tutors should make available those that apply to learners areas of study. Learners will be required to develop a portfolio of evidence covering practical operations to include machine details, repair procedures undertaken, job cards and tutor feedback on performance. The portfolio may contribute to assessment decisions.

Learning outcome 2 will be delivered primarily through formal lectures and discussions that could be complemented by visits to appropriate shows and working demonstrations.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan gives **an indication of the volume of learning it would take the average learner** to achieve the learning outcomes. It is **indicative and is one way of achieving the credit value.**

Learning time should address all learning (including assessment) relevant to the learning outcomes, regardless of where, when and how the learning has taken place.

Topic and suggested assignments/activities and/assessment
Introduction to the unit.
Assignment 1: Practical Diaries for Land-based Equipment Braking System Service and Repair (P1, P2, P3, M1, D1)
Evidence gathering.
Braking system recognition, construction and working principles.
Inspection of braking systems in preparation for service, component replacement and repair tasks.
Service, component replacement and repair of braking systems.
Assignment 2: Construction and Function of Land-based Vehicle and Equipment Braking Systems (P4, P5, M2)
Safe working practices, service and repair records, safety and environmental issues.
Assignment 3: Recognition of Braking System Faults and Remedies (P6, P7, P8, M3)
Fault diagnosis of braking systems.
Trailer braking legislation, safe loading and capacities.
Overview of progress, assignment 1.
Performance evaluations and comparisons.
Overview of progress, assignment 2/3.
Practical assessments on component replacement and brake testing procedures.
Unit review.

Assessment

To achieve P1, P2 and P3, learners need required to identify systems and components and carry out identified practical repair and replacement tasks on mechanical and hydraulic operated braking systems that relate to their chosen area of learning. Learners must prepare and set up the equipment in readiness for work according to manufacturers' recommended data. All practical tasks and tutor feedback needs to be recorded by way of a portfolio of evidence using observation records and/or witness statement that include a record of machine details and the work carried out. Learners must demonstrate an ability to recognise faults in systems and components and record findings as part of the evidence portfolio.

To achieve M1, learners need to demonstrate safe and correct use of tools and equipment when undertaking service and repair tasks and component replacement. All legislation and codes of practice relevant to practical operations should be named, explained and recorded in the portfolio. To achieve D1, learners need to provide information on measuring procedures, specialist tools and equipment used, together with manufacturers' setting data.

To achieve P4 and P5, learners are required to describe the construction, working principles and functions of the braking systems, and used to generate evidence for P1, P2 and P3. Learners will also be required to describe procedures for the overhaul of those systems.

To achieve P6 and P7, learners are describe the effects of heat generated by friction in braking systems and the effects on systems when brakes are used incorrectly when towing equipment that is loaded incorrectly.

To achieve M2, learners are be required to describe a range of situations, including ground conditions, gradient and travel speeds, and give examples and reasons for the choice of braking system for equipment operated in those conditions.

To achieve P8 learners need explain the procedures for recognising 5 common braking system faults outlined in the unit content. To achieve M3, learners must explain how faults may be minimised by either changes in operational procedures or upgrading of components or adjustment.

P4, P5, P6, P7, P8, M1, M2, M3 and D1 could be evidenced through a report or project work.

Programme of suggested assignments

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Pearson assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2, P3, M1, D1	Practical Diaries for Land-based Equipment Braking System Service and Repair	A selection of four braking systems require inspection, maintenance repair and performance testing before to being put to work. The equipment owner requires the work to be carried out and expects a portfolio of records to be produced to enable service documentation to be transferred into a company planned maintenance recording system.	Practical work records. Observations. Portfolio. Inspection records. Health and safety procedures and records. Observation of correct use of service tools and equipment.
P4, P5, M2	Construction and Function of Land-based Vehicle and Equipment Braking Systems	Produce summary and comparisons of a range of selected vehicle and equipment braking systems including suggestions as to the situations the different systems would be most suited to.	Written evidence. Verbal evidence. Record of Q&A.
P6, P7, P8, M3	Recognition of Braking System Faults and Remedies	Outline a minimum of five potential braking system faults and describe how the faults may be recognised or diagnosed. Suggest the reasons for these faults and how reoccurrence may be minimised.	Written evidence of knowledge of potential braking system fault and remedies Q&A records.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC land-based sector suite. This unit links with many units in this specification and has particular links with:

Level 2	Level 3
LEO14 Service and Repair Braking Systems on Land-based Equipment	Understanding and Working with Land-based Vehicle Engine Technology

Essential resources

Learners will need access to a range of currently available land-based vehicle and equipment braking systems and appropriate operator handbooks or service manuals. Suitable work areas need to be equipped to enable decontamination and repair activities and suitable facilities need to be available to allow vehicles and equipment to be checked for correct operation and performance. Specialist tools and equipment will also be needed to allow measurements and settings to be made in line with manufacturers' information. Learners will need access to spare parts details and list and to IT equipment and appropriate software.

Employer engagement and vocational contexts

Learners should be encouraged to contact land-based vehicle and equipment dealers and manufacturers to obtain relevant information and possibly build up a relationship that may enable them to engage in work experience activities to strengthen their experience and learning. Where learners do not have prior experience of the working principles of specific land-based vehicle and equipment braking systems, it may be useful for them to be given the opportunity to operate the machines in a commercial environment.

Indicative reading for learners

Textbooks

Bell B – *Farm Machinery* (Old Pond Publishing, 2005) ISBN 1903366682

Brian Cairns – *The Farmers and Groundsmans guide to Planning Vehicle and Machinery Maintenance* (The Crowood PressLTD) ISBN 1847971104

Culpin C – *Farm Machinery, 12th edition,* (Blackwell Scientific, 1992) ISBN 0632031597

Hillier V and Coombes P – *Hillier's Fundamentals of Motor Vehicle Technology, 5th edition* (Nelson Thornes, 2004) ISBN 0748780823

Journals

Horticultural Weekly

Profi International

Other publications

Manufacturers' publications and manuals

Lubrication charts and data sheets

Websites

www.bagma.com British Agricultural and Garden Machinery Association

www.hse.gov.uk Health and Safety Executive

Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit:

Skill	When learners are …
Creative thinkers	identifying types of land-based vehicle braking systems describing the operation and function of systems
Reflective learners	identifying types of land-based vehicle braking systems and reporting on braking system faults.
Self-managers	Performing test procedures and carrying out practical service, replacement and repair tasks on braking systems
Effective participators	Performing test procedures and carrying out practical service, replacement and repair tasks on braking systems.

Although PLTS opportunities are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are …
Independent enquirers	contacting dealers and manufacturers for product and service information.

Functional Skills – Level 2

Skill	When learners are …
ICT – Use ICT systems	
Select, interact with and use ICT systems independently for a complex task to meet a variety of needs	sourcing manufacturers' data and information for braking system function and components
Manage information storage to enable efficient retrieval	producing a portfolio of evidence for practical tasks
Follow and understand the need for safety and security practices	undertaking practical activities
Troubleshoot	identifying and rectifying faults on braking systems
ICT – Find and select information	
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	sourcing manufacturers' data and information for braking system function and components
ICT – Develop, present and communicate information	
Enter, develop and format information independently to suit its meaning and purpose including: • text and tables • images • numbers • records	photographic evidence when undertaking practical tasks
Mathematics	
Understand routine and non-routine problems in a wide range of familiar and unfamiliar contexts and situations	measuring braking system components for suitability and wear
Draw conclusions and provide mathematical justifications	comparing manufacturers' wear limits on braking system components.

Unit 15: Service and Repair Wheeled and Tracked Steering Systems on Land-based Equipment

Unit code: D/600/3419

Level 2: BTEC First

Credit value: 5

Guided learning hours: 30

Aim and purpose

The aim of this unit is to provide the learner with the knowledge and skills required to work with wheeled and tracked steering systems on Land-based equipment.

Unit introduction

Engine technology and its associated control systems have advanced rapidly in the last few years. Modern engines are now capable of outstanding performance compared to older, similar sized power units. This, together with advances in transmission design, means that the typical land-based vehicle is capable of greater traction and speed than before.

These factors have lead to an increased need for wheeled steering and tracked steering system technology able to cope with the forces associated with modern vehicle performance characteristics.

Learning outcomes

On completion of this unit a learner should:

1 Be able to perform service operations on wheeled or tracked steering systems

2 Know the construction, function and operation of wheeled and tracked steering systems

3 Know the symptoms and causes of steering faults.

Unit content

1 Be able to perform service operations on wheeled or tracked steering systems

Wheeled steering systems: types eg manual, power assisted, hydrostatic; steering modes eg front, rear, four wheel, articulated, skid-steer, crab steer;

Checking and set steering geometry: steering lock; toe in/out; track rod; costs; maintenance requirements; health and safety; personal protective equipment (PPE)

Tracked steering systems: steering clutch, band brakes, oil immersed brakes, controlled differential steering;

2 Know the construction, function and operation of wheeled and tracked steering systems

Steering systems: types, working principles and application (manual, mechanical power assisted, hydrostatic); steering modes eg front, rear, four wheel, articulated, skid-steer, crab steer; front and/or rear axle steering; slew; zero turn

Components: types eg steering box types, rack and pinion, linkage, steering metering valve steering boxes, centre pivot, steering axle components; steering system brake units; independent; tracked; zero turn

Steering principles: Ackerman layout; toe in/out; castor, camber and king pin inclination; 2wd/4wd; how equipment balance, loading and application can influence steering performance

3 Know the symptoms and causes of steering faults

Test steering: recognition of faulty components; visual inspection; testing procedures as recommended by manufacturers' service manuals to determine successful repairs; steering pulling; wheel wobble/shake; lazy/sluggish steering; heavy steering; steering wheel free play; incorrect tyre pressure and sizes; health and safety; PPE

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria					
To achieve a pass grade the evidence must show that the learner is able to:		**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**		**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**	
P1	remove, dismantle, reassemble, and reinstate steering systems to meet manufacturer's/technical/ legislative compliance [EP, TW, SM, IE]	**M1**	report service and repair findings to appropriate colleagues	**D1**	evaluate wheeled and tracked steering systems in terms of cost and maintenance requirements
P2	using appropriate tools and equipment, check and set steering geometry [EP, TW, SM, IE]				
P3	identify and rectify the cause of steering faults [EP, SM, RL]				
P4	describe the working principles of mechanical, power assisted and hydrostatic steering systems and their application	**M2**	compare and explain the constructional differences between two different types of steering system		
P5	describe the types, construction and function of steering system components [IE, CT, SM, RL]				
P6	describe the principles and geometry of steering systems [IE, CT, SM, RL]				
P7	describe how to remove, dismantle, reassemble and replace steering system components [IE, CT, SM, RL]				
P8	state the methods of checking and adjusting steering geometry [IE, CT, SM, RL]				

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P9 identify the basic mechanical operating principles of auto steer and guidance systems used in land-based equipment [IE, CT, SM, RL]		
P10 describe the symptoms characteristics and causes of common steering system faults. [IE, CT, SM, RL]	**M3** describe how to diagnose faults in wheeled and tracked steering systems.	D2 explain the effect that a lack of maintenance has on the performance of wheeled and tracked steering systems.

PLTS: This summary references where applicable in the pass criteria, in the square brackets, the elements of the **PLTS**: This summary references where applicable, in the square brackets, the elements of the personal, learning and thinking skills applicable in the pass criteria. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key			
	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

All centres must comply with the requirements of relevant, current legislation and codes of practice eg the *Prevention of Accidents to Children in Agriculture Regulations 1998*. Learners must be made aware of, and have access to, relevant health and safety legislation and know the importance of the use of risk assessments appropriate to each situation. Appropriate risk assessments must precede all practical machinery activities and learners must work in a safe manner at all times when using equipment or working with machinery. Learners must be supervised at all times and tutors must not ask learners to undertake tasks that are beyond their physical capabilities.

Delivery of this unit will involve practical assessments, written assessment, visits to suitable collections and will link to industrial experience placements.

Tutors have the opportunity to use as wide a range of techniques as possible. Lectures, discussions, seminar presentations, site visits, supervised tractor and/or land-based machinery operation practicals, internet and library-based research and the use of personal and/or industrial experience would all be suitable. Delivery should stimulate, motivate, educate and enthuse learners.

Work placements should be monitored regularly in order to ensure the quality of the learning experience. It would be beneficial if learners and supervisors were made aware of the requirements of this unit before any work-related activities, so that naturally occurring evidence can be collected at the time. For example, learners may have the opportunity to operate tractors or land-based machines and they should be encouraged to ask for observation records and/or witness statements to be provided as evidence. Guidance on the use of observation records and witness statements is provided on the Pearson website.

Tutors should consider integrating the delivery, private study and assessment relating to this unit with any other relevant units and assessment instruments learners may also be taking as part of their programme of study.

Learning outcome 1 is likely to be delivered through a series of demonstrations, site visits, supervised land-based service and repair practicals and formal lectures. Learner will develop skills relating to the service of wheeled and tracked steering systems. Visiting expert speakers could add to the relevance of the subject for learners. For example, a representative from a land-based machine manufacturer could talk about the company's products and how they are used.

Learning outcomes 2 and 3 are likely to be delivered using formal lectures, discussion, site visits and independent learner research. Learners will become aware of the construction, function and operation of wheeled and tracked steering systems and common steering faults. These are intended to be wide ranging learning outcomes. Tutors must cover the range listed in the unit content. However, they may wish to spend longer delivering information relating to commonly used tyres and tracks in the primary sector(s) being studied. Ideally, learners should have access to actual examples of the equipment listed in the unit content. Visiting expert speakers could add to the relevance of the subject learners. For example, a farm worker or forester could talk about their work and the equipment they use. Visits, country shows where land-based machine manufacturers' display their products could be useful.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan gives **an indication of the volume of learning it would take the average learner** to achieve the learning outcomes. It is **indicative and is one way of achieving the credit value.**

Learning time should address all learning (including assessment) relevant to the learning outcomes, regardless of where, when and how the learning has taken place.

Topic and suggested assignments/activities and/assessment
Introduction to the unit.
Assignment 1: Perform Service Operations on Wheeled and Tracked Steering Systems (P1, P2, P3, M1) Introduction to the assignment and learner- centred research.
Remove dismantle, repair and reinstate steering systems to manufacturers/technical/legislative compliance.
Assessment 2: Construction, Function and Operation of Wheeled and Tracked Steering Systems (P4, P5, P6, P7, P8, P9, M2, D1) Introduction to the assignment and learner-centred research.
Compare and explain the constructional differences between two different types of steering system.
Assessment 3: Symptoms and Causes of Steering Faults (P10, M3, D2) Introduction to the assignment and learner-centred research.
Describe how to diagnose faults in wheeled and tracked steering systems.
Explain the effect that a lack of maintenance has on the performance of wheeled and tracked steering systems.
Unit review.

Assessment

For P1, P2 and P3, learners need to remove, dismantle, identify faults, repair and reinstate wheeled and tracked steering systems. Tutors should identify the systems or agree them through discussion with learners. Where possible, to ensure fairness of assessment the size and complexity of the task should be the same for all learners. It is expected that learners will provide evidence for equipment commonly used in the land-based industry sector that is primary area of interest.

For P4, P5 and P6, learners need to provide information on different steering systems. Where possible, the size and complexity of the task should be the same for each learner to ensure fairness of assessment. Evidence may be in the form of a project assignment or through recorded questioning and answering.

For P7 and P8, learners need to describe how to remove, dismantle, repair and adjust wheeled and tracked steering systems. Where possible, the size and complexity of the task should be the same for each learner to ensure fairness of assessment. Evidence may be in the form of a project assignment or through recorded questioning and answering.

For P9, learners need to identify the basic mechanical operating principles of auto steer and guidance systems used in wheeled and tracked steering systems. Evidence may be in the form of a project assignment or through recorded questioning and answering.

For P10, learners need to describe the symptoms, characteristics and causes of common steering system faults. Where possible, the size and complexity of the task should be the same for each learner to ensure fairness of assessment. It is expected that learners will provide evidence for equipment commonly used in the land-based industry sector that is learners primary area of interest.

M1 requires learners to report on service and repair findings to appropriate staff. Learners are expected to provide evidence for two different activities. Tutors should identify the activities or agree them through discussion with learners. The activities may be the same as those used to provide evidence for other assessment and grading criteria. Where possible, to ensure fairness of assessment the size and complexity of the tasks should be the same for all learners. Evidence may be in the form of a project assignment or through recorded questioning and answering

M2 requires learners to compare and explain the constructional differences between two different types of steering system. Tutors should identify the machines or agree them through discussion with learners. Where possible, to ensure fairness of assessment the size and complexity of the task should be the same for all learners. Evidence may be in the form of a project assignment or through recorded questioning and answering

M3 requires learners to describe how to diagnose faults in wheeled and tracked steering systems. Tutors should identify the systems and objectives or agree them through discussion with learners. The systems may be the same as those used to provide evidence for other assessment and grading criteria. Where possible, to ensure fairness of assessment the size and complexity of the tasks should be the same for all learners.

For D1, learners must evaluate wheeled and tracked steering systems in terms of cost and maintenance. Tutors should identify the systems or agree them in discussion with the learner. The systems may be the same as those used to provide evidence for other assessment and grading criteria. Where possible, to ensure fairness of assessment the size and complexity of the tasks should be the same for all learners.

D2 requires learners to explain the effect that a lack of maintenance has on the performance of wheeled and tracked steering systems. Tutors should identify the systems or agree them in discussion with the learner. The systems may be the same as those used to provide evidence for other assessment and grading criteria. Where possible, to ensure fairness of assessment the size and complexity of the task should be the same for all learners.

Programme of suggested assignments

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Pearson assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2, P3, M1	Perform Service Operations on Wheeled and Tracked Steering Systems	You are working for a local agricultural dealership that repairs different types of Land-based machinery. You should be able to service and repair different types of wheeled and tracked steering systems and their components.	Practical. Report. Job card. Work logs.
P4, P5, P6, P7, P8, P9, M2, D1	Construction, Function and Operation of Wheeled and Tracked Steering Systems	You are working for a local agricultural dealership that repairs land-based vehicles. You will need to describe the construction, principle of operation and geometry of wheeled and tracked steering systems and the construction, principle of operation and geometry of wheeled and tracked steering systems, You will also need to describe the operating principles of auto steer and guidance systems.	Assignment. Report. Presentation
P10, M3, D2	Symptoms and Causes of Steering Faults	You are working for a local agricultural dealership that repairs Land-based vehicles. You will need to be able to describe how to diagnose faults in wheeled and tracked steering systems.	Assignment. Report. Presentation

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC land-based sector suite. This unit has particular links with:

Level 2	Level 3
LEO15 Service and repair wheeled and tracked steering Systems on land-based Equipment	Undertaking Land-based Workshop Practice

Essential resources

Learners will need access to a range of land-based vehicles with different types of equipment and simulation equipment to support their practical investigation. They will also need access to sufficient test and repair equipment and materials to enable accurate evaluation of wheeled and tracked steering systems.

Manufacturers' training videos, service manuals and test data will make a significant contribution to learners achievement.

Tutors delivering this unit should be familiar with wheeled and tracked steering systems.

Employer engagement and vocational contexts

Learners could be introduced to a variety of professionals from different companies and organisations to broaden their knowledge and make the learning experience interesting and contextualised. This could be through guest lectures, work placements or off-site visits to different establishments.

Indicative reading for learners

Textbooks

Heisler H – *Vehicle and Engine Technology* (Butterworth-Heinemann, 1998) ISBN 0340691867

Hillier V and Coombes P – *Hillier's Fundamentals of Motor Vehicle Technology* (Nelson Thornes, 2004) ISBN 0748780823

Nunney N J – *Light and Heavy Vehicle Technology* (Butterworth-Heinemann, 1998) ISBN 0750638273

Websites

www.bagma.com	British Agricultural and Garden Machinery Association
www.defra.gov.uk	Department for Environment, Food and Rural Affairs
www.howstuffworks.com	HowStuffWorks
www.hse.gov.uk	Health and Safety Executive
www.iagre.org	Institution of Agricultural Engineers
www.lantra.co.uk	Lantra Sector Skills Council

Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit:

Skill	When learners are …
Independent enquirers	explaining the function of wheeled and tracked steering systems explaining principles of operation
Creative thinkers	explaining the function of wheeled and tracked steering systems assessing risk
Reflective learners	discussing the correct selection of components describing methods of fault diagnosis
Team workers	Carrying out maintenance and repair work diagnosing faults using a variety of sources
Self-managers	carrying out maintenance and repair work diagnosing faults using a variety of sources
Effective participators	diagnosing faults using a variety of sources.

Although PLTS opportunities are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are …
Independent enquirers	planning and carrying out research activities related to the unit evaluating and carrying out extended thinking
Creative thinkers	asking questions to extend their thinking during lectures and practical sessions adapting ideas as circumstances change eg repairs on a variety of machinery
Reflective learners	identifying opportunities for their own achievements setting goals for themselves to achieve eg time management reviewing progress in practical tasks and coursework
Team workers	working with others to carry out repair and maintenance tasks reaching clear agreements regarding who is carrying out which tasks during practical activities working together when diagnosing faults
Self-managers	dealing with pressures in an emergency situation managing time and resources during practical activities
Effective participators	discussing issues of concern relating to time management and resources during practical activities identifying improvements that could be implemented during practical tasks.

Functional Skills – Level 2

Skill	When learners are …
ICT – Use ICT systems	
Select, interact with and use ICT systems independently for a complex task to meet a variety of needs	completing their course work using ICT facilities using interactive materials for teaching and learning researching subjects on the internet
Use ICT to effectively plan work and evaluate the effectiveness of the ICT system they have used	
Manage information storage to enable efficient retrieval	
Follow and understand the need for safety and security practices	
Troubleshoot	
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	
ICT – Develop, present and communicate information	
Enter, develop and format information independently to suit its meaning and purpose including: • text and tables • images • numbers • records	
Bring together information to suit content and purpose	
Present information in ways that are fit for purpose and audience	
Evaluate the selection and use of ICT tools and facilities used to present information	
Select and use ICT to communicate and exchange information safely, responsibly and effectively including storage of messages and contact lists	

Skill	When learners are …
Mathematics	
Understand routine and non-routine problems in a wide range of familiar and unfamiliar contexts and situations	planning an activity and obtaining relevant information from relevant sources Using this information to carry out multi-stage calculations to do with amounts or sizes, scales or proportion using formulae interpret the results of calculations, presenting findings and justifying methods
Identify the situation or problem and the mathematical methods needed to tackle it	
Select and apply a range of skills to find solutions	
Use appropriate checking procedures and evaluate their effectiveness at each stage	
Interpret and communicate solutions to practical problems in familiar and unfamiliar routine contexts and situations	
Draw conclusions and provide mathematical justifications	
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	reading material on the subject from a variety of sources for their assignment work reading around subjects and producing clear and concise documents using correct engineering terminology presenting information to a group of people ideally in a classroom situation with their peers.
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	

Unit 16: Service and Repair Tyres and Tracks on Land-based Equipment

Unit code: K/600/3410

Level 2: BTEC First

Credit value: 5

Guided learning hours: 30

Aim and purpose

The aim of this unit is to provide the learner with the knowledge and skills required to perform service and repair operations on tyres, wheel assemblies and/or tracks and their components on Land-based equipment.

Unit introduction

Engine technology and its associated control systems have advanced rapidly in the last few years. Modern engines are now capable of outstanding performance compared to older, similar sized power units. This, together with advances in transmission design, means that the typical land-based vehicle is capable of greater traction and speed than before.

These factors have led to an increased need for tyres and wheel assemblies and track technology able to cope with the forces associated with this performance.

Learning outcomes

On completion of this unit a learner should:

1 Be able to perform service and repair operations on tyres, wheel assemblies or tracks and their components

2 Know the types, construction and operating principles of tyres, wheel assemblies and tracks and their components

3 Know how to carry out service and maintenance operations on tyres and tracks.

Unit content

1 Be able to perform service and repair operations on tyres, wheel assemblies or tracks and their components

Wheels, tyre tracks and running gear: wheel rim types and sizes; tyre securing aids; tyre types and sizes; performance capabilities; tractive aids; floatation aids; ballast types, wheel fixings; track types, rubber and steel tracks; sprockets; idlers; rollers; track tensioner types; track running gear

2 Know the types, construction and operating principles of tyres, wheel assemblies and tracks and their components

Wheels, tyres tracks and running gear: wheel rim types and sizes; tyre securing aids; tyre types and sizes; performance capabilities; tractive aids; floatation aids; ballast types, wheel fixings; track types, rubber and steel tracks; sprockets; idlers; rollers; track tensioner types; track running gear; excessive slip; slip control; ground pressure; balance; tyre pressures; dual and/or cage wheels; liquid ballast and weights; decreasing and variable loads; extending arms loaders; implications of track widths; weight distribution and transfer

Ballast and tractive aids: axle loadings; tyre loadings; gross weight; police notification; escort vehicles; road and/or bridge restrictions; stability traction; the relationships between driven axles and tractive power; PTO driven axles; 4 WD axle ratios; correct tyre combinations; 4 wheel drive with equal and/or unequal size wheels; wheel slip; tyre creep/slip; vibration and bouncing

3 Know how to carry out service and maintenance operations on tyres and tracks

Wheels, tyres tracks and running gear: inter axle mechanical ratios; suitability of tyre combinations; wheel rim conformity; wheel alignment; tyre conformity; alignment of tracks; torque wind up; no- conformity; cracking/creaking; misalignment; uneven wear and/or rapid wear; deflation; de-lamination; track jump off

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria					
To achieve a pass grade the evidence must show that the learner is able to:		**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**		**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**	
P1	remove, dismantle, repair and reinstate tyres and wheel assemblies or tracks, their running gear and components to manufacturer's specifications [EP, TW, SM, IE]	**M1**	report service and repair findings to appropriate colleagues	**D1**	evaluate selected tyres and wheel assemblies and/or tracks, their running gear and components
P2	attach, adjust and remove stability and tractive aids [EP, TW, SM, IE]				
P3	identify and rectify faults relating to tyres, wheel assemblies or tracks and their components [EP, SM, RL]				
P4	outline the types, construction and operating principles of tyres, and wheel assemblies and tracks, their running gear and components [IE, CT, SM, RL]	**M2**	justify the application of two different types of tyres and wheel assemblies and/or two types of tracks and their running gear and components		
P5	describe the types, construction and applications of wheels, tyres, tracks and tractive aids [IE, CT, SM, RL]				
P6	outline the implications of weight distribution and transfer on tractive performance and stability [IE, CT, SM, RL]				

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P7 outline the implications of track widths, weight distribution and transfer, ballast and tractive aids on legislative and legal responsibilities [IE, CT, SM, RL]		
P8 describe the methods of removing, dismantling, repairing and reinstatement of tyres and wheel assemblies and tracks, their running gear and components [IE, CT, SM, RL]	**M3** describe the tools and equipment required to carry out repairs, tests and checks to tyres and wheel assemblies and/or tracks, their running gear and components.	**D2** explain the effect that a lack of maintenance has on the performance of tyres and wheel assemblies and/or tracks, their running gear and components.
P9 describe how to carry out land-based equipment tests and checks [IE, CT, SM, RL]		
P10 describe how to identify and rectify faults relating to tyres, wheel assemblies and tracks and their components. [IE, CT, SM, RL]		

PLTS: This summary references where applicable in the pass criteria, in the square brackets, the elements of the personal, learning and thinking skills. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key			
	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

All centres must comply with the requirements of relevant, current legislation and codes of practice eg the Prevention of Accidents to Children in Agriculture Regulations 1998. Learners must be made aware of, and have access to, relevant health and safety legislation and know the importance of the use of risk assessments appropriate to each situation. Appropriate risk assessments must precede all practical machinery activities and learners must work in a safe manner at all times when using equipment or working with machinery. Learners must be supervised at all times and tutors must not ask learners to undertake tasks that are beyond their physical capabilities.

Delivery of this unit will involve practical assessments, written assessment, visits to suitable collections and will link to industrial experience placements.

Tutors have the opportunity to use as wide a range of techniques as possible. Lectures, discussions, seminar presentations, site visits, supervised tractor and/or land-based machinery operation practicals, internet and library-based research and the use of personal and/or industrial experience would all be suitable. Delivery should stimulate, motivate, educate and enthuse learners.

Work placements should be monitored regularly in order to ensure the quality of the learning experience. It would be beneficial if learners and supervisors were made aware of the requirements of this unit before any work-related activities, so that naturally occurring evidence can be collected at the time. For example, learners may have the opportunity to operate tractors or land-based machines and they should be encouraged to ask for observation records and/or witness statements to be provided as evidence. Guidance on the use of observation records and witness statements is provided on the Pearson website.

Tutors should consider integrating the delivery, private study and assessment relating to this unit with any other relevant units and assessment instruments learners may also be taking as part of their programme of study.

Learning outcome 1 is likely to be delivered through a series of demonstrations, site visits, supervised land-based service and repair practical and formal lectures. Learners will develop skills relating to the service and repair of tyres, wheel assemblies or tracks and their components. Visiting expert speakers could add to the relevance of the subject learners. For example, a representative from a land-based machine manufacturer could talk about the company's products and how they are used.

Learning outcomes 2 and 3 are likely to be delivered using formal lectures, discussion, site visits and independent learner research. Learners will become aware of the underpinning principles in relation to tyres, wheel assemblies or tracks and their components. These are intended to be a wide ranging learning outcomes. Tutors must cover the range listed in the unit content. However, they may wish to spend longer delivering information relating to commonly used tyres and tracks in the primary sector(s) being studied. Ideally, learners should have access to actual examples of the equipment listed in the unit content. Visiting expert speakers could add to the relevance of the subject for learners. For example, a farm worker or forester could talk about their work and the equipment they use. Visits, country shows where land-based machine manufacturers display their products could be useful.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan gives **an indication of the volume of learning it would take the average learner** to achieve the learning outcomes. It is **indicative and is one way of achieving the credit value**.

Learning time should address all learning (including assessment) relevant to the learning outcomes, regardless of where, when and how the learning has taken place.

Topic and suggested assignments/activities and/assessment
Introduction to the unit.
Assignment 1: Perform Service and Repair Operations on Tyres, Wheel Assemblies or Tracks and their Components (P1, P2, P3, M1) Introduction to the assignment and learner-centred research.
Remove dismantle, repair and reinstate tyres and wheel assemblies or tracks, their running gear and components.
Assignment 2: Types, Construction and Operating Principles of Tyres, Wheel assemblies and Tracks and Their Components (P4, P5, P6, P7, M2, D1) Introduction to the assignment and learner-centred research.
Justify and evaluate the application of two different types of tyres and wheel assemblies and/or two types of tracks and their running gear and components.
Assignment 3: Service and Maintenance Operations on Tyres and Tracks (P8, P9, P10, M3, D2) Introduction to the assignment and learner- centred research.
Describe the tools and equipment required to carry out repairs, tests and checks to tyres and wheel assemblies and/or tracks, their running gear and components.
Explain the effect that a lack of maintenance has on the performance of tyres and wheel assemblies and/or tracks, their running gear and components.
Unit review.

Assessment

For P1 and P3, learners need to remove, dismantle, identify faults, repair and reinstate tyres and wheel assemblies and/or tracks, their running gear and components. Tutors should identify the systems or agree them through discussion with learners. Where possible, to ensure fairness of assessment the size and complexity of the task should be the same for all learners. It is expected that learners will provide evidence for equipment commonly used in the land-based industry sector that is their primary area of interest.

For P2, learners need to attach, adjust and remove stability and tractive aids. Where possible, the size and complexity of the task should be the same for each learner to ensure fairness of assessment. It is expected that learners will provide evidence for equipment commonly used in the land-based industry sector that is their primary area of interest.

For P4, learners need to outline the types, construction and operating principles of tyres, and wheel assemblies and tracks, their running gear and components. Where possible, the size and complexity of the task should be the same for each learner to ensure fairness of assessment. Evidence may be in the form of a project assignment or through recorded questioning and answering.

For P5, learners need to describe the types, construction and applications of wheels, tyres, tracks and tractive aids. Where possible, the size and complexity of the task should be the same for each learner to ensure fairness of assessment. Evidence may be in the form of a project assignment or through recorded questioning and answering.

For P6, learners need to outline the implications of weight distribution and transfer on tractive performance and stability. Where possible, the size and complexity of the task should be the same for each learner to ensure fairness of assessment. Evidence may be in the form of a project assignment or through recorded questioning and answering.

For P7 learners need to outline the implications of track width, weight distribution and transfer, ballast and tractive aids for legislative and legal responsibilities. Where possible, the size and complexity of the task should be the same for each learner to ensure fairness of assessment. Evidence may be in the form of a project assignment or through recorded questioning and answering.

For P8, P9 and P10, learners need to describe how to carry out testing, identify faults, remove, dismantle, repair and reinstate tyres and wheel assemblies and tracks, their running gear and components. Where possible, the size and complexity of the task should be the same for each learner to ensure fairness of assessment. It is expected that learners will provide evidence for equipment commonly used in the land-based industry sector that is learners primary area of interest.

M1 requires learners to report on service and repair findings to appropriate staff. Learners are expected to provide evidence for two different activities. Tutors should identify the activities or agree them through discussion with learners. The activities may be the same as those used to provide evidence for other assessment and grading criteria. Where possible, to ensure fairness of assessment the size and complexity of the tasks should be the same for all learners. Evidence may be in the form of a project assignment or through recorded questioning and answering

M2 requires learners, to justify the application of two different types of tyres and wheel assemblies and/or two types of tracks and their running gear and components. Tutors should identify the machines or agree them through discussion with learners. Where possible, to ensure fairness of assessment the size and complexity of the task should be the same for all learners. Evidence may be in the form of a project assignment or through recorded questioning and answering

M3 requires learners to select the tools, equipment and materials required to carry out repair tasks to tyres and wheel assemblies and/or tracks, their running gear and components. Tutors should identify the systems and objectives or agree them through discussion with learners. The systems may be the same as those used to provide evidence for other assessment and grading criteria. Where possible, to ensure fairness of assessment the size and complexity of the tasks should be the same for all learners.

For D1, learners must evaluate selected tyres and wheel assemblies and/or tracks, their running gear and components in terms of cost and effectiveness. Tutors should identify the systems or agree them in discussion with learners. The systems may be the same as those used to provide evidence for other assessment and grading criteria. Where possible, to ensure fairness of assessment the size and complexity of the tasks should be the same for all learners.

D2 requires learners to explain the effect that a lack of maintenance has on the performance of tyres and wheel assemblies and/or tracks, their running gear and components. Tutors should identify the systems or agree them in discussion with learners. The systems may be the same as those used to provide evidence for other assessment and grading criteria. Where possible, to ensure fairness of assessment the size and complexity of the task should be the same for all learners.

Programme of suggested assignments

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Pearson assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2, P3, M1	Perform Service and Repair Operations on Tyres, Wheel Assemblies or Tracks and their Components	You are working for a local agricultural dealership that repairs different types of land-based machinery. You should be able to service and repair tyres, wheel assemblies or tracks and their components.	Practical, Report. Job card. Work logs.

Criteria covered	Assignment title	Scenario	Assessment method
P4, P5, P6, P7, M2, D1	Types, Construction and Operating Principles of Tyres, Wheel Assemblies and Tracks and their Components.	You are working for a local agricultural dealership that repairs land-based vehicles. You will need to know the different types, construction and operation of tyres, wheel assemblies or tracks and their components.	Assignment Report. Presentation.
P8, P9, P10, M3, D2	Service and Maintenance Operations on Tyres and Tracks	You are working for a local agricultural dealership that repairs land-based vehicles. You will need to be able to explain how to dismantle, repair, reinstate, test and rectify faults on tyres, wheel assemblies or tracks and their components.	Assignment Report. Presentation.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC land-based sector suite. This unit has particular links with:

Level 2	Level 3
LEO16 Service and Repair Tyres and Tracks on Land-based Equipment	Undertaking Land-based Workshop Practice

Essential resources

Learners will need access to a range of land-based vehicles with different types of equipment and simulation equipment to support their practical investigation, They will also need access to sufficient test and repair equipment and materials to enable accurate evaluation of tyres and wheel assemblies and/or tracks, their running gear and components.

Manufacturers' training videos, service manuals and test data will make a significant contribution to learner's achievement.

Tutors delivering this unit should be familiar with tyres and wheel assemblies and/or tracks, their running gear and components.

Employer engagement and vocational contexts

Learners could be introduced to a variety of professionals from different companies and organisations to broaden their knowledge and make the learning experience interesting and contextualised. This could be through guest lectures, work placements or off-site visits to different establishments.

Indicative reading for learners

Textbooks

Heisler H – *Vehicle and Engine Technology* (Butterworth-Heinemann, 1998) ISBN 0340691867

Hillier V and Coombes P – *Hillier's Fundamentals of Motor Vehicle Technology* (Nelson Thornes, 2004) ISBN 0748780823

Nunney N J – *Light and Heavy Vehicle Technology* (Butterworth-Heinemann, 1998) ISBN 0750638273

Websites

www.bagma.com	British Agricultural and Garden Machinery Association
www.defra.gov.uk	Department for Environment, Food and Rural Affairs
www.howstuffworks.com	HowStuffWorks
www.hse.gov.uk	Health and Safety Executive
www.iagre.org	Institution of Agricultural Engineers
www.lantra.co.uk	Lantra Sector Skills Council

Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit:

Skill	When learners are …
Independent enquirers	explaining the function of tyres and wheel assemblies and/or tracks, their running gear and components assessing risk explaining principles of operation
Creative thinkers	explaining the function of tyres and wheel assemblies and/or tracks, their running gear and components assessing risk explaining principles of operation discussing the correct selection of components
Reflective learners	discussing the correct selection of components describing methods of fault diagnosis
Team workers	carrying out maintenance and repair work diagnosing faults using a variety of sources
Self-managers	carrying out maintenance and repair work diagnosing faults using a variety of sources
Effective participators	diagnosing faults using a variety of sources.

Although PLTS opportunities are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are …
Independent enquirers	planning and carrying out research activities related to the unit evaluating and carrying out extended thinking
Creative thinkers	asking questions to extend their thinking during lectures and practical sessions adapting ideas as circumstances change eg repairs on a variety of machinery
Reflective learners	identifying opportunities for their own achievements setting goals for themselves eg time management reviewing progress in practical tasks and coursework
Team workers	working with others to carry out repair and maintenance tasks reaching clear agreements regarding who is carrying out which tasks during practical activities working together when diagnosing faults
Self-managers	dealing with pressures in an emergency situation managing time and resources during practical activities
Effective participators	discussing issues of concern relating to time management and resources during practical activities identifying improvements that could be implemented during practical tasks.

Functional Skills – Level 2

Skill	When learners are …
ICT – Use ICT systems	
Select, interact with and use ICT systems independently for a complex task to meet a variety of needs	completing their course work using ICT facilities using interactive materials for teaching and learning researching subjects on the internet
Use ICT to effectively plan work and evaluate the effectiveness of the ICT system they have used	
Manage information storage to enable efficient retrieval	
Follow and understand the need for safety and security practices	
Troubleshoot	
Mathematics	
Understand routine and non-routine problems in a wide range of familiar and unfamiliar contexts and situations	plan an activity and obtaining relevant information from relevant sources using this information to carry out multi-stage calculations to do with amounts using formulae. interpreting the results of calculations, presenting findings and justifying your methods
Identify the situation or problem and the mathematical methods needed to tackle it	
Select and apply a range of skills to find solutions	
Use appropriate checking procedures and evaluate their effectiveness at each stage	
Interpret and communicate solutions to practical problems in familiar and unfamiliar routine contexts and situations	
Draw conclusions and provide mathematical justifications	
English	

Skill	When learners are …
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	reading material on the subject from a variety of sources for their assignment work reading around subjects and producing clear and concise documents using correct engineering terminology presenting information to a group of people ideally in a classroom situation with their peers.
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	

Unit 17: Service and Repair Land-based Cutting and Mowing Equipment

Unit code: T/600/3409

Level 2: BTEC First

Credit value: 5

Guided learning hours: 30

Aim and purpose

The aim of this unit is to provide the learner with the knowledge and skills required for servicing Land-based cutting and mowing equipment. This unit aims to introduce learners to how these can be applied in practice. It is designed for learners in centre-based settings looking to progress into the sector or onto further/higher education.

Unit introduction

Cutting and mowing equipment is core to the harvesting of crops and to the maintenance of grass and amenity areas. Modern land-based practices means that harvest periods are intensive operations and manufacturers have developed harvesting machinery that is complex in design yet reliable and effective in operation.

Employees required to service and repair this equipment must have the knowledge and skills to undertake potentially costly and complex activities. In this unit knowledge and skills needed to understand the principles of cutting and mowing equipment.

They should also investigate the construction and function of the equipment and understand how it operates.

Finally, learners should know how the performance of the equipment is affected by the conditions in which it operates.

Learning outcomes

On completion of this unit a learner should:

1 Be able to service cutting and mowing equipment

2 Know the construction, function and operation of cutting and mowing equipment

3 Know how the performance of cutting and mowing equipment is affected by conditions.

Unit content

1 Be able to service cutting and mowing equipment

Pre-season: inspection procedures; compliance with legislation; compliance with manufacturers' specifications; lubrication; common causes of component and assembly failure; repair procedures (replacement of worn components, safe practices, sharpening, re-bevelling, clearance setting)

In-season servicing: maintenance information in manufacturers' handbooks and instructions; reasons for following manufacturer's instructions eg safety, warranty; safe working practice in maintenance operations; correct use and storage of tools, equipment and materials; correct disposal of waste; record keeping; health and safety; relevant, current legislation and codes of practice

Post-season: corrosion protection; common causes of component and assembly failure; identification of worn components; cleaning

Sharpen and adjust cutting mechanisms: saw blades and chains, rotary blades, cylinders, sheer blade, flails and hand tools

Workshop settings: manufacturers' manuals and data; attachment; drive-line; height; speed; levels; operation of controls; timing of components; chop length; alignment; attachments/options

Health and safety: risk assessment; personal protective equipment (PPE); relevant current legislation eg Health and Safety at Work Act 1974, Control of Substances Hazardous to Health Regulations (COSHH)

2 Know the construction, function and operation of cutting and mowing equipment

Working principles of cutting and mowing equipment and their components: lawn and professional turf mowers, hedge trimmers, green crop mowers and toppers, harvester cutting mechanisms, saws, chippers, hand tools

Cutting system principles: drum; disc; rotary blade; rigid blade/bar; flail; reciprocating knife; flywheel; cylinder

Methods of sharpening and setting cutting mechanisms and components: saw blades and chains, stationary and moving/rotating knives, flails and hand tools

3 Know how the performance of cutting and mowing equipment is affected by conditions

Measuring performance: work rates-spot, effective; field efficiency; quality of task carried out

Operational settings: depth; height; levels; alignment; speed; material flow

Crop condition: age/maturity; height; volume; moisture

Ground conditions: aspect; topography; surface condition and smoothness; impurities such as stones

Specification: spacing; width; capacity; options; speeds; machine protection devices

Machine compatibility: uses; sequence in field operations; rows; beds; power requirement

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria					
To achieve a pass grade the evidence must show that the learner is able to:		**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**		**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**	
P1	identify cutting and mowing equipment used in the land-based sector [IE]	**M1**	identify the components which would be most likely to require maintenance and servicing	**D1**	suggest the cutting and mowing equipment most suitable for a given task and crop conditions.
P2	dismantle, repair and reinstate cutting or mowing machinery and tools to manufacturers' specifications [SM]				
P3	sharpen and adjust cutting mechanisms to conform with manufacturers' specification [SM]				
P4	identify faults affecting cutting performance and rectify to perform within the manufacturers' specification [SM, IE, CT, RL]				
P5	describe the working principles of cutting and mowing equipment and their components	**M2**	compare a range of mowing and cutting mechanisms for ease of repair and servicing		
P6	describe how to dismantle, repair and reinstate cutting and mowing equipment				
P7	describe the methods of sharpening and setting cutting mechanisms and components [RL]				

Assessment and grading criteria					
To achieve a pass grade the evidence must show that the learner is able to:		**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**		**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**	
P8	describe the effect of crop/ product type and conditions on the cutting and mowing process	**M3**	compare a range of cutting and mowing the equipment for ability to cope with a range of crop or working conditions.		
P9	state how adjustments and settings affect the performance of cutting and mowing equipment.				

PLTS: This summary references where applicable in the pass criteria, in the square brackets, the elements of the personal, learning and thinking skills. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

All centres must comply with the requirements of relevant, current legislation and codes of practice eg the *Prevention of Accidents to Children in Agriculture Regulations 1998*. Learners must be made aware of, and have access to, relevant health and safety legislation and know the importance of the use of risk assessments appropriate to each situation. Appropriate risk assessments must precede all practical machinery activities and learners must work in a safe manner at all times when using equipment or working with machinery. Learners must be supervised at all times and tutors must not ask learners to undertake tasks that are beyond their physical capabilities.

Delivery of this unit will involve practical assessments, written assessment, visits to suitable collections and will link to industrial experience placements.

Tutors have the opportunity to use as wide a range of techniques as possible. Lectures, discussions, seminar presentations, site visits, supervised tractor and/or land-based machinery operation practicals, internet and library-based research and the use of personal and/or industrial experience would all be suitable. Delivery should stimulate, motivate, educate and enthuse learners.

Work placements should be monitored regularly in order to ensure the quality of the learning experience. It would be beneficial if learners and supervisors were made aware of the requirements of this unit before any work-related activities, so that naturally occurring evidence can be collected at the time. For example, learners may have the opportunity to operate tractors or land-based machines and they should be encouraged to ask for observation records and/or witness statements to be provided as evidence. Guidance on the use of observation records and witness statements is provided on the Pearson website.

Tutors should consider integrating the delivery, private study and assessment relating to this unit with any other relevant units and assessment instruments learners may also be taking as part of their programme of study.

Learners are required to identify cutting and mowing equipment and be aware of the broad range of equipment available and its uses. Visiting expert speakers could add to the relevance of the subject for learners. For example, representatives from manufacturers or importers could talk about their equipment and its features. Visits to dealerships would also be beneficial so that learners have access to as wide a range of equipment as possible. Learners are required to dismantle, service, repair and sharpen this equipment.

Learners will also be required to understand how cutting and mowing equipment works and explain how it is maintained. Learners must be aware of how operating and crop conditions, as well as the type of product required, can affect the cutting and/or mowing process.

It is expected that practical activities should form a major part of the delivery of his unit. Visiting expert speakers could add to the relevance of the subject for learners. For example, land-based machinery technicians or workshop managers could talk about their work and the techniques they use. Learners would benefit from operating the equipment or seeing the equipment working in real environments.

Health and safety issues relating to working in repair workshops must be stressed and reinforced regularly, and risk assessments must be undertaken before practical activities and before learners visit any workshop. Adequate personal protective equipment (PPE) must be provided and used following the production of suitable risk assessments.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan gives **an indication of the volume of learning it would take the average learner** to achieve the learning outcomes. It is **indicative and is one way of achieving the credit value**.

Learning time should address all learning (including assessment) relevant to the learning outcomes, regardless of where, when and how the learning has taken place.

Topic and suggested assignments/activities and/assessment
Introduction and review of unit; testing of previous knowledge.
Theory Session: Cutting and mowing equipment used in the land-based sector.
Theory session: Cutting mechanisms and their servicing and repair.
Assignment 1: The Servicing and Repair of Cutting and mowing Equipment (P1, P2, P3, P4, P6, P7, M1) Tutor introduces the assignment brief.
Workshop demonstration: sharpening cutting mechanisms.
Workshop Practical: sharpening cutting mechanisms.
Theory Session: Faults with cutting mechanisms and cutting and mowing equipment.
Assignment 2: Cutting and Mowing Equipment (P5, P8, P9, M2, M3, D1) Tutor introduces the assignment brief.
Workshop demonstration and practical: fault finding.
Workshop Practical: service and repair.
Workshop practical: setting and testing cutting mechanisms.
Theory Session: crop and ground condition effects of mowing and cutting performance.
Assignment and self study.
Unit review.

Assessment

For P1, learners are required to identify a range of cutting and mowing equipment used in the land-based sector. P1 could be assessed directly by the tutor during practical activities. If this format is used then suitable evidence from guided activities would be observation records completed by learners and the tutor, and accompanied by appropriate worklogs or other relevant learner notes. If assessed during a work placement, witness statements should be provided by a suitable representative and verified by the tutor.

Alternatively, evidence could take the form of a pictorial presentation with notes (possibly using appropriate software or an overhead projector), an annotated poster or an assignment.

For P2, learners must carry out maintenance and repair procedures on selected cutting and mowing equipment to meet given objectives. Tutors should identify the equipment, the maintenance and repairs required and the objectives, or agree them through discussion with learners. The equipment may be the same as that used to provide evidence for other assessment and grading criteria. Where possible, to ensure fairness of assessment, the size and complexity of the task should be the same for all learners. Learners are expected to provide evidence for at least two different activities. They must consider the disposal of waste materials and used components in line with current environmental guidelines and legislation.

P2 could be assessed directly by the tutor during practical activities. If this format is used then suitable evidence from guided activities would be observation records completed by learners and the tutor, and accompanied by appropriate worklogs or other relevant learner notes. If assessed during a work placement, witness statements should be provided by a suitable representative and verified by the tutor.

For P3, learners must sharpen and adjust cutting mechanisms. Tutors should identify the equipment or agree it through discussion with learners. The equipment could be the same as used in P2. Where possible, to ensure fairness of assessment, the size and complexity of the task should be the same for all learners. Learners are expected to provide evidence for at least three types of equipment using different cutting mechanisms. Assessment and evidence could be in the same form as for P2.

In P4, learners must identify faults affecting cutting performance and rectify these, setting the machine up to perform within the manufacturers' specifications. Learners should have access to and use manufacturers' handbooks and data sheets. Assessment and evidence could be in the same form as for P2.

For P5, learners must describe the principles of operation of selected cutting and mowing equipment. Tutors should identify the equipment or agree it through discussion with learners. Where possible, to ensure fairness of assessment, the size and complexity of the task should be the same for all learners. Learners are expected to provide evidence for at least three types of machine. P5 could be assessed in the same way as P1 and evidence provided in the same format.

For P6, learners must describe how to dismantle, repair and reinstate cutting and mowing equipment. This could be the same equipment as in P2 and this could be assessed at the same time. Tutors should identify the equipment or agree it through discussion with learners. Where possible, to ensure fairness of assessment, the size and complexity of the task should be the same for all learners. Learners are expected to provide evidence for at least three types of machine. Assessment and evidence could be in the same form as in P1.

In P7, learners must describe the methods of sharpening and setting cutting mechanisms and components. This could be the same equipment as in P2 and could be assessed at the same time. Whatever equipment is used the cutting mechanism must include both cylinder and blade sharpening. Tutors should identify the equipment or agree it through discussion with learners. Where possible, to ensure fairness of assessment the size and complexity of the task should be the same for all learners. Learners are expected to provide evidence for at least three types of machine. Assessment and evidence could be in the same form as for P1.

For P8, learners must describe the effect of crop/product type and conditions on the cutting and/or mowing process. Tutors should identify a range of crops and/or tasks to ensure suitable coverage or agree these through discussion with learners. Evidence could take the form of a pictorial presentation with notes (possibly using appropriate software or an overhead projector), an annotated poster or a written assignment.

P9 requires learners to discuss the adjustments available on selected cutting and mowing equipment and how these affect performance and the ability to deal with different crops, crop conditions and ground conditions. Tutors should identify the machinery or agree it through discussion with learners. The machinery may be the same as that used to provide evidence for other assessment and grading criteria. Where possible, to ensure fairness of assessment the size and complexity of the tasks should be the same for all learners. Learners are expected to provide evidence for at least two machines. Assessment and evidence could be in the same form as for P2.

M1 requires learners to identify the components in selected cutting and lifting equipment which would be most likely to fail and explain why. Tutors should identify the machinery or agree it through discussion with learners. The machinery may be the same as that used to provide evidence for other assessment and grading criteria. Where possible, to ensure fairness of assessment the size and complexity of the task should be the same for all learners. Learners are expected to provide evidence for at least two different machines. Assessment and evidence could be in the same form as for P1.

For M2, learners must compare a range of cutting and mowing equipment for ease of repair. Assessment and evidence could be in the same form as for P1.

For M3, learners are required to compare a range of mowing and cutting mechanisms for the ability to cope with a range of crop or working conditions. Tutors should identify the equipment or agree it through discussion with learners. The machinery may be the same as that used to provide evidence for other assessment and grading criteria. The equipment must include- cylinder, rotary and flail mechanisms for comparison. Assessment and evidence could be in the same form as for P2.

D1 requires learners to select and justify the choice of cutting and mowing equipment to meet a given work situation. Tutors should identify the work situation.

Where possible, to ensure fairness of assessment the size and complexity of the tasks should be the same for all learners. Learners are expected to provide evidence for a minimum of three different work situations. Assessment and evidence could be in the same form as for P4.

Programme of suggested assignments

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Pearson assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2, P3, P4, P6, P7, M1	The Servicing and Repair of Cutting and Mowing Equipment	You are working as a fitter in an agricultural engineering workshop. Three machines for cutting and/or mowing are brought in for repair. You are required to identify, service and repair the three items, explaining to your supervisor the tasks you carried out.	Practical tasks.
P5, P8, P9, M2, M3, D1	Cutting and Mowing Equipment	Report on types of cutting and mowing systems and their suitability for use in a variety of tasks and conditions.	Verbal and/or written report or presentation.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC land-based sector suite. This unit has particular links with:

Level 2	Level 3
LEO17 Service and Repair Land-based Cutting and Mowing Equipment	Understanding and Working with Groundcare Equipment

Essential resources

Learners will need access to a range of cutting and mowing equipment and simulation equipment to support their practical investigation. They will also require access to sufficient test and repair equipment and materials to enable servicing and repair, including sharpening of cutting mechanisms, to be carried out.

Manufacturers' service manuals and test data will make a significant contribution to learner's achievement.

Tutors delivering this unit should be familiar with current cutting and mowing equipment.

Employer engagement and vocational contexts

It is essential that this unit is delivered in an applied and vocational context. Work-based experience will also be important. The unit will be enhanced by contact with employers. Centres are encouraged to develop links with local businesses, manufacturers and machinery dealers, who can support the breadth and application of this unit. Employers can provide real-work practical exercises, guest speakers and experts to support the learning experience. Employer engagement will ensure the use of technically up-to-date information and processes.

Indicative reading for learners

Textbooks

Bell B – *Farm Machinery, 5th Edition* (Old Pond Publishing, 2005) ISBN 1903366682

Culpin C – *Farm Machinery, 12th Edition* (Oxford: Blackwell Scientific, 1992) ISBN 063203159X

Hawker MFJ and Keenlyside JF – *Horticultural Machinery* (Longman Higher Education, 1985) ISBN 0582408075

HSE – *Essentials of Health and Safety at Work* (HSE Books, 2006) ISBN 0717661792

Journals

Horticultural Week

Profi

Farmers Weekly

Websites

www.bagma.com	British Agricultural and Garden Machinery Association
www.hse.gov.uk	Health and Safety Executive
www.howstuffworks.com	HowStuffWorks

Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit:

Skill	When learners are …
Independent enquirers	identifying cutting and mowing equipment used in the land-based sector identifying faults affecting cutting performance and rectifying these to perform within the manufacturers' specification
Creative thinkers	identifying faults affecting cutting performance and rectifying these to perform within the manufacturers' specification
Reflective learners	identifying faults affecting cutting performance and rectifying these to perform within the manufacturers' specification describing the effect of crop/product type and conditions on the cutting and/or mowing process
Self-managers	dismantling, repairing, and reinstating cutting or mowing machinery and tools to manufacturers' specifications sharpening and adjusting cutting mechanisms to conform with manufacturers' specification identifying faults affecting cutting performance and rectifying these to perform within the manufacturers' specification.

Although PLTS opportunities are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are …
Team workers	dismantling, repairing, and reinstating cutting or mowing machinery and tools to manufacturers' specifications identifying faults affecting cutting performance and rectifying these to perform within the manufacturers' specification.

Functional Skills – Level 2

Skill	When learners are …
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	using manufacturers' handbooks and technical information to support dismantling, repair, sharpening, reassembly and setting
ICT – Develop, present and communicate information	
Enter, develop and format information independently to suit its meaning and purpose including: • text and tables • images • numbers • records	
Bring together information to suit content and purpose	
Present information in ways that are fit for purpose and audience	giving presentation to peers
Evaluate the selection and use of ICT tools and facilities used to present information	
Select and use ICT to communicate and exchange information safely, responsibly and effectively including storage of messages and contact lists	

Skill	When learners are …
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	describing the working principles of cutting and mowing equipment and their applications describing how to dismantle and repair and reinstate cutting and mowing equipment describing the sharpening and setting of cutting mechanisms and components describing the effect of crop/product type and conditions on the cutting and/or mowing process
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	using manufacturer's handbooks to gain information concerning setting up and maintenance of cutting/mowing equipment
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	

Unit 18: Service and Repair Land-based Harvesting and Processing Equipment

Unit code: M/600/3408

Level 2: BTEC First

Credit value: 10

Guided learning hours: 60

Aim and purpose

The aim of this unit is to provide the learner with the knowledge, understanding and skills required to service and repair harvesting and processing equipment.

Unit introduction

Technical advancements to land-based harvesting and processing equipment over recent years have increased the requirements for machines to be serviced and repaired regularly to ensure machine performance is kept at it's optimum and 'down time' due to unexpected breakdowns is kept to a minimum.

Machine operators and service/repair personnel are now required to have a greater understanding of working principles and service and repair procedures. This is mainly due to the increase in complexity of mechanisms and the integration of electronic control and monitoring processes, which many machines and items of equipment now depend on to ensure safe, efficient, economic and environmentally acceptable operations are performed.

This unit enables learners to develop and improve their ability to understand why harvesting and processing equipment needs to be maintained according to manufacturers' recommendations and to recognise the need to replace or repair worn, missing or damaged components. There is a vast range of equipment available to meet modern day requirements of land–based harvesting and processing operations. It would be impossible for learners to demonstrate an ability with equipment and understanding of all, therefore, learners will select from a range of equipment typical to their area of study.

On completion of the unit, learners will have successfully demonstrated knowledge, understanding and an ability to perform specific tasks on their chosen range of equipment. They must also be made aware of the need to follow future developments which are increasingly being introduced by manufacturers.

Due to the increased complexities and performance requirements of modern equipment there are increased risks of accidents and injuries. It is essential that, throughout the unit, learners demonstrate safe practices and conform to legislative requirements.

Learning outcomes

On completion of this unit a learner should:

1 Be able to perform service and repair operations on harvesting and processing equipment

2 Know how to service and repair harvesting and processing equipment.

Unit content

1 Be able to perform service and repair operations on harvesting and processing equipment

Perform service operations: service interval; scheduled; unscheduled; manufacturers' recommendations; machine data; serial numbers; lubrication charts; service records

Perform repair operations: need for repairs; replacement components; sources of replacement components; safe working practices; correct removal, replacement and repair procedures; correct and safe disposal of wastes; risk assessments; relevant legislation and codes of practice eg Health and Safety at Work Act 1974; PUWER; Grinding Wheel Regulations; PPE

2 Know how to service and repair harvesting and processing equipment

Service operations: decontamination and preparation of equipment to be serviced; preparation of work areas; selection and preparation of tools; manufacturers' recommendations; adjustments; operational checks on performance; calibrations; inspection reports; selection of correct lubricants; pre-season preparations machine storage

Repair operations: machine inspections; sensory and non-sensory tests; identification of faults and breakages; job cards; recording repairs and replacement components; acceptable modifications to increase efficiency; identification and use of specialised tools; construction, types and function of harvesting and processing equipment eg green crop harvesters, combine harvesters, root crop harvesters, balers and presses, grain driers, timber processors, wrappers, chippers and/or choppers, grinders, mowers and/or conditioners, pasteurisation, grading equipment

Processes: processes used with harvesting and processing equipment eg separation, drying, pasteurisation, compression, tying, wrapping, grinding, chipping and chopping, cleaning, grading, disposal and/or dispersal of waste products, threshing, metering; methods of material handling within the harvesting process (elevating/lifting eg conveying, transfer, presentation and/or orientation, packing, blowing, gathering); causes of crop or product loss and poor sample quality contamination, damage, wastage and non-compliance with specifications eg cleanliness, hygiene, bacterial count, sizing, bale and/or timber sizes, chop length, bruising, cracking, density, leakage; how to prepare seasonal harvesting and processing equipment for periods of storage and lay up eg bulk handling and storage facilities, crop driers, seasonal equipment, mowers/conditioners, harvesters, balers, wrappers

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria					
To achieve a pass grade the evidence must show that the learner is able to:		**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**		**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**	
P1	dismantle, repair and reinstate harvesting and processing equipment to the manufacturer's specifications and standards [CT, RL, SM]	**M1**	use specialist tools and equipment to measure and set components following repair/replacement	**D1**	complete component replacement and repair documentation to record specified tasks carried out on harvesting and processing equipment.
P2	identify and rectify performance faults in equipment to achieve optimal performance [IE, EP]				
P3	identify and rectify faults in equipment which cause crop or product loss [IE, EP]				
P4	prepare equipment for periods of storage or lay up when not in use [EP]				

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P5 describe the construction, types and function of harvesting and processing equipment [RL]	**M2** describe the safety precautions, safe working practices, environmental legislation and health and safety issues to be conformed with when maintaining and repairing harvesting and processing equipment.	
P6 describe how to remove, dismantle, repair and reinstate and set-up harvesting and processing equipment to manufacturer's specifications		
P7 describe the processes used in harvesting and processing equipment		
P8 describe the methods of material handling within the harvesting process		
P9 describe the appropriate methods of clearing blockages from harvesting and processing equipment		
P10 identify the causes of crop or product loss and poor sample quality contamination, damage, wastage and non-compliance.		

PLTS: This summary references where applicable in the pass criteria, in the square brackets, the elements of the personal, learning and thinking skills. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key			
	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

All centres must comply with the requirements of relevant, current legislation and codes of practice eg the Prevention of Accidents to Children in Agriculture Regulations 1998. Learners must be made aware of, and have access to, relevant health and safety legislation and know the importance of the use of risk assessments appropriate to each situation. Appropriate risk assessments must precede all practical machinery activities and learners must work in a safe manner at all times when using equipment or working with machinery. Learners must be supervised at all times, they must not undertake tasks that are beyond their physical capabilities.

Delivery of this unit will involve practical assessments, written assessment, visits to suitable dealer facilities and relevant shows and demonstrations and may have links to industrial experience placements.

Tutors have the opportunity to use as wide a range of techniques as possible. Lectures, discussions, seminar presentations, site visits, supervised land-based machinery operation practicals, internet and library-based research and the use of personal and/or industrial experience would all be suitable. Delivery should stimulate, motivate, educate and enthuse learners.

Work placements should be monitored regularly in order to ensure the quality of the learning experience. It would be beneficial if learners and supervisors were made aware of the requirements of this unit before any work-related activities, so that naturally occurring evidence can be collected at the time. For example, learners may have the opportunity to operate tractors or land-based machines. Assessors should complete observation records and/or witness statements to confirm criteria achieved. Guidance on the use of observation records and witness statements is provided on the Pearson website.

Tutors should consider integrating the delivery, private study and assessment relating to this unit with any other relevant units and assessment instruments learners may also be taking as part of their programme of study.

Learning outcome 1 could be delivered through demonstrations, visits and a series of supervised practical repair sessions supplemented by lectures to cover the technical and safety aspects. There is a vast range of equipment available to cover harvesting and processing, tutors should cover items that apply to learners' areas of study. Learners will be required to develop a portfolio of evidence covering practical operations to include machine details, repair procedures undertaken, job cards and tutor feedback on performance. The portfolio may contribute to assessment evidence and decisions.

Learning outcome 2 will be delivered primarily through formal lectures and discussions that could be complemented by visits to appropriate shows and working demonstrations.

Tutors will cover the broad range of machines and equipment listed but learners need to be encouraged to research and develop a finer understanding of items of equipment that relate to their area of learning and those items which will be selected to satisfy learning outcome 1.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan gives **an indication of the volume of learning it would take the average learner** to achieve the learning outcomes. It is **indicative and is one way of achieving the credit value**.

Learning time should address all learning (including assessment) relevant to the learning outcomes, regardless of where, when and how the learning has taken place.

Topic and suggested assignments/activities and/assessment
Introduction to the unit.
Assignment 1: Practical Diaries for Machine and Equipment Component Replacement and Repair Procedures (P1, P2, P3, P4, M1, D1)
Evidence gathering – learner research activities.
Machine and equipment recognition, construction and working principles.
Preparation, inspection of machines and equipment, in preparation for component replacement and repair tasks.
Component replacement and repair of machines and equipment.
Assignment 2: Construction, Function and Set-up of Harvesting and Processing Equipment (P5, P6)
Safe working practices, service and repair records, environmental issues.
Assignment 3: Operational Processes and Performance of Harvesting and Processing Equipment (P7, P8, P9, P10)
Practical field operations and machine settings.
Material conveyance systems and mechanisms.
Assignment 4: Health and Safety when Working with Harvesting Machines and Processing Equipment (M2)
Performance evaluations and comparisons.
Overview of Assignment progress.
Practical assessments on component replacement and machine set-up procedures.
Overview of assignment progress.
Unit review.

Assessment

To achieve P1, P2, P3 and P4, learners will be required to carry out identified practical services repair and replacement tasks on a minimum of four harvesting machines or items of processing equipment which relate to their chosen area of learning. Learners will prepare and set up the equipment in readiness for work according to manufacturers' recommended data. They will follow the procedures to be adopted before machine and equipment lay up or long-term storage. All practical tasks, learners' assessment evidence and tutor feedback needs to be recorded in a portfolio of evidence covering machine details and work carried out.

To achieve M1, learners need to demonstrate safe and correct use of specialist tools and equipment when measuring and setting components after repairs and replacements have been carried out on equipment. To achieve D1, learners need to produce information on measuring procedures, specialist tools and equipment used together with manufacturers' setting data that can be recorded in the portfolio of evidence produced for P1, P2, P3 and P4. Assessors must complete observation records to confirm criteria achieved.

To achieve P5, P6, P7, P8, P9 and P10, learners are required to describe the construction, working principles and processes of a minimum of six harvesting machines and items of processing equipment, of their choice, selected from the lists from the unit content. Learners will also be required to identify methods of crop handling during crop harvest or processing. They must refer to reasons for crop losses and inadequate crop or product sample and possible reasons and rectification methods for poor performance of the equipment.

To achieve M2, learners need to describe the health and safety issues relating to preparing, setting up, maintaining and repairing the chosen harvesting machines and processing equipment. Evidence could be through a recorded question and answer session, supported by appropriate assessor witness testimony, or leaflet.

Programme of suggested assignments

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Pearson assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2, P3, P4, M1, D1	Practical Diaries for Machine and Equipment Component Replacement and Repair Procedures	A chosen range of machines and equipment requires pre-season inspection, preparation and repair. Following inspection, wearing components need to be checked against manufacturers' specifications to determine suitability for work, and set to provide optimum performance. During inspection, any damaged, broken or missing components need to be identified and replaced. All settings and adjustments need to be carried out to manufacturers' specifications.	Practical observations Practical tasks Portfolio development. Observation records/ witness testimony.
P5, P6	Construction, Function and Set-up of Harvesting and Processing Machines and Equipment	Following repair activities the equipment needs to be set up to perform harvesting or processing tasks, its performance checked against manufacturers' stated outputs and adjustments made to reach those outputs. Machines and equipment will be prepared for long-term storage or lay up.	Written evidence or oral assessment accompanied by tutor feedback on performance. Practical and oral assessments on machine preparation and storage preparation procedures. Observation records/ witness testimony.
P7, P8, P9, P10	Operational Processes and Performance of Harvesting and Processing Equipment	It is important that machine operators are aware of the processes used in harvesting and processing equipment, the methods for material handling and clearing blockages and of the causes of crop/product loss and poor sample quality.	Written evidence. Checklists. Observation.
M2	Health and Safety when Working with Harvesting Machines and Processing Equipment	During component replacement and repair activities, health and safety issues needs to be treated as a priority issue due to the nature of machine contamination, sharp components, electrical and hydraulic stored energy. Operators need to be aware of all safe working practices, and legislation relating to such operations.	Written evidence. Observation checklists.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC land-based sector suite. This unit has particular links with:

Level 2	Level 3
LEO18 Service and Repair Land-based Harvesting and Processing Equipment	Understanding and Servicing Land-based Harvesting Machinery (Cutting and Lifting)
	Understanding and Servicing Land-based Harvesting Machinery (Processing)

Essential resources

Learners will need access to a range of currently available harvesting machines and processing equipment together with appropriate operator handbooks or service manuals. Suitable work areas equipped to allow for decontamination and repair activities will be required, plus suitable facilities to allow machines and equipment to be checked for correct operation and performance. Specialist tools and equipment need to be available to allow measurements and settings to be made in line with manufacturers' information.

Employer engagement and vocational contexts

Learners should be encouraged to contact machinery dealers and manufacturers to obtain relevant information and possibly build up a relationship that may enable them to engage in work experience activities to strengthen their experience and learning. Where learners do not have prior experience of the working principles of specific machines and equipment, it may be useful for them to have the chance to operate the machines in a commercial environment. Indicative reading for learners

Textbooks

Bell B – *Farm Machinery* (Old Pond Publishing, 2005) ISBN 1903366682

Cairns B – *The Farmer's and Groundsman's Workshop: A Guide to Planning Vehicle and Machinery Maintenance* (The Crowood Press, 2009) ISBN 9781847971104

Culpin C – *Farm Machinery, 12th edition,* (Blackwell Scientific, 1992) ISBN 0632031597

Hillier V and Coombes P – *Hillier's Fundamentals of Motor Vehicle Technology, 5th edition* (Nelson Thornes, 2004) ISBN 0748780823

Journals

Horticultural Weekly

Profi International

Websites

www.bagma.com	British Agricultural and Garden Machinery Association
www.hse.gov.uk	Health and Safety Executive

Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit:

Skill	When learners are …
Independent enquirers	identifying and rectifying performance faults on equipment when trying to achieve optimum performance
Creative thinkers	planning practical component replacement and repair tasks on machines and equipment
Reflective learners	dismantling and replacing worn or damaged components on machines and equipment describing construction, types and function of machines and equipment identifying and rectifying faults on harvesting and processing machines and equipment
Self-managers	identifying and rectifying performance faults on equipment when trying to achieve optimum performance
Effective participators	identifying and rectifying performance faults on equipment when trying to achieve optimum performance preparing equipment for long-term storage and lay up.

Although PLTS opportunities are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are …
Independent enquirers	obtaining technical information from outside sources
Team workers	taking part in group practical work experience activities
Effective participators	performing operational tasks with machines and equipment to gain additional experience.

Functional Skills – Level 2

Skill	When learners are …
ICT – Use ICT systems	
Select, interact with and use ICT systems independently for a complex task to meet a variety of needs	obtaining technical information from outside sources
Manage information storage to enable efficient retrieval	building a portfolio of evidence to cover practical activities
Follow and understand the need for safety and security practices	undertaking practical activities
Troubleshoot	adjusting and setting machines and equipment to meet optimum performance
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	completing verbal assessment question and answer sessions.

Unit 19: Service and Repair Land-based Soil Preparation and Plant Establishment Equipment

Unit code: K/600/3407

Level 2: BTEC First

Credit value: 10

Guided learning hours: 60

Aim and purpose

The aim of this unit is to provide the learner with the knowledge and skills required to service and repair soil preparation and plant establishment equipment.

Unit introduction

The servicing and repair of soil preparation and plant establishment equipment is an essential part of the role of employees working in a wide variety of land-based industries.

This equipment includes ploughs and cultivation equipment for soil preparation and transplanters, seeders, sprayers and fertiliser spreaders for plant establishment equipment. Safe working practices are essential when using any equipment or machines.

This unit covers the safe servicing and setting up of this equipment and the principles of the safe working practices required when working with equipment. Correct setting is essential to good performance in the field. The requirements of preparing machines before use, using them correctly and storing and maintaining them will also be covered. Relevant, current legislation and codes of practice are considered along with the prevention and potential consequences of accidents at work.

Learners will develop a understanding of the construction, function and operation of soil preparation and, cultivation and plant establishment equipment.

Learners will also develop knowledge of the factors which affect equipment and its performance.

Learning outcomes

On completion of this unit a learner should:

1 Be able to service and set up soil preparation equipment

2 Know the construction, function and operation of soil preparation, cultivation and plant establishment equipment

3 Know the factors which affect equipment and performance.

Unit content

1 Be able to service and set up soil preparation equipment

Pre-season-inspection procedures: compliance with legislation; compliance with manufacturers' specifications; lubrication; common causes of component and assembly failure; repair procedures; replacement of worn components, safe practices, clearance setting, setting up

Workshop settings: manufacturers' manuals and data; attachment; drive-line; height; speed; levels; operation of controls; timing of components; attachments/options

Servicing: maintenance information in manufacturers' handbooks and instructions; reasons for following manufacturers' instructions eg safety, warranty; safe working practice in maintenance operations; correct use and storage of tools, equipment and materials; correct disposal of waste; record keeping; health and safety; relevant current legislation and codes of practice

Post-season: corrosion protection; common causes of component and assembly failure; identification of worn components; cleaning

Health and safety procedures: personal protective equipment (PPE); risk assessment; employee responsibilities; employer responsibilities; personnel cleaning requirements and facilities

Legislation: Health and Safety at Work Act 1974 (HASAWA); Control of Substances Hazardous to Health 1989 (COSHH); Manual Handling Operations Regulations (1992); Provision and Use of Work Equipment Regulations 1998 (PUWER)

2 Know the construction, function and operation of soil preparation, cultivation and plant establishment equipment

Soil engaging equipment for: lifting; moving; draining; inverting; separating; profiling; preparing land; tilth production

Plant establishment equipment for: planting; sowing; irrigating; fertilising; applying crop protection products; spreading

Causes of excessive wear to equipment and or components: lack of lubrication, soil types, incorrect setting up and adjustment, type of and impurities in spreading material

Methods and mechanisms used to meter and calibrate application rates of: plants, crop protection products, seeds, liquids, and fertilisers including sprayers, seed drills, spreaders and any other appropriate equipment

Operation of equipment: machine setting and adjusting; health and safety requirements for using machinery; use of power take-off (PTO) guards; machines fit for purpose, personal protective equipment (PPE); safe operational requirements for a range of working environments; health and safety; risk assessment; relevant current legislation and codes of practice; manufacturers' handbooks or instructions

3 Know the factors which affect equipment and performance

Measuring performance: work rates-spot, effective; field efficiency; quality of task carried out

Operational settings: depth; height; levels; alignment; speed; material flow

Crop condition: age/maturity; height; volume; and moisture

Ground conditions: aspect; topography; surface condition and smoothness; soil type

Specification: spacing; width, material capacity; options; speeds; machine protection devices

Machine compatibility: uses; sequence in field operations; rows; beds; power requirement

Operator competence: training requirements, use of manufacturers' handbooks

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria					
To achieve a pass grade the evidence must show that the learner is able to:		**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**		**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**	
P1	remove, dismantle, repair and reinstate soil preparation and plant establishment machinery to manufacturers' specification [SM]	**M1**	explain the reasons for setting up and preparing soil preparation and crop establishment equipment correctly	**D1**	justify the use of appropriate soil preparation and crop establishment equipment to meet given objectives.
P2	set up trailed and mounted machines to work effectively with the prime mover [SM, RL]				
P3	describe the types, construction and function of soil engaging, preparation and cultivation machinery and plant establishment equipment	**M2**	compare a range of soil engaging, preparation and crop establishment equipment for ease of repair and servicing		
P4	describe how to remove, dismantle, repair and reinstate soil preparation, cultivation and plant establishment machinery and equipment				
P5	describe how to set up and verify the performance of soil preparation, cultivation and plant establishment equipment [RL]				
P6	describe the methods and mechanisms used to meter and calibrate application rates				
P7	outline the impact of soil, seed, fertilizer types, crops, weather conditions on equipment performance settings. [IE, CT, RL]	**M3**	suggest suitable equipment for given conditions and performance requirements.		

PLTS: This summary references where applicable in the pass criteria, in the square brackets, the elements of the personal, learning and thinking skills. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

All centres must comply with the requirements of relevant, current legislation and associated codes of practice eg the *Prevention of Accidents to Children in Agriculture Regulations 1998*. Learners must be made aware of, and have access to, relevant health and safety legislation and know the importance of the use of risk assessments appropriate to each situation. Appropriate risk assessments must precede all practical machinery activities and learners must work in a safe manner at all times when using equipment or working with machinery. Learners must be supervised at all times and tutors must not ask learners to undertake tasks that are beyond their physical capabilities.

Delivery of this unit will involve practical assessments, written assessment, visits to suitable collections and will link to industrial experience placements.

Tutors have the opportunity to use as wide a range of techniques as possible. Lectures, discussions, seminar presentations, site visits, supervised tractor and/or land-based machinery operation practicals, internet and library-based research and the use of personal and/or industrial experience would all be suitable. Delivery should stimulate, motivate, educate and enthuse learners.

Work placements should be monitored regularly in order to ensure the quality of the learning experience. It would be beneficial if learners and supervisors were made aware of the requirements of this unit before any work-related activities, so that naturally occurring evidence can be collected at the time. For example, learners may have the opportunity to operate tractors or land-based machines and they should be encouraged to ask for observation records and/or witness statements to be provided as evidence. Guidance on the use of observation records and witness statements is provided on the Pearson website.

Tutors should consider integrating the delivery, private study and assessment relating to this unit with any other relevant units and assessment instruments learners may also be taking as part of their programme of study.

Learners are required to set up and service soil preparation, cultivation and plant establishment equipment. They need to know the construction, function and operation of these equipment types and the factors that affect equipment and performance in the field. Visiting expert speakers could add to the relevance of the subject for learners. For example, a representative from a land-based machine manufacturer could talk about the company's products and how they should be prepared, operated and maintained.

Formal lectures, site visits, discussions and demonstrations could set out the equipment, procedures, operating principles and safety considerations before any practical work is undertaken. It is expected that practical activities should form a major part of the delivery. Visiting expert speakers could add to the relevance of the subject for learners. For example, land-based machinery technicians or workshop managers could talk about their work and the techniques they use. Learners would benefit from operating the equipment or seeing the equipment working in real environments.

Health and safety issues relating to working in repair workshops must be stressed and reinforced regularly, and risk assessments must be undertaken before practical activities and before learners visit any workshop. Adequate personal protective equipment (PPE) must be provided and used following the production of suitable risk assessments.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan gives **an indication of the volume of learning it would take the average learner** to achieve the learning outcomes. It is **indicative and is one way of achieving the credit value**.

Learning time should address all learning (including assessment) relevant to the learning outcomes, regardless of where, when and how the learning has taken place.

Topic and suggested assignments/activities and/assessment
Introduction and review of unit; testing of previous knowledge.
Theory session: equipment for soil preparation.
Theory session: equipment for plant establishment.
Theory session: reasons for setting up and servicing.
Workshop practical: dismantling and repair of crop establishment equipment.
Assignment 1: The Repair of Soil Preparation and Plant Establishment Equipment (P1, P2, P4, P5, M1) Tutor introduces the assignment brief.
Workshop practical: dismantling and repair of crop establishment equipment.
Assignment 2: Equipment for Soil Preparation and Plant Establishment (P3, P6, P7, M2, M3, D1) Tutor introduces the assignment brief.
Workshop demonstration and practical: calibration.
Theory session: factors affecting machine operation.
Assignment and self-study.
Unit review.

Assessment

For P1, learners must service and set-up soil preparation and plant establishment equipment. Tutors could identify the specified equipment or negotiate them with learners. Work should be undertaken on three machines-one for soil preparation and two for plant establishment. Where possible, the size and complexity of the equipment should be the same for each learner to ensure fairness of assessment. The equipment chosen can be that commonly found in the primary land-based industry sector(s) being studied.

This could be assessed directly by the tutor during practical activities. If this format is used, suitable evidence from guided activities would be observation records completed by the learner and tutor and accompanied by appropriate work logs or other relevant learner notes. If assessed during a work placement, witness statements should be provided by a suitable representative and verified by the tutor.

P2 requires learners to set up trailed and mounted machines to work effectively with the prime mover. Where possible, to ensure fairness of assessment the size and complexity of the task should be the same for all learners. This could be assessed and evidenced in the same format as for P1.

In P3 learners must describe the types, construction and function of soil engaging, preparation and cultivation machinery and plant establishment equipment. The specified machines and situations could be the same as those used to meet the requirements of P1 and P2. Learners should provide evidence for three different types of machine or three machines within one or more of these categories that are used for different functions. Evidence may be in the same form as for P1.

Alternatively, evidence could take the form of a pictorial presentation with notes (possibly using appropriate software or an overhead projector), an annotated poster or a written assignment.

P4 requires learners to describe how to remove, dismantle, repair and reinstate soil preparation, cultivation and plant establishment machinery and equipment. The specified machines could be the same as those

used to meet the requirements of P1 and P2. Where possible, to ensure fairness of assessment the size and complexity of the task should be the same for all learners. Learners should provide evidence for three different types of machine or three machines within one or more of these categories that are used for different functions. Evidence may be in the same form as for P1. Alternatively, evidence for this could take the form of a pictorial presentation with notes (possibly using appropriate software or an overhead projector), an annotated poster or a written assignment.

P5 requires learners to describe how to set up and verify the performance of soil preparation, cultivation and plant establishment equipment. Evidence could be provided in the same form as for P1. Alternatively, evidence could take the form of a pictorial presentation with notes (possibly using appropriate software or an overhead projector), an annotated poster or a written assignment.

P6 requires learners to describe the methods and mechanisms used to meter and calibrate application rates. Evidence could be provided in the same form as for P1. Alternatively, evidence for this could take the form of a pictorial presentation with notes (possibly using appropriate software or an overhead projector), an annotated poster or a written assignment.

For P7, learners must outline the impact of soil, seed, fertiliser types, crops, and weather conditions on equipment performance settings. Assessment could take the form of verbal questioning in the workplace. Alternatively, evidence this could take the form of a pictorial presentation with notes (possibly using appropriate software or an overhead projector), an annotated poster or a written assignment.

M1 requires learners to explain the reasons for setting up and preparing soil preparation and crop establishment equipment correctly before use. Assessment and evidence for this could take the same from as in P7.

For M2, learners must compare a range of soil preparation and crop establishment equipment for ease of repair and servicing. Tutors could identify the specified equipment or negotiate them with the learner. Assessment and evidence for this could take the same form as for P1.

M3 requires learners to suggest suitable equipment for given conditions and performance requirements. This could be assessed by verbal questioning in the field. Alternatively, evidence for this could take the form of a pictorial presentation with notes (possibly using appropriate software or an overhead projector), an annotated poster or a written assignment.

D1 requires learners to justify the use of appropriate soil preparation and crop establishment equipment to meet given objectives. Evidence may be in the same form as for P2. Alternatively, evidence could take the form of a pictorial presentation with notes (possibly using appropriate software or an overhead projector), an annotated poster or a written assignment.

Programme of suggested assignments

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Pearson assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2, P4, P5, M1	The Repair of Soil Preparation and Plant Establishment Equipment	You are a fitter in an agricultural workshop and a customer brings in three items of equipment: one for soil preparation and two for plant establishment. You are required to dismantle, repair, reassemble and set up all three and to work with the prime mover, describing the operations to the customer.	Practical assessment.
P3, P6, P7, M2, M3, D1	Equipment for Soil Preparation and Plant Establishment	Report on the types of equipment available for soil preparation and plant establishment and how they are affected by external factors.	Written report and/or presentation.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC land-based sector suite. This unit has particular links with:

Level 2	Level 3
LEO19 Service and repair land-based soil preparation, cultivation and plant establishment equipment	Understanding and Servicing Land-based Machines (Cultivation and Planting Equipment)

Essential resources

Facilities required for this unit include regular and routine supervised access to safe, specialist land-based machines and work areas. Whilst the range of machines may reflect local or vocational needs, this should not restrict learners from gaining an appreciation of machines used in a variety of areas.

Access to resources should be sufficient to give all learners adequate opportunities to develop practical ability and confidence over a period of time. Learners should have access to learning materials, such as operating manuals.

Learners must also have access to relevant personal protective equipment.

Employer engagement and vocational contexts

It is essential that this unit is delivered in an applied and vocational context. Work-based experience will also be important. The unit will be enhanced by contact with employers. Centres are encouraged to develop links with local businesses, manufacturers and machinery dealers, who can support the breadth and application of this unit. Employers not only can provide real-work practical exercises, guest speakers and experts to support the learning experience. Employer engagement will ensure the use of technically up-to-date information and processes.

Indicative reading for learners

Textbooks

Bell B – *Farm Machinery, 5th Edition* (Old Pond Publishing, 2005) ISBN 1903366682

Culpin C – *Farm Machinery, 12th Edition* (Oxford: Blackwell Scientific, 1992) ISBN 063203159X

Hawker MFJ and Keenlyside JF – *Horticultural Machinery* (Longman Higher Education, 1985) ISBN 0582408075

HSE – *Essentials of Health and Safety at Work* (HSE Books, 2006) ISBN 0717661792

Journals

Horticultural Week

Profi

Farmers Weekly

Websites

www.bagma.com	British Agricultural and Garden Machinery Association
www.hse.gov.uk	Health and Safety Executive
www.howstuffworks.com	HowStuffWorks

Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit:

Skill	When learners are …
Independent enquirers	outlining the impact of soil, seed, fertiliser types, crops, weather conditions on equipment performance settings
Creative thinkers	outlining the impact of soil, seed, fertiliser types, crops, weather conditions on equipment performance settings
Reflective learners	outlining the impact of soil, seed, fertiliser types, crops, weather conditions on equipment performance settings describing how to set up and verify the performance of soil preparation and plant establishment equipment
Self-managers	removing, dismantling, repairing and reinstating machinery to manufacturers' specifications setting up trailed and mounted machines to work effectively with the prime mover.

Although PLTS opportunities are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are …
Reflective learners	setting up trailed and mounted machines to work effectively with the prime mover.

Functional Skills – Level 2

Skill	When learners are …
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	using manufacturers' handbooks and technical information to support dismantling, repair, reassembly and setting up
ICT – Develop, present and communicate information	
Enter, develop and format information independently to suit its meaning and purpose including: • text and tables • images • numbers • records	
Bring together information to suit content and purpose	
Present information in ways that are fit for purpose and audience	giving presentation to peers
Evaluate the selection and use of ICT tools and facilities used to present information	
Select and use ICT to communicate and exchange information safely, responsibly and effectively including storage of messages and contact lists	
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	describing how to remove, dismantle, repair and reinstate soil preparation, cultivation and plant establishment machinery and equipment describing the methods and mechanisms to meter and calibrate application rates
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	using manufacturers' handbooks to gain information concerning setting up and maintenance of soil preparation and plant establishment equipment.
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	

Unit 20: Service and Repair Land-based Transport, Handling and Storage Equipment

Unit code: H/600/3406

Level 2: BTEC First

Credit value: 10

Guided learning hours: 60

Aim and purpose

The aim of this unit is to provide the learner with the knowledge and skills required when working with transport, handling and storage equipment within land-based operations.

Unit introduction

Technical advancements in land-based transport, handling and storage equipment over recent years increased the requirements for equipment to be serviced and repaired regularly to ensure it is safe, capable of optimum performance and 'down time' is kept to a minimum.

Machine operators and service/repair personnel are now required to have a greater understanding of working principles and service and repair procedures. This is mainly due to the increase in complexity of mechanisms and the integration of electronic control and monitoring processes, which items of equipment now depend on to ensure safe, efficient, economic and environmentally acceptable operations are performed.

In this unit learners will develop and improve their ability to understand why transport, handling and storage equipment needs to be maintained according to manufacturers' recommendations and to recognise the need to replace or repair worn, missing or damaged components. There is a vast range of equipment available to meet modern day requirements of land–based transport, handling and storage operations. It would be impossible for learners to demonstrate an ability with and understanding of all units, therefore, learners will select from a range of equipment typical to their area of study.

On completion of the unit, learners will have successfully demonstrated knowledge, understanding and an ability to perform specific tasks on their chosen range of equipment. There must also be made aware of the need to follow future developments which are increasingly being introduced by manufacturers.

Learning outcomes

On completion of this unit a learner should:

1 Be able to service and repair transport, handling and storage equipment

2 Know the construction, function and operation of transport, handling and storage equipment.

Unit content

1 Be able to service and repair transport, handling and storage equipment

Service: manufacturers' recommended installation procedures; periodic; scheduled; non-scheduled; lubrication system requirements and lubricants; wear assessment; condition inspections, decontamination and cleanliness; stored energy release; manufacturers' data and specifications; machine data; serial numbers; lubrication charts; service records; road transport regulations

Repair: worn components; replacement of damaged or broken components; hydraulics; electrical control and equipment; modifications; refitting and refabrication of wear areas; identification of the need for repairs; identification of replacement components; sources of replacement components; safe working practices; correct removal, replacement and repair procedures; correct and safe disposal of wastes; risk assessments; relevant legislation and codes of practice eg Health and Safety at Work Act 1974; PUWER; Grinding Wheel regulations; PPE; COSHH

Transport, handling and storage equipment and their components: eg lifting equipment, cranes, forklifts, handlers, loaders and elevated platforms, winches, skylines and cable systems, latching and hitching systems, trailers, tankers, forage and feed wagons, timber forwarders, conveyors, elevators, augers, suction blowers, fixed and mobile tanks and or silos, slurry storage equipment, crop storage equipment, temperature, humidity controlled storage equipment, ingestors, bale collectors, grass collection systems; how to identify and isolate services from handling and storage equipment eg oil, water, gas, electrical, fuel; how to install and commission new transport, handling and storage equipment

Layout and characteristics of transport, handling and storage areas: eg lifting equipment, cranes, forklifts, handlers, loaders and elevated platforms, winches, skylines and cable systems, latching and latching systems, trailers, tankers, forage and feed wagons, timber forwarders, conveyors, elevators, augers, suction blowers, fixed and mobile tanks and or silos, slurry storage equipment, crop storage equipment, temperature, humidity controlled storage equipment, ingestors, bale collectors, grass collection systems

2 Know the construction, function and operation of transport, handling and storage equipment

Construction and function: equipment main frame and chassis frameworks; wheel equipment, tyres, brakes and suspension; ground anchoring systems; power supply; drive systems; lifting equipment attachment and security; safe lifting capacities; safety locks and devices; operator and bystander safe working areas and radius; machine and equipment stability on slopes and under load; lubrication systems and lubricants; pivot points, pins and bushings; lift mechanisms; cables and slides; winch types, single and double drum; winch cable types, under and overwound, safe lifting and hauling capacities; timber grabs, grapples and rotators; elevators, chain and slat, belt, cups, moving floor; auger flights, working angles, diameters; pneumatic conveyance, fan types, air flow control, ducting, restrictions through lift height and bends; fixed and mobile tank and silo construction; bunding; ventilation; unloading and loading systems; temperature measuring, probes, sampling equipment, temperature control; humidity measuring, moisture meters, acceptable moisture content for storage, moisture control systems; ingestor system construction process, ingested materials; ingested waste extraction and storage, anaerobic process

Operation: site security; operator training; use of manufacturers' handbooks and manuals; legislative operator requirements; power unit pre-start checks; service requirements; periodic test requirements; lifting regulations; material security during road transport; liquid movement on side slopes and gradients; angle of repose for loaded grains and particle material; log roll; sheeting and roping of loads; changes to centre of gravity during transport; effects of dust and fumes; PPE selection; risk assessments

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria					
To achieve a pass grade the evidence must show that the learner is able to:		**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**		**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**	
P1	clean and prepare transport, handling and storage equipment for service and maintenance [RL, EP]	**M1**	carry out and report findings of thorough condition inspections on a selected range of appropriate transport, handling and storage equipment	**D1**	carry out tests on the range of transport, handling and storage equipment to establish whether throuputs, safe working loads and safety devices conform to legislative and/or manufacturers' recommendations.
P2	remove, dismantle, repair and reinstate transport, handling and storage equipment to manufacturer's specifications [RL, SM, EP]				
P3	safely clear blockages from equipment [SM, EP]				

Assessment and grading criteria				
To achieve a pass grade the evidence must show that the learner is able to:		**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**		**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P4	identify transport, handling and storage equipment and their components	**M2**	compare transport, handling and storage equipment and systems to establish suitability for handling liquids, granular, powder and solid mass materials.	
P5	explain how to remove, dismantle, repair and reinstate transport, handling and storage equipment and their components			
P6	describe how to identify and isolate services from handling and storage equipment			
P7	describe the layout and characteristics of transport, handling and storage equipment			
P8	describe how to clean and prepare transport, handling and storage equipment for service and repair operations			
P9	describe the methods of shortening, lengthening and joining belts, elevators and conveyors			
P10	define the appropriate methods of clearing blockages from transport, handling and storage equipment.			

PLTS: This summary references where applicable in the pass criteria, in the square brackets, the elements of the personal, learning and thinking skills. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

All centres must comply with the requirements of relevant, current legislation and codes of practice eg the *Prevention of Accidents to Children in Agriculture Regulations 1998*. Learners must be made aware of, and have access to, relevant health and safety legislation and know the importance of the use of risk assessments appropriate to each situation. Appropriate risk assessments must precede all practical machinery activities and learners must work in a safe manner at all times when using equipment or working with machinery. Learners must be supervised at all times and tutors must not ask learners to undertake tasks that are beyond their physical capabilities.

Delivery of this unit will involve practical assessments, written assessment, visits to suitable industrial premises or sites facilities and relevant shows and demonstrations and may have links to industrial experience placements.

Tutors have the opportunity to use as wide a range of techniques as possible. Lectures, discussions, seminar presentations, site visits, supervised land-based transport, handling and storage equipment practical operations, internet and library-based research and the use of personal and/or industrial experience would all be suitable. Delivery should stimulate, motivate, educate and enthuse learners.

Work placements should be monitored regularly in order to ensure the quality of the learning experience. It would be beneficial if learners and supervisors were made aware of the requirements of this unit before any work-related activities, so that naturally occurring evidence can be collected at the time. For example, learners may have the opportunity to operate tractors or land-based machines and they should be encouraged to ask for observation records and/or witness statements to be provided as evidence. Guidance on the use of observation records and witness statements is provided on the Pearson website.

Tutors should consider integrating the delivery, private study and assessment relating to this unit with any other relevant units and assessment instruments learners may also be taking as part of their programme of study.

Learning outcome 1 could be delivered through demonstrations, visits and by a series of supervised practical maintenance and repair sessions supplemented by lectures to cover the technical and safety aspect. There is a vast range of equipment available to cover the transport, handling and storage of land-based materials, and tutors should cover items that apply to learners' areas of study. Learners will be required to develop a portfolio of evidence covering practical operations to include machine details, repair procedures undertaken, job cards and tutor feedback on performance. The portfolio may contribute to assessment outcome decisions.

Learning outcome 2 will be delivered primarily through formal lectures and discussions that could be complemented by visits to appropriate shows and working demonstrations.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan gives **an indication of the volume of learning it would take the average learner** to achieve the learning outcomes. It is **indicative and is one way of achieving the credit value**.

Learning time should address all learning (including assessment) relevant to the learning outcomes, regardless of where, when and how the learning has taken place.

Topic and suggested assignments/activities and/assessment
Introduction to the unit.
Assignment 1: Practical Diaries for Transport, Handling and Storage Equipment Preparation, Service and Repair (P1, P2, P3, M1, D1)
Evidence gathering.
Equipment recognition, construction and working principles.
Inspection of machines and equipment, in preparation for service, component replacement and repair tasks.
Service, component replacement and repair of machines and equipment.
Assignment 2: Construction and Function of Transport, Handling and storage Equipment (P4, M2)
Safe working practices, service and repair records, environmental issues.
Assignment 3: Operation and Maintenance of Transport, Handling and Storage Equipment (P5, P6, P7, P8, P9, P10)
Practical operations and machine settings.
Material conveyance systems and mechanisms.
Overview of progress, Assignment 1.
Performance evaluations and comparisons.
Overview of progress, Assignment 2.
Practical assessments on component replacement and machine set-up procedures.
Unit review.

Assessment

For P1, P2 and 3, learners are required to carry out identified practical service, repair and component replacement tasks on a minimum of 4 items of transport, handling and storage equipment which relate to their chosen area of learning. They must relieve blockages on the chosen equipment safely. The selected range of equipment should consist of at least one transport unit, one handling unit and one storage unit. All practical tasks and tutor feedback needs to be recorded in a portfolio of evidence covering machine details and work carried out.

For M1, learners are required to carry out detailed inspections of their chosen equipment to identify wear, damage, lost or broken components. Findings may be reported verbally to the tutor who will record information by using suitable documentation or learners may wish to formulate their own inspection checklists and records.

For D1, learners carry out test procedures to identify accuracy of settings, ie pressure, torque, electrical values, to determine equipment efficiency against manufacturers' data. Safety mechanisms and devices must also be tested to ensure compliance legislative requirements and manufacturers' recommendations. Any shortfalls do no need to be rectified as part of the assessment process but must be brought to the tutor's attention.

For P4 and P7, learners need to identify and explain the construction, function and operation of the four items of equipment chosen for P1, P2 and P3. Evidence may be written or verbal. Where verbal evidence is generated the tutor must record using suitable records.

For M2, learners need to expand on P4 by comparing alternative machines and equipment designed to transport, handle and store liquid, granular, powder and solid materials. References should be made to efficiency, safety and environmental advantage.

For P5 and P8, learners must describe in detail the procedures adopted, equipment and facilities used and health and safety codes of practice and legislations to be observed when carrying out preparation, service, maintenance and repair of transport, handling and storage equipment.

For P6, P9 and P10, learners must describe stated operational task procedures according to manufacturers' recommendations and settings. Evidence may be a by way of project assignment, observed practical test or pictorial presentation with notes using appropriate software, slides or OHPs.

Programme of suggested assignments

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Pearson assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2, P3, P4, M1, D1	Practical Diaries for Transport, Handling and Storage Equipment Preparation, Service and Repair	Four items of equipment require inspection, maintenance repair and performance testing before being put to work. The equipment owner requires the work to be carried out and expects a portfolio of records to be produced to enable service documentation to be transferred into a company planned maintenance recording system. The owner also requires information on the overall condition of the machines to enable future replacement decisions to be progressed.	Practical work records Observations Portfolio, Inspection. Test procedures on output and performance.
P4, M2	Construction and Function of Transport, Handling and storage Equipment	Produce a summary and comparisons for a range of selected machines and equipment and suggest alternative machines and equipment to transport, handle and store various types of materials.	Written evidence verbal evidence record of Q&A.
P5, P6, P8, P9, P10	Operation and Maintenance of Transport, Handling and Storage Equipment	Produce records of preparation, maintenance and repair tasks carried out on selected machines and equipment in a suitable form that will contribute to company planned maintenance records. Demonstrate knowledge of safe procedures to be adopted when carrying out stated operator maintenance tasks according to manufacturers' instructions.	Written evidence records of procedures adopted for practical tasks.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC land-based sector suite. This unit has particular links with:

Level 2	Level 3
LEO20 Service and repair land-based transport, handling and storage equipment	Undertake and Review Work-related Experience in the Land-based industries

Essential resources

Learners will need access to a range of currently available transport, handling and storage equipment and facilities together with appropriate operator handbooks or service manuals. Suitable work areas equipped to allow for decontamination and repair activities will be required, suitable facilities to allow machines and equipment to be checked for correct operation and performance. Specialist tools and equipment to allow measurements and settings to be made in line with manufacturers' information will be required plus access to spare parts details and lists. Access to IT equipment and appropriate software.

Employer engagement and vocational contexts

Learners should be encouraged to contact machinery dealers and manufacturers to obtain relevant information and possibly build up a relationship that may enable them to engage in work experience activities to strengthen their experience and learning. Where learners do not have prior experience of the working principles of specific machines and equipment, it may be useful for them to have the chance to operate the machines in a commercial environment.

Indicative reading for learners

Textbooks

Bell B – *Farm Workshop, 2nd Edition* (Farming Press, 1992) ISBN 0852362374

Pearce A – *Farm Welding, 2nd Edition* (Old Pond Publishing Press, 2006) ISBN1905523300

Barber, T W – *Repair and Maintenance of Machinery* (Bibliobazaar, LLC, 2010) ISBN 1142904652

Jeffrey Dick – *Principles of Machinery Maintenance* (Nelson Thornes Ltd, 1993) ISBN 0170087050

Cairns Brian – *Farmers and Groundsman's Workshop, A Guide to Planning Vehicle and Machinery Maintenance* (Crowood Press Ltd, 2009) ISBN 18479711105

Journals

Farm Ideas

Farmers Weekly

Profi International

Other publications

Lifting and Handling leaflets for Agriculture, Forestry and Arboriculture (Health and Safety Executive leaflet)

Fatal Attraction, Avoiding Agricultural Transport Accidents (Health and Safety Executive leaflet)

Managing Confined Spaces (Health and Safety Executive leaflet)

Websites

www.hse.gov.uk Health and Safety Executive

Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit:

Skill	When learners are …
Reflective learners	performing practical tasks on machines and equipment
Self-managers	performing practical service, maintenance and repair tasks on machines and equipment
Effective participators	cleaning and preparing machines and equipment for service maintenance and repair performing practical service, maintenance and repair tasks on machines and equipment clearing blockages on transport, handling and storage machines and equipment safely.

Although PLTS opportunities are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are …
Creative thinkers	preparing and delivering presentations
Effective participators	preparing and delivering presentations.

Functional Skills – Level 2

Skill	When learners are …
ICT – Use ICT systems	
Select, interact with and use ICT systems independently for a complex task to meet a variety of needs	preparing presentation material
Use ICT to effectively plan work and evaluate the effectiveness of the ICT system they have used	
Manage information storage to enable efficient retrieval	producing a portfolio of evidence to cover practical work
Follow and understand the need for safety and security practices	operating and clearing blockages on machines and equipment
Troubleshoot	producing machine inspection checklists
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	
ICT – Develop, present and communicate information	
Enter, develop and format information independently to suit its meaning and purpose including: • text and tables • images • numbers • records	
Bring together information to suit content and purpose	
Present information in ways that are fit for purpose and audience	delivering presentations
Evaluate the selection and use of ICT tools and facilities used to present information	evaluating the delivery of a presentation
Select and use ICT to communicate and exchange information safely, responsibly and effectively including storage of messages and contact lists	

Skill	When learners are …
Mathematics	
Understand routine and non-routine problems in a wide range of familiar and unfamiliar contexts and situations	calculating and measuring during service and repair procedures
Identify the situation or problem and the mathematical methods needed to tackle it	
Select and apply a range of skills to find solutions	
Use appropriate checking procedures and evaluate their effectiveness at each stage	
Interpret and communicate solutions to practical problems in familiar and unfamiliar routine contexts and situations	
Draw conclusions and provide mathematical justifications	
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	responding to verbal assessments When delivering presentations
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	making reference to manufacturers' information.
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	

Unit 21: Service and Repair Electrical Systems on Land-based Equipment

Unit code: Y/600/3404

Level 2: BTEC First

Credit value: 10

Guided learning hours: 60

Aim and purpose

The aim of this unit is to provide the learner with the knowledge, understanding and skills required to carry out service and repair on electrical systems within land-based equipment. The learner will need to ensure they comply with current legislation and guidelines to complete this unit. This unit aims to introduce learners to skills and knowledge in the service and repair of electrical systems and how these can be applied in practice. It is designed for learners in centre-based settings looking to progress into the sector or onto further/higher education.

Unit introduction

In this unit learners will develop an understanding of the fundamentals of electrical maintenance and the knowledge and skills required when carrying out electrical maintenance activities. In carrying out these activities learners will developing knowledge and skills in selecting fault-finding techniques and diagnose faults. Learners will also develop the skills needed to dismantling, reassemble and carry out routine maintenance on electrical equipment and circuits such as motors and control systems.

Learners will need to demonstrate an understanding of safe working practices when carrying out fault location and maintenance activities and take the necessary safeguards to protect their own safety and that of others in the workplace.

Learning outcomes

On completion of this unit a learner should:

1 Be able to perform service and repair operations on electrical systems and their components used in land-based equipment

2 Know the construction, function and operation of electrical systems and circuits and their components.

Unit content

1 Be able to perform service and repair operations on electrical systems and their components used in land-based equipment

Electrical risks: welding, short circuit, battery open circuit, overcharging, reverse polarity

Dismantling and assembly: use of manufacturers' service manuals; parts lists and drawings; approved working procedures

Removal and replacement: eg damaged wires and cables, electrical units/components, termination and connection, soldering and de-soldering; appropriate tools and equipment; approved working procedures

Inspection and maintenance routines: maintenance routines eg power supplies and/or batteries, on electrical equipment and circuit components, devices and systems, wiring harnesses, connectors and connections, earthing; inspection and functional testing eg voltage, current, continuity, resistance, battery, condition, continuity, wear, overheating, missing or loose fittings, carrying out adjustments as necessary; recording of condition; the use of maintenance manuals and documentation

Types of instruments: eg multimeter, light meter, Power Probe

Fault diagnosis techniques: eg use of fault-finding aids, functional charts, diagrams, trouble shooting charts, six point (collect evidence, analyse evidence, locate fault, determine and remove cause, rectify fault, check system), half split, input/output, unit substitution, emergent sequence, component data sheets, operation and maintenance manuals, software-based records and data, visual examination, unit substitution, fault/repair reporting, final test handover procedures

Repairs to manufacturers' specifications: eg starting systems, charging systems, safety and/or circuit protection systems, ignition systems, spark ignition systems, lighting systems, instrumentation systems, ancillary systems

Problem: eg short circuit, open circuit, high resistance, intermittent, partial failure/out-of-specification output, complete breakdowns

Report findings: eg scheduled maintenance report, corrective maintenance report, other company-specific report, job cards, maintenance log

2 Know the construction, function and operation of electrical systems and circuits and their components

System components: electrical supply eg cables and connectors, batteries; lead acid, gel, maintenance free, dry cell; transformers, rectifiers, contactors; circuit components eg capacitors, circuit boards, switches, solenoids, thermistors, devices eg overload protection device, relays, sensors; use of maker's catalogue or database for selecting replacements

Identification of components and function: series and parallel connections, power supply and battery types, circuit protect devices, fixed and/or variable resistors, diodes, relays switches, wire types and sizes, electrical consumers

Identification and interpretation of circuit diagrams to include the following: electrical component symbols, colour coding, wire identification and sizing, series and parallel connections; alternating and direct current and the common voltages in use

Principles, construction and function of electrical circuits and their component types: starter circuits eg inertia, pre-engaged; cold start circuits eg heat start, safety start, ignition circuits; charging circuits eg alternators, rectifiers, lighting circuits eg indicators, brake lights, side, head, dip, marker lights, work lights; Instrumentation circuits eg fuel, temperature, tachometer, hour meter. spark ignition circuits eg spark generation; ancillary circuits eg wiper motors, stop circuits, ventilation, horn, switches, actuators; safety and/or circuit protection circuits eg battery isolation safety isolation, fuses and fuseable links, thermal switches, over – under voltage switching, relays, RCCB, earth bonding, double insulation

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria					
To achieve a pass grade the evidence must show that the learner is able to:		**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**		**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**	
P1	identify electrical circuits and components and their functions from wiring diagrams and visual recognition [IE, CT]	**M1**	explain the relationship between component faults and the malfunction of a given electrical system	**D1**	compare and contrast two fault diagnosis techniques when carrying out maintenance work on an electrical system.
P2	perform tests using equipment and practices to measure and verify the correct operation of electrical systems and their components [SM, IE, TW]				
P3	identify and rectify faults in electrical systems and components [RL, EP]				
P4	maintain the integrity of electrical systems [EP, IE]				
P5	remove, dismantle, rectify faults, repair and reinstate electrical components and circuits to manufacturer's specifications and standards [EP, IE, TW]				

Assessment and grading criteria					
To achieve a pass grade the evidence must show that the learner is able to:		**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**		**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**	
P6	identify and interpret electrical circuit diagrams [IE]	**M2**	explain the importance of applying safe working practices when carrying out maintenance on an electrical system.		
P7	summarise Ohm's law, its application and principles [IE]				
P8	compare the specification, safe maintenance and charging of different types of battery [RL,IE,TW,CT]				
P9	describe the principles, construction and function of electrical circuits and their components [CT]				
P10	describe how to remove, dismantle, test, verify, repair and reinstate electrical circuits and their components [CT, RL]				
P11	outline risks posed to electrical systems and components by other activities or incidents. [IE, RL, SM, EP CT]				

PLTS: This summary references where applicable in the pass criteria, in the square brackets, the elements of the personal, learning and thinking skills. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

All centres must comply with the requirements of relevant, current legislation and codes of practice the *Prevention of Accidents to Children in Agriculture Regulations 1998*. Learners must be made aware of, and have access to, relevant health and safety legislation and know the importance of the use of risk assessments appropriate to each situation. Appropriate risk assessments must precede all practical machinery activities and learners must work in a safe manner at all times when using equipment or working with machinery. Learners must be supervised at all times and tutors must not ask learners to undertake tasks that are beyond their physical capabilities.

Delivery of this unit will involve practical assessments, written assessment, visits to suitable collections and will link to industrial experience placements.

The unit provides an opportunity for learners to work in teams or groups when diagnosing component or system faults. Delivery of this unit should focus on learners developing diagnostic and practical skills, together with an understanding of electrical components and systems maintenance.

The learning outcomes are ordered logically and it would be reasonable to develop them sequentially throughout the unit. In this way, learners will be able to apply health and safety system and component operation to diagnostic, testing and maintenance techniques. All learning outcomes suit to a practical approach rather than too much time spent in theory lessons. For example, a short introduction to a component (or range of components), the function of the component within the larger system, the tools necessary to carry out the maintenance task together with any safety considerations, followed by practice. Learners need a broad overview of the different electrical components and systems so they can select and apply the correct maintenance, diagnostic and testing techniques

Learners will need to ensure they comply with current legislation and guidelines to complete this unit.

Evidence may be collected from well-planned investigative assignments or reports of workshop activities. Evidence can be accumulated through learners building up a portfolio from investigations, case studies and maintenance operations through a tutor-led series of assignments, realistic maintenance exercises and tests.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan gives **an indication of the volume of learning it would take the average learner** to achieve the learning outcomes. It is **indicative and is one way of achieving the credit value**.

Learning time should address all learning (including assessment) relevant to the learning outcomes, regardless of where, when and how the learning has taken place.

Topic and suggested assignments/activities and/assessment
Electrical basics: include Ohm's law, what is needed in a circuit, series and parallel circuits.
Assignment 1: Electrical Health and Safety (P10, P11, M2)
Assignment 2: Maintenance of Electrical Equipment (P1, P2, P4, P5)
Practical activities to cover unit content as required.

Topic and suggested assignments/activities and/assessment
Assignment 3: Electrical Theory (P6, P7, P9) Recognising components, working with circuit diagrams, understanding ohm's law and its application.
Assignment 4: Batteries (P8) How batteries work, types of battery, battery application, the future of battery technology.
Assignment 5: Electrical Fault Finding (P3, M1, D1) Practical assessment activities that capture evident as described in unit content.
Unit review.

Assessment

For P1, P2, P3, P4 and P5 learners are required to demonstrate practices and use of equipment to identify, measure and rectify faults in electrical systems and their components/circuits. All practical tasks and tutor feedback needs to be recorded using appropriate documentation.

For P6, P7, P8, P9, P10 and P11, learners must provide information relating to operational task procedures relating to the service and repair of electrical systems. Evidence may be a by way of project assignment, observed practical test or pictorial presentation with notes using appropriate software, slides or OHPs.

For M1, M2 and D1, learners must provide detailed information on electrical fault diagnosis, malfunctions and safe working practices. Evidence could be in the form of a report, test or presentation.

Programme of suggested assignments

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Pearson assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P10, P11, M2	Electrical Health and Safety	Electrics can be dangerous and working on vehicle electrics can damage the components beyond repair. Look at the risks involved with electrical system maintenance and repair.	Assignment.
P1, P2, P4, P5	Maintenance of Electrical Equipment	As with other systems, electrical systems need maintenance and repair. Carry out tests, maintenance and repairs to electrical systems and components.	Portfolio of evidence.
P6, P7, P9	Electrical Theory	Electrical systems can become very complex. It is essential that you understand circuit diagrams and the theory of electric systems.	Open book test.
P8	Batteries	though vehicle electrics have change drastically over a short period of time, the same cannot be said for the humble battery. Investigate the different types of vehicle battery with a view to the future.	Investigative report.

Criteria covered	Assignment title	Scenario	Assessment method
P3, M1, D1	Electrical Fault Finding	Quick fault diagnosis will save considerable time, effort and expense. Use fault-finding techniques to identify system faults and rectify them.	Practical assessment.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC land-based sector suite. This unit has particular links with:

Level 2	Level 3
LEO22 Service and Repair Electrical Systems on Land-based Equipment	Undertake and Review Work-related Experience in the land-based Industries

Essential resources

Centres delivering this unit must have access to land-based vehicle standard components and systems, testing instruments and rigs. This unit relies heavily on the learner being able to investigate the manufactured specification of components and service manuals.

Employer engagement and vocational contexts

Visits to vehicle electric specialist firms in relation to fault finding would be of benefit to learners as well as visits to manufacturing organisations or similar with a focus on electrical components, their installation and service requirements. Learners will be made aware of the vast range and scope of electrical components and sensors used in the land-based engineering sector.

Indicative reading for learners

Textbooks

Health and Safety Executive – *Essentials of Health & Safety at Work* (HSE, 1995) ISBN 071760716X

Adams J – *Electrical Safety: A Guide to the Causes and Prevention of Electrical Hazards* (Institution of Electrical Engineers, 1994) ISBN 085296806X

Websites

uk.rs-online.com	RS is Europe's leading distributor of electronic, electrical and industrial components.
www.ehow.com	eHow.com is an online community dedicated to providing visitors the ability to research, share, and discuss solutions and tips for completing day-to-day tasks and projects.
www.hse.gov.uk	Health and Safety Executive

Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit:

Skill	When learners are …
Independent enquirers	carrying out fault finding electrical systems
Creative thinkers	carrying out fault finding on electrical systems
Reflective learners	making comparisons between components and systems
Team workers	gathering test data
Self-managers	investigating faults
Effective participators	gathering test data.

Although PLTS opportunities are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are …
Independent enquirers	planning and carrying out research activities related to the unit evaluating and carrying out extended thinking
Creative thinkers	asking questions to extend their thinking during lectures and practical sessions trying out alternatives or new solutions
Reflective learners	identifying opportunities for their own achievements
Team workers	assisting in group activities
Self-managers	setting own targets for accurate completion of work asking for assistance
Effective participators	encouraging debate.

Functional Skills – Level 2

Skill	When learners are …
ICT – Use ICT systems	
Select, interact with and use ICT systems independently for a complex task to meet a variety of needs	using ICT-based systems to define component functionality
Use ICT to effectively plan work and evaluate the effectiveness of the ICT system they have used	
Manage information storage to enable efficient retrieval	
Follow and understand the need for safety and security practices	
Troubleshoot	
Select and use ICT to communicate and exchange information safely, responsibly and effectively including storage of messages and contact lists	
Mathematics	
Understand routine and non-routine problems in a wide range of familiar and unfamiliar contexts and situations	describing Ohm's law and its application
Identify the situation or problem and the mathematical methods needed to tackle it	
Select and apply a range of skills to find solutions	using electrical fault-finding techniques
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	discussing fault-finding techniques.
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	

Unit 22: Service and Repair Hydraulic Systems and Components on Land-based Equipment

Unit code: L/600/3402

Level 2: BTEC First

Credit value: 10

Guided learning hours: 60

Aim and purpose

The aim of this unit is to provide the learner with the knowledge, understanding and skills required to service and repair hydraulic systems and components in Land-based equipment. This unit will introduce learners to how these can be applied in practice. It is designed for learners in centre-based settings looking to progress into the sector or onto further/higher education.

Unit introduction

Many land-based machines and equipment rely heavily on fully functioning and effective hydraulic systems to carry out the varied tasks that modern machine owners and operators require of them. The application of the machine's engine power for massive earth moving tasks and the precise application of fertiliser or seed to a given area are both common functions of hydraulic systems on modern land-based machinery.

Current tractors and power units have built in multiple function systems and are capable of delivering exact levels of pressure or torque to a wide range of system actuators; to do this, the system must respond as the manufacturer intended. This unit will look at hydraulic systems and their components with a view to recognising correct performance and the ways and means by which this can be established and where necessary corrected. The unit will also look at the elements of care that can be applied to these intricate and often complicated systems to ensure that, when operating at peak performance, the correct level of efficiency is maintained and the likely causes of malfunction and/or failure can be identified.

At all times learners will be made aware of the hazards associated with working with hydraulic systems. Relevant health and safety and Environment Agency advice and guidance, in particular the need to risk assess any operation will be integral to all delivery activities. The environmental impact of working with hydraulic systems and the storage and disposal of waste will also be embedded in unit delivery.

Learning outcomes

On completion of this unit a learner should:

1 Be able to perform service and maintenance operations on hydraulic systems and their components

2 Know the construction, function and operation of hydraulic circuit systems and their components used in land-based engineering applications.

Unit content

1 Be able to perform service and maintenance operations on hydraulic systems and their components

Health and safety: safe release of stored energy eg pipes, hoses and component parts; risk assessment; personal protective equipment (PPE); codes of practice; relevant current legislation

Sensory checks: visual, sound, smell, touch

Functional testing: identification of system purpose (single and multi function, position, draft, response, intermix, external services); system fit for purpose; operating limits; cycle time testing

Use of test equipment: pressure gauge; flow meter; temperature gauge; analogue; digital

Identify and locate serviceable components: reservoir; filtration (suction, pressure, return); pump; hoses and pipe-work, valves eg directional control, pressure control, flow control; actuators eg linear, rotary, semi rotary

Service and maintenance: manufacturers' specifications; manufacturers' recommendations; service tasks (renew, repair, replacement, adjustment, set up, modification); types and use of information sources eg workshop manuals, service bulletins, operator manuals, internet

System contamination: cleanliness; ingress points; filtration; straining; control and disposal of waste; leak detection.

Failures and symptoms: incorrect oil type; oil level; contamination; overload; cavitation

Recording and reporting: enquiry sheet; job cards; materials; maintenance recording systems eg manual, electronic; machine history records

2 Know the construction, function and operation of hydraulic circuit systems and their components used in land-based engineering applications

Characteristics of fluids: incompressibility; no shape; transmission of applied pressure.
Hydraulic circuits: open centre; closed centre; load sensed; high and low pressure; combined high/low pressure; auxiliary systems
Circuit components: reservoirs (pressurised, non-pressurised); pumps (fixed and variable displacement, single and two directional, rotary radial and axial); pressure control valves eg pressure maintaining, pressure relief, pressure reducing, shock and sequence; directional control valves (open centre, closed centre); proportional; valve operation eg manual, solenoid, pilot; flow dividing valves; orbital valves; priority valves; flow restrictors (single and two directional); accumulators; linear actuators (double acting, single acting, differential, non-differential, cushioned); rotary actuators (double and single acting, semi and 360deg variable and fixed displacement)

Hose and pipe construction; hose and pipe construction; fittings and terminations eg BSP, JIC, Metric; welded; reusable; swaged; skive; non-skive

Component representation: BS 2917 graphical representation of system components; circuit construction and standards

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria					
To achieve a pass grade the evidence must show that the learner is able to:		**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**		**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**	
P1	identify and locate hydraulic systems and their components [IE, TW, EP]	**M1**	map the hydraulic circuit of two different land-based machines using BS 2917 hydraulic component symbols	**D1**	diagnose pressure and flow faults in two hydraulic circuits (open centre and closed centre) using both sensory checks and test equipment and recommend rectification procedures.
P2	build and test a basic hydraulic circuit [CT, RL, TW, SM]				
P3	prepare the hydraulic system to be tested and carry out tests using system diagnostic tools [CT, RL, TW, SM]				
P4	remove, dismantle, repair and reinstate hydraulic systems and components to manufacturer's specifications and factory settings [IE, TW, SM, EP]				
P5	describe how to read and interpret hydraulic circuit diagrams and symbols [IE, CT, RL]	**M2**	construct a fault-finding flow chart for a given hydraulic circuit.		
P6	describe how to remove, dismantle, repair and reinstate hydraulic components and systems [RL, SM]				
P7	describe different types of hydraulic circuits and the construction and function of hydraulic system components [RL, SM]				
P8	describe the primary causes of hydraulic failure and their symptoms. [IE, CT, RL, SM]				

PLTS: This summary references where applicable in the pass criteria, in the square brackets, the elements of the personal, learning and thinking skills. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

All centres must comply with the requirements of relevant, current legislation and codes of practice eg the *Prevention of Accidents to Children in Agriculture Regulations 1998*. Learners must be made aware of, and have access to, relevant health and safety legislation and know the importance of the use of risk assessments appropriate to each situation. Appropriate risk assessments must precede all practical machinery activities and learners must work in a safe manner at all times when using equipment or working with machinery. Learners must be supervised at all times and tutors must not ask learners to undertake tasks that are beyond their physical capabilities.

Delivery of this unit will involve practical assessments, written assessment, visits to suitable organisations and will have links to industrial experience placements. Tutors delivering this unit have opportunities to use as wide a range of techniques as possible. Lectures, discussions, seminar presentations, site visits, supervised practicals, research using the internet and/or library resources and the use of personal and/or industrial experience would all be suitable. Delivery should stimulate, motivate, educate and enthuse learners.

Work placements should be monitored regularly in order to ensure the quality of the learning experience. It would be beneficial if learners and supervisors were made aware of the requirements of this unit before any work-related activities so that naturally occurring evidence can be collected at the time. For example, learners may have the opportunity to carry out hydraulic maintenance, service and repair activities and assessors should complete observation records and/or witness statements to confirm learner achievement. Guidance on the use of observation records and witness statements is provided on the Pearson website.

Visiting expert speakers could add to the relevance of the subject for learners. For example, land-based vehicle technicians or workshop managers could talk about their work, the situations they face and the methods they use.

Learning outcome 1 deals with the practical aspects of working with hydraulic systems on land-based machinery and is likely to be delivered in a closely supervised practical environment supported by formal lectures discussion and demonstrations. It is expected that learners will develop some skills in operating hydraulic systems to gain an appreciation of functionality and system capabilities. Learners should be made aware of the potential dangers of working with pressurised systems and the precautions that must be taken in respect of personal safety and the safety of others in the same environment. Access to a range of land-based machinery, workshop facilities, tools and test equipment are considered essential for the delivery of this learning outcome

Learning outcome 2 provides opportunities to investigate circuit construction and the individual components that go to make up land-based hydraulic systems. It is expected that it will be delivered in a supervised practical environment supported by formal lectures, discussion and demonstration, independent research and/or visits to hydraulic equipment suppliers and manufacturers. Learners should have access to as wide a range as possible of the components identified in the unit content for investigation and skill development in fault finding, removal, dismantling, repair and reinstatement. Access to information on BS 2917 symbols and their definition is essential. The use of hydraulic system simulation software, though not essential, would enhance learning and help embed the recognition of circuit types and the use of BS Symbols.

Whichever delivery methods are used, it is essential that tutors stress the impact that operating hydraulic systems correctly can have on the overall performance of the land-based vehicle or machine.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan gives **an indication of the volume of learning it would take the average learner** to achieve the learning outcomes. It is **indicative and is one way of achieving the credit value**.

Learning time should address all learning (including assessment) relevant to the learning outcomes, regardless of where, when and how the learning has taken place.

Topic and suggested assignments/activities and/assessment
Unit introduction and assessment requirements.
Assignment 1: Hydraulic Systems and Components (P1, P5, M1)
Health and safety when working with hydraulics.
Practical activity: operation of hydraulic systems (position control, draft control, response and intermix; external services, single and multi function systems).
Practical activity: sensory tests and cycle times.
Circuit construction and component identification.
Assignment 2: Hydraulic System Operation and Testing (P2, P3, P7, M2)
Practical activity: service and maintenance tasks.
Test equipment care and use (pressure gauges, flow meters, thermometers).
Practical activity: test procedures, results and analysis.
Reporting and machine history records.
Characteristics of fluids.
Circuit design: open and closed centre.
Directed research: circuit mapping and circuit diagrams.
Assignment 3: Practical File (P4, P6, P8, M1, D1)
Practical activity: hose construction and manufacture.
Practical activity: circuit components, removal, inspection, dismantling and reinstatement (see Unit content).
Directed research: BS 2917 symbols recognition – application to circuits and components.
Unit review.

Assessment

For P1, learners must be able to locate the major components within the hydraulic system of a land-based vehicle or machine. This could be coupled with P5 in the identification of the same circuit and components using BS 2917 symbols accompanied by an explanation of symbol construction and related flow patterns. Assessment could take the form of an observation/discussion or group presentation using pictorial evidence. Learners are expected to provide evidence for open centre and closed centre hydraulic systems. Tutors should identify the systems or agree them through discussion with learners.

P2 requires learners to assemble an hydraulic circuit from a supply of given components to operate either a linear or rotary actuator to a specified maximum system pressure and flow rate. The task should involve the specification and construction/manufacture of hydraulic hoses. This exercise could also support P3 as learners devise a means of proving the circuit operation by applying standard pressure, flow and temperature measurement. It could also be linked to P7 are also possible with a description of the different types of circuit that could produce similar outputs.

Tutors should identify the circuits and components or agree them through discussion with learners. Evidence for this could take the form of a practical observation linked to an oral examination, pictorial presentation with notes (possibly using appropriate simulation software or an overhead projector), an annotated poster or written assignment.

For P4, P6 and P8, learners could set up and maintain a portfolio of evidence recording their on going practical activities in the removal, dismantling, inspection and reinstatement of hydraulic components within the range identified in the unit content. If this format is used, suitable evidence from guided activities would be observation records completed by learners and the tutor, appropriate worklogs, authenticated job cards or other relevant learner notes. If assessed during a placement, witness statements should be provided by a suitable representative and verified by the tutor.

For M1, learners could produce a block diagram of two different hydraulic circuits (open centre and closed centre) as investigated for P1 and P5 and extend this to construct the same circuits using BS 2917 symbols in a recognised format. Tutors should identify the circuits or agree them through discussion with learners. Evidence for this could take the form of an oral examination, pictorial presentation with notes (possibly using appropriate simulation software or an overhead projector), an annotated poster or written assignment.

M2 requires learners to develop a fault-finding flow chart for hydraulic systems. This could build on the work carried out for P2, P3 and P7 in identifying and testing circuits and components by illustrating areas of potential circuit or individual component failure and describing the likely symptoms such failures would produce as indicated in the unit content. Evidence could take the form of an annotated poster or interactive spreadsheet/flow diagram.

For D1, learners should be able to apply the skills and knowledge they have gained to identify faulty hydraulic circuitry or individual component operation using both sensory checks and test equipment. Evidence could be gathered during structured practical sessions where faults, either real or simulated, can be diagnosed in both open and closed centre applications. Learners should describe the symptoms and relate these to manufacturers' documentation, such as trouble shooting charts and circuit diagrams, and to describe and implement rectification procedures.

Tutors must identify suitable machinery, circuitry and session objectives or agree them through discussion with learners. Where possible, to ensure fairness of assessment, the size and complexity of tasks should be the same for all learners. Evidence could take the form of direct observation supported by written analysis and reporting. If assessed during a work placement, witness statements should be provided by a suitable representative and verified by the tutor.

Programme of suggested assignments

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Pearson assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P5, M1	Hydraulic Systems and Components	Learners to inspect two land-based machine hydraulic circuits (one open centre system one closed centre system) and state the type of system for each and identify the major components of each system using pictorial and graphical representation.	Observation Pictorial report. Practical investigation. Group work.

Criteria covered	Assignment title	Scenario	Assessment method
P2, P3, P7, M2	Hydraulic System Operation and Testing	From a given brief, learners to assemble hydraulic components into a specified circuit describing the principles of operation of the circuit and components selected. The circuit should be tested for maximum pressure, on and off load flow rates and operating temperature.	Practical observation. Pictorial presentation.
P4, P6, P8, M1, D1	Practical File	Learners to maintain a practical file detailing the removal, inspection dismantling, repair and reinstatement of the range of hydraulic components identified in the unit content, with potential causes of failure for each.	Portfolio of worksheets and or job cards. Practical observation. Witness statements. Pictorial records.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC land-based sector suite. This unit has particular links with:

Level 2	Level 3
LEO24 Service and Repair Hydraulic Systems and Components on Land-based Equipment	Service and Repair Hydraulic Systems and Components on land-based Equipment

Essential resources

Learners will need access to a range of vehicles with relevant hydraulic systems and simulation equipment to support their practical investigation. They will also require access to sufficient test and repair equipment and materials to investigate hydraulic system assemblies and components.

Manufacturers' training videos, service manuals and test data will make a significant contribution to learners achievement, as will access to hydraulic circuit design and simulation software.

Tutors delivering this unit should be familiar with transmission systems as used by current equipment manufacturers.

Employer engagement and vocational contexts

The unit has a practical focus and in this respect employer engagement will place hydraulic systems, their maintenance and operation in context. Centres are encouraged to create and maintain links with sector employers and manufacturers of land-based machinery and equipment to secure a valuable resource for the benefit of their learners. Work placement opportunities should be actively sought alongside visits by experienced practitioners to illustrate current equipment, trends and practice in testing and diagnostics. Learners could be encouraged to develop links with employers and arrange visits and demonstrations.

Indicative reading for learners

Textbooks

Bell B – *Farm Machinery, 5th Edition* (Old Pond Publishing, 2005) ISBN 1903366682

Hillier V and Coombes P – *Hillier's Fundamentals of Motor Vehicle Technology, 5th Edition* (Nelson Thornes, 2004) ISBN 0748780823

Whipp J and Brooks R – *Transmission, Chassis and Related Systems* (Vehicle Maintenance & Repair Series: Level 3), 3rd Edition (Thomson Learning, 2001) ISBN 186152806X

Tooley M – *BTEC First Engineering* (Newnes, 2006) ISBN 0750680601

Turner I – *Engineering Applications of Pneumatics and Hydraulics* (Butterworth-Heinemann, 1995) ISBN 0340625260

Journals

Farmers Guardian

Farmers Weekly

Profi International

Websites

www.bagma.com	British Agricultural and Garden Machinery Association
www.defra.gov.uk	Department for Environment, Food and Rural Affairs
www.hse.gov.uk	Health and Safety Executive
www.howstuffworks.com	HowStuffWorks
www.iagre.org	Institution of Agricultural Engineers
www.lantra.co.uk	Lantra Sector Skills Council

Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit:

Skill	When learners are …
Independent enquirers	reviewing BS symbols and comparing to illustrations investigating hydraulic circuitry
Creative thinkers	building hydraulic circuits analysing test results
Reflective learners	comparing test results with specifications, standards or manufacturers' information designing hydraulic systems for a particular purpose
Team workers	working in groups to investigate component operation selecting equipment and undertaking testing activities
Self-managers	planning practical activities organising assessment workloads
Effective participators	undertaking practical activities recording results and observations.

Although PLTS opportunities are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Functional Skills – Level 2

Skill	When learners are …
ICT – Use ICT systems	
Select, interact with and use ICT systems independently for a complex task to meet a variety of needs	using web-based resources to research BS symbols and standards
Manage information storage to enable efficient retrieval	creating a person file system for recording creating and maintaining portfolios of evidence
Follow and understand the need for safety and security practices	accessing HSE and Environment Agency websites
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	accessing manufacturers' information for specifications and data
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	using web-based resources to research symbols and standards
ICT – Develop, present and communicate information	
Enter, develop and format information independently to suit its meaning and purpose including: • text and tables • images • numbers • records	compiling system condition reports inserting images and records of practical activities into portfolios compiling machine history records recording and analysing test results constructing flow diagrams
Bring together information to suit content and purpose	delivering assessment information via reports, posters and or illustrated presentations
Present information in ways that are fit for purpose and audience	delivering assessment information via reports, posters and or illustrated presentations

Skill	When learners are …
Mathematics	
Understand routine and non-routine problems in a wide range of familiar and unfamiliar contexts and situations	compiling and manipulating data sets for hydraulic outputs analysing test results
Identify the situation or problem and the mathematical methods needed to tackle it	transposing hydraulic formulae to confirm test results
Use appropriate checking procedures and evaluate their effectiveness at each stage	reviewing test results against standards and specifications
Draw conclusions and provide mathematical justifications	reviewing test results against standards and specifications
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	conducting oral assessments working in groups submitting assignments
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	reviewing information on fluid characteristics reporting on the condition of hydraulic systems against standards and specifications.

Unit 23: Service and Repair Pneumatic Systems and Components for Land-based Equipment

Unit code: J/600/3401

Level 2: BTEC First

Credit value: 5

Guided learning hours: 30

Aim and purpose

The aim of this unit is to provide the learner with the knowledge, understanding and skills required to repair and service pneumatic systems and components for Land-based equipment.

Unit introduction

Pneumatics is emerging as a popular means of transmitting power for some applications on land-based machinery and equipment. This versatile and clean way of operating devices quickly and cheaply is giving manufacturers real alternatives to mechanical or electrical systems. Linked very closely with fluid mechanics and the characteristics of gases recognised long ago, engineers have developed compact and efficient operating systems that give the owners and operators of modern equipment and machinery great flexibility.

This unit will look at pneumatic systems and their components with a view to recognising correct performance, and the ways and means by which this can be established and, where necessary, corrected. The unit will also look at the elements of care that can be applied to these intricate and often complicated systems to ensure that, when operating at peak performance, the correct level of efficiency is maintained and the likely causes of malfunction and/or failure can be identified.

At all times learners should be made aware of the hazards associated with working with air under pressure. Relevant health and safety and Environment Agency advice and guidance, in particular the need to risk assess any operation, will be integral to delivery.

Learning outcomes

On completion of this unit a learner should:

1 Be able to perform service and repair operations on pneumatic systems and their components

2 Know the construction, function and operation of pneumatic systems and components used in land-based engineering.

Unit content

1 Be able to perform service and repair operations on pneumatic systems and their components

Health and safety: safe release of stored energy eg receivers, pipes, hoses and component parts; control of condensate; risk assessment; personal protective equipment (PPE); codes of practice; relevant current legislation

Sensory checks: visual; sound; smell; touch

Functional testing: identification of system purpose eg braking, distribution, suspension; system fit for purpose; operating limits; cycle time testing

Use of test equipment: pressure gauge; air flow meter; temperature gauge; analogue; digital

Serviceable components: receivers and separators; filtration (suction, pressure); air compressor; hoses and pipe-work; valves eg air pressure control valves, handbrake valve, footbrake valves, relief valves, diaphragm operated valves, air pressure regulating valves, dump valves; air flow control; actuators eg linear, rotary, semi rotary

Service and maintenance: manufacturers' specifications; manufacturers' recommendations; service tasks (renew, repair, replacement, adjustment, set up, modification); types and use of information sources eg workshop manuals, service bulletins, operator manuals, internet

System contamination: cleanliness; ingress points; filtration; control and disposal of waste

Failures and symptoms: incorrect oil type; oil level; contamination; water; fatigue; leaks; methods of leak detection in air systems

Recording and reporting: enquiry sheet; job card; materials; recording systems eg manual, electronic; machine history records

2 Know the construction, function and operation of pneumatic systems and components used in land-based engineering

Characteristics of gases: compressibility; moisture; types of compression eg isothermal, adiabatic

Pneumatic circuits: high pressure; low pressure; static; mobile; single line; twin line

Circuit components: air compressors; air pressure regulating valves; relief and dump valves; air pressure control valves; hand brake and foot brake valves; diaphragm operated valves; air activated cylinders; air cushions; fail-safe emergency system components; air receivers dryers and separators; actuators (single and double acting) eg linear, rotary

Hose and pipe construction: identification of pipes and fittings; assembly of pipes and fittings; repair of pipes and fittings

Component representation: BS 2917 graphical representation of system components; circuit construction and standards

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria					
To achieve a pass grade the evidence must show that the learner is able to:		**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**		**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**	
P1	assemble or repair pipes and hoses used within pneumatic systems [RL, SM, EP]	**M1**	map the pneumatic circuit of two different land-based machines using BS 2917 pneumatic component symbols	**D1**	diagnose pressure and air flow faults in two pneumatic circuits (single line and twin line), using both sensory checks and test equipment and recommend rectification procedures.
P2	build and test a basic air pressure circuit (to include compressor, control valve, relief valve, pneumatic consumer) [CT, RL, TW, SM]				
P3	remove, dismantle, repair and reinstate pneumatic systems and components to manufacturers' specifications [IE, TW, SM, EP]				
P4	identify pneumatic systems and components [IE, TW, EP]	**M2**	construct a fault-finding flow chart for a given pneumatic circuit.		
P5	describe the different types of pneumatic circuit including single line and twin line				
P6	describe how to remove, dismantle, repair and reinstate pneumatic components and systems [RL, SM]				
P7	describe the construction, types and function of pneumatic system components [RL, SM]				
P8	describe the primary causes of pneumatic failures and their symptoms. [IE, CT, RL, SM]				

PLTS: This summary references where applicable in the pass criteria, in the square brackets, the elements

of the personal, learning and thinking skills. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

All centres must comply with the requirements of relevant, current legislation and associated codes of practice eg the *Prevention of Accidents to Children in Agriculture Regulations 1998*. Learners must be made aware of, and have access to, relevant health and safety legislation and know the importance of the use of risk assessments appropriate to each situation. Appropriate risk assessments must precede all practical machinery activities and learners must work in a safe manner at all times when using equipment or working with machinery. Learners must be supervised at all times and tutors must not ask learners to undertake tasks that are beyond their physical capabilities.

Delivery of this unit will involve practical assessments, written assessment, visits to suitable collections and will link to industrial experience placements.

Tutors delivering this unit have opportunities to use as wide a range of techniques as possible. Lectures, discussions, seminar presentations, site visits, supervised practicals, research using the internet and/or library resources and the use of personal and/or industrial experience would all be suitable. Delivery should stimulate, motivate, educate and enthuse learners.

Work placements should be monitored regularly in order to ensure the quality of the learning experience. It would be beneficial if learners and supervisors were made aware of the requirements of this unit before undertaking any work-related activities, so that naturally occurring evidence can be collected at the time. For example, learners may have the opportunity to carry out pneumatic system maintenance, service and repair activities and assessors should complete observation records and/or witness statements to confirm learner achievement. Guidance on the use of observation records and witness statements is provided on the Pearson website.

Visiting expert speakers could add to the relevance of the subject for learners. For example, land-based vehicle technicians or workshop managers could talk about their work, the situations they face and the methods they use.

Whichever delivery methods are used, it is essential that tutors stress the impact operating pneumatic systems correctly can have on the overall performance of the land-based vehicle or machine.

Learning outcome 1 deals with the practical aspects of working with pneumatic systems on land-based machinery and is likely to be delivered in a closely supervised practical environment supported by formal lectures, discussion and demonstrations. It is expected that learners will develop some skills in operating of pneumatic systems to gain an appreciation of functionality and system capabilities. Learners should be made aware of the potential dangers of working with pressurised air systems and the precautions that must be taken in respect of personal safety and the safety of others in the same environment. Access to a range of land-based machinery, workshop facilities, tools and test equipment are considered essential for delivery of this learning outcome.

Learning outcome 2 provides opportunities to investigate circuit construction and the individual components that go to make up land-based pneumatic systems. It is expected that it will be delivered in a supervised practical environment, supported by formal lectures, discussion and demonstration, independent research and or visits to pneumatic equipment suppliers and manufacturers. Learners should have access to as wide a range as possible of the components identified in the unit content for investigation and skill development in fault finding, removal, dismantling, repair and reinstatement. Access to information on BS 2917 symbols and their definition is essential, the use of circuit simulation software, though not essential, would enhance learning and help embed the recognition of circuit types and the use of BS Symbols.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan gives **an indication of the volume of learning it would take the average learner** to achieve the learning outcomes. It is **indicative and is one way of achieving the credit value**.

Learning time should address all learning (including assessment) relevant to the learning outcomes, regardless of where, when and how the learning has taken place.

Topic and suggested assignments/activities and/assessment
Unit introduction and discussion of assessment requirements.
Health and safety when working with compressed air.
Assignment 1: Pneumatic Systems and Components (P4, P7)
Practical activity: operation of pneumatic systems. Functionality and cycle times.
Circuit construction and component identification.
Practical activity: service and maintenance tasks.
Assignment 2: Pneumatic System Operation and Testing (P1, P2, P5)
Test equipment care and use (pressure gauges, air flow meters, thermometers, moisture meters).
Practical activity: test procedures, results and analysis.
Reporting and machine history records.
Characteristics of gases.
Directed research: circuit mapping and circuit diagrams.
Assignment 3: Practical File (P3, P6, P8, M1, M2, D1)
Practical activity: hose and pipework construction and manufacture.
Practical activity: circuit design and build.
Practical activity: locate circuit components, removal, inspection, dismantling and reinstatement (see unit content).
Directed research: BS 2917 symbols recognition – application to circuits and components.
Unit review.

Assessment

P1 and P2 require learners to assemble a pneumatic circuit, from a supply of given components, to operate either a linear or rotary actuator to a specified maximum system pressure and speed. For P1, the task should involve the specification and construction/manufacture of pneumatic lines to industry standards. For P2, the exercise could support learners as they devise a means of proving circuit operation by applying standard pressure, air flow and temperature measurement. Integration of P5 is possible if learners provide a description of the different types of circuits that could produce similar outputs.

For P4 and P7, learners must identify and describe the construction of the major components within a pneumatic system of a land-based vehicle or machine. Assessment could take the form of an observed machine identification practical followed by a discussion or group presentation using pictorial evidence. Learners are expected to provide evidence for single and twin line systems. Tutors should identify the systems or agree them through discussion with learners.

For P3, P6 and P8, learners could set up and maintain a portfolio of evidence recording their on going practical activities in the removal, dismantling, inspection and reinstatement of pneumatic components within the range identified in the unit content. If this format is used, suitable evidence from guided activities would be observation records completed by the tutor, appropriate worklogs, authenticated job cards or other relevant learner notes. If assessed during a work placement, witness statements should be provided by a suitable representative and verified by the tutor.

For M1, learners could produce a block diagram of two different pneumatic circuits (single line and twin line) as investigated for P5 and extend this to construct the same circuits using BS 2917 symbols in a recognised format. Tutors should identify the circuits or agree them through discussion with learners. Evidence for this could take the form of verbal discussion or examination, pictorial presentation with notes (possibly using appropriate simulation software or an overhead projector), an annotated poster or written assignment.

M2 requires learners to develop a fault-finding flow chart for a pneumatic system. This could build on the work done for P4 and P7 by illustrating areas of potential circuit or individual component failure and describing the likely symptoms such failures would produce, as indicated in the unit content. Evidence could take the form of an annotated poster or interactive spreadsheet/flow diagram.

For D1, learners should apply the skills and knowledge they have gained to identify faulty pneumatic circuitry or individual component operation using both sensory checks and test equipment. Evidence could be gathered during structured practical sessions where faults, either real or simulated, can be diagnosed in both single and twin line applications. Learners should describe the symptoms and relate these to manufacturers' documentation such as trouble shooting charts and circuit diagrams, and to describe and implement rectification procedures.

Tutors must identify suitable machinery, circuitry and session objectives or agree them through discussion with learners. Where possible, to ensure fairness of assessment, the size and complexity of tasks should be the same for all learners. Evidence could take the form of direct observation supported by written analysis and reporting. If assessed during a work placement, witness statements should be provided by a suitable representative and verified by the tutor.

Programme of suggested assignments

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Pearson assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P4, P7	Pneumatic Systems and Components	Learners to inspect two land-based machine pneumatic circuits (one single line and one twin line) and state the type of system for each. Identify and describe the major components of each system using pictorial and graphical representation.	Observation records. Pictorial report. Practical investigation.
P1, P2, P5	Pneumatic System Operation and Testing	From a given brief, assemble pneumatic components into a specified circuit describing the principles of operation of the circuit and components selected. The circuit, to be tested for maximum pressure, speed of operation and operating temperature.	Observation records. Practical observation. Pictorial presentation.

Criteria covered	Assignment title	Scenario	Assessment method
P3, P6, P8, M1, M2, D1	Practical File	Learners to maintain a practical file detailing the removal, inspection dismantling, repair and reinstatement of the range of pneumatic components identified in the unit content, with potential causes of failure for each.	Portfolio of worksheets and/or job cards. Observation records. Witness statements. Pictorial records.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC land-based sector suite. This unit has particular links with:

Level 2	Level 3
LEO26 Service and repair powershift, hydrostatic, CVT transmissions on Land-based-equipment	Service and Repair Pneumatic Systems and Components for Land-based Equipment
	Service and Repair Powershift, Hydrostatic and/or CVT Transmissions on Land-based Equipment

Essential resources

Learners will need access to a range of vehicles with relevant pneumatic systems and simulation equipment to support their practical investigation. They will also require access to sufficient test and repair equipment and materials to enable accurate assessment of pneumatic system assemblies and components.

Manufacturers' training videos, service manuals and test data will make a significant contribution to learner's achievement as will access to, pneumatic circuit design and simulation software.

Tutors delivering this unit should be familiar with air braking systems as used by current equipment manufacturers.

Employer engagement and vocational contexts

The unit has a practical focus and in this respect employer engagement will place the maintenance and operation of pneumatic systems into context. Centres are encouraged to create and maintain links with sector employers and manufacturers of land-based machinery and equipment to secure a valuable resource for the benefit of their learners. Work placement opportunities should be actively sought alongside visits by experienced practitioners to illustrate current equipment, trends and practice in testing and diagnostics. Learners could be encouraged to develop links with employers and arrange visits and demonstrations.

Indicative reading for learners

Textbooks

Bell B – *Farm Machinery, 5th Edition* (Old Pond Publishing, 2005) ISBN 1903366682

Hillier V and Coombes P – *Hillier's Fundamentals of Motor Vehicle Technology, 5th Edition* (Nelson Thornes, 2004) ISBN 0748780823

Tooley M – *BTEC First Engineering* (Newnes, 2006) ISBN 0750680601

Turner I – *Engineering Applications of Pneumatics and Hydraulics* (Butterworth-Heinemann 1995) ISBN 0340625260

Whipp J and Brooks R – *Transmission, Chassis and Related Systems* (Vehicle Maintenance & Repair Series: Level 3), 3rd Edition (Thomson Learning, 2001) ISBN 186152806X

Journals

Farmers Guardian

Farmers Weekly

Profi International

Websites

www.bagma.com	British Agricultural and Garden Machinery Association
www.defra.gov.uk	Department for Environment, Food and Rural Affairs
www.hse.gov.uk	Health and Safety Executive
www.howstuffworks.com	HowStuffWorks
www.iagre.org	Institution of Agricultural Engineers
www.lantra.co.uk	Lantra Sector Skills Council

Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit:

Skill	When learners are …
Independent enquirers	reviewing BS symbols and comparing to illustrations investigating pneumatic circuitry
Creative thinkers	building pneumatic circuits analysing test results
Reflective learners	comparing test results with specifications, standards or manufacturers' information designing pneumatic systems for a particular purpose
Team workers	working in groups to investigate component operation selecting equipment and undertaking testing activities
Self-managers	planning practical activities organising assessment workloads
Effective participators	undertaking practical activities recording results and observations.

Although PLTS opportunities are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Functional Skills – Level 2

Skill	When learners are …
ICT – Use ICT systems	
Select, interact with and use ICT systems independently for a complex task to meet a variety of needs	using web-based resources to research BS symbols and standards
Manage information storage to enable efficient retrieval	creating a person file system for recording creating and maintaining portfolios of evidence
Follow and understand the need for safety and security practices	accessing HSE and Environment Agency websites
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	accessing manufacturers' information for specifications and data
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	using web-based resources to research symbols and standards
ICT – Develop, present and communicate information	
Enter, develop and format information independently to suit its meaning and purpose including: • text and tables • images • numbers • records	compiling system condition reports inserting images and records of practical activities into portfolios compiling machine history records recording and analysing test results constructing flow diagrams
Bring together information to suit content and purpose	delivering assessment information via reports, posters and or illustrated presentations
Present information in ways that are fit for purpose and audience	delivering assessment information via reports, posters and or illustrated presentations
Mathematics	
Understand routine and non-routine problems in a wide range of familiar and unfamiliar contexts and situations	compiling and manipulating data sets for pneumatic outputs analysing test results
Identify the situation or problem and the mathematical methods needed to tackle it	transposing pneumatic formulae to confirm test results
Use appropriate checking procedures and evaluate their effectiveness at each stage	reviewing test results against standards and specifications
Draw conclusions and provide mathematical justifications	reviewing test results against standards and specifications

Skill	When learners are …
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	conducting oral assessments working in groups submitting assignment
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	reviewing information on gas characteristics reporting on the condition of pneumatic systems against standards and specifications.

Unit 24: Undertake Work-Related Experience in the Land-based Industries

Unit code: H/600/9335

Level 2: BTEC First

Credit value: 10

Guided learning hours: 60

Aim and purpose

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

Unit introduction

Work experience is an important part of any vocational course.

Learners on vocational courses should have experience of the type of work that they hope to do and an idea of the expectations of those who may employ them. Actual work experience may be gained by a number of routes, eg as part of an industrial placement while at college; while working on a planned daily or weekly basis on the college's commercial and/or educational facilities; while undertaking voluntary work within the industry; in the form of previous relevant and current work experience in the industry; or as a member of a group of learners invited to carry out practical work in, for example, a country park, farm or animal care centre. All of the above may be useful in gathering evidence against the assessment and grading criteria for this unit.

Work related experience should not just involve actually undertaking activities in a work environment. Talking to, listening to and watching those with experience of particular industries and/or situations is a very valid way of beginning to understand the work involved and what is required of the employee.

Learning outcomes

On completion of this unit a learner should:

1 Know the range and scope of job roles within an environmental and land-based industry

2 Be able to use relevant documents and skills relating to work experience

3 Be able to plan and review self-development during work experience

4 Be able to report on the work experience.

Unit content

1 Know the range and scope of job roles within an environmental and land-based industry

Environmental and land based industry: range of sectors represented eg production (livestock, crops), leisure/tourism, equestrian, forestry/arboriculture, fishery management, aquaculture, farriery, floristry, fencing, gamekeeping, animal care/welfare, conservation, countryside management, land-based engineering, landscaping and horticulture

Job roles: the range of roles available within the chosen sector

2 Be able to use relevant documents and skills relating to work experience

Documents: job advertisement; CV; covering letter; application form; job/role description; essential and desirable personal requirements; using these documents in an appropriate way

Skills: identification of skills required to work in the sector eg interpersonal skills, communication, technical knowledge, practical skills; use of skills

3 Be able to plan and review self-development during work experience

Personal skills: identify own skills

Planning self-development: methods of reviewing own development needs eg skills audit

Self-development: methods of reviewing self-development eg meeting/discussion with supervisor, self review

4 Be able to report on the work experience

Evidence required: description of employer's business; description of employees' roles; pictorial evidence about the employer/site eg maps, plans, photos, leaflets; description of how the business makes income; your own role within the organisation and tasks you carried out.

Methods of presentation: verbal, written, visual

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria					
To achieve a pass grade the evidence must show that the learner is able to:		**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**		**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**	
P1	describe different types of jobs within an environmental and land-based industry [IE]	**M1**	prepare a person specification for a job in the chosen sector	**D1**	review a job application against a given person specification
P2	describe the skills and qualifications required for different types of jobs within an environmental and land-based industry [CT]				
P3	locate three advertisements for jobs from different sources available within the environmental and land-based industry [IE]	**M2**	identify common themes from three job advertisements	**D2**	prepare a job advertisement.
P4	produce an application for work experience in the environmental and land-based sector [IE, SM]				
P5	prepare for an interview for work experience [IE, SM]	**M3**	prepare questions to be used in a job interview.		
P6	undertake an interview for work experience [IE, SM]				
P7	review own skills and experience against the requirements for a specific industry [RL]				
P8	prepare a self-development plan for work experience [RL]				

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P9 review a self-development plan during and after work experience [RL]		
P10 gather and prepare evidence during the work experience [IE]		
P11 present information to others on work experience. [RL]		

PLTS: This summary references where applicable in the pass criteria, in the square brackets, the elements of the personal, learning and thinking skills. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key			
	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

All centres must comply with the requirements of relevant current legislation and codes of practice, for example the *Prevention of Accidents to Children in Agriculture Regulations 1998*. Learners must be made aware of, and have access to, relevant health and safety legislation and know the importance of the use of risk assessment appropriate to each situation. Appropriate risk assessment must precede all practical machinery activities, learners must work in a safe manner at all times when using equipment or working with machinery. Learners must be supervised at all times and tutors must not request learners undertake tasks that are beyond their physical capabilities.

Delivery of this unit will involve both practical and written assessment and, most importantly, will have links to industrial experience placements.

Tutors could use a wide range of techniques including lectures, discussions, seminar presentations, visiting speakers, site visits and practicals, research using the internet and/or library resources and the use of personal and/or industrial experience. Delivery should stimulate, motivate, educate and enthuse the learner.

Work placements should be monitored regularly to ensure the quality of the learning experience. Learners and supervisors should be aware of the requirements of this unit prior to any work related activities, so that naturally occurring evidence might be collected at the time. Learners should be encouraged to ask for observation records and/or witness statements to be provided as evidence. Guidance on the use of observation records and witness statements is provided on the Pearson website.

Work related experience could be as part of an industrial placement while at college; daily or weekly work at the college's commercial and/or educational facilities; voluntary work within the sector, for example in an animal care centre, country park, farm, estate, garden centre.

Tutors could integrate the delivery, private study and assessment relating to this unit with any other relevant units and assessment instruments used in the learner's programme of study. Learners must be given supported time to plan and review their own development. They should do a minimum of 150 hours or related study/work to complete this unit successfully. Learners could keep a diary/log to show that they have achieved the requirement of completing their work experience. Tutors should encourage as wide a range of experience as possible so that learners develop relevant knowledge and skills.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan gives **an indication of the volume of learning it would take the average learner** to achieve the learning outcomes. It is **indicative and is one way of achieving the credit value**.

Learning time should address all learning (including assessment) relevant to the learning outcomes, regardless of where, when and how the learning has taken place.

Topic and suggested assignments/activities and/assessment
Introduction and overview of the unit.
Assignment 1: Advertising a Job in the Land-based Sector (P1, P2, P3, M1, M2, D1, D2) Introduction of brief.
Theory session.

Topic and suggested assignments/activities and/assessment
Research the industry and roles, research advertisements, write person specification, prepare questions, review job application, prepare job advert.
Assignment 2: Getting a Job in the Land-based Sector (P4, P5, P6, M3) Introduction of brief.
Theory session.
Compete job application, prepare answers to likely questions, undertake interview.
Assignment 3: Workplace Self-Development (P7, P8, P9) Introduction of brief.
Theory session.
Review own skills, prepare self development plan, review self development plan.
Assignment 4: My Work Experience Placement (P10, P11) Introduction of brief.
Theory session.
Gather information, prepare and present information.
Work experience.
Unit review.

Assessment

For P1, learners must describe different types of jobs within an environmental and land-based industry. This should be a sector of the industry in which learners have an interest or which relates to their vocational or chosen course of study or intended future career.

P2 requires learners to describe the skills and qualifications required for different types of jobs within an environmental and land-based industry. The evidence could focus on two or three different jobs from within the same sector and describe both the common skills and qualifications as well as the areas where the requirements differ.

For P3, learners must locate three advertisements for jobs from different sources available within the environmental and land-based industry. They must provide evidence that they have looked at three different sources for these advertisements.

P4 must include evidence that the learner can produce an application for work experience in the environmental and land-based sector. This could be done on a pro forma application designed by the learners themselves or one provided by the tutor.

For P5, learners must prepare for an interview for work experience. They will evidence this by providing a list of answers to questions which it is considered are likely to be asked by an interviewer. These questions may be provided/suggested by the tutor or could be drawn up by the learner. The evidence could be presented in the form of an interview (see P6) or could be presented as written answers or an audio recording of them practising the answers.

To meet P6, learners will undertake an interview for work experience, where they will have the opportunity to present their answers to the questions they prepared for P5, and to show other aspects of preparation such as appropriate personal presentation, and asking appropriate questions. This could either be evidenced via mock interviews with other learners acting as the interview panel and using the evidence they have prepared for M1 and M3, or it could be evidenced by a real interview for a work experience placement, supported by a witness statement from the interviewer.

For P7, learners will provide evidence that they can review their own skills and experience against the requirements for a specific industry. This can be linked closely with the evidence presented for P2, with learners identifying their 'skills gap' either through a skills audit or similar.

To evidence P8, learners will need to prepare a self-development plan for their work experience placement. This could be done on a pro forma provided by, or in a format suggested by the tutor. The plan will identify areas of improvement that the learners need to develop during their work experience, and show how the learners are going to do this.

For P9, learners need to review the self-development plan during and after work experience. Evidence could be in the form of witness statements or tutor observations to show that the plan had been discussed and reviewed, that progress to date had been discussed and how future progress may occur.

To meet P10, learners must gather and prepare evidence during the work experience. This evidence will cover the content.

For P11, learners must present information to others on work experience. This can be done in any suitable format – it may be a poster with photos, leaflets and learner-prepared text about the employer; it could be a verbal presentation with accompanying slides/pictorial evidence; or it could be an audio-visual presentation made at the placement.

For M1, learners need to prepare a person specification for a job in the chosen sector. The specification could be based on one of the advertisements researched in P3, and should show the major skills, qualities and qualifications required for that role, and an indication of whether these are essential or desirable.

To evidence M2, learners are required to identify common themes from three job advertisements – what are the main areas of commonality, are there things that all three have? It may also be that learners consider what differences there are between the advertisements. This could be presented in a poster format with annotations to show areas of difference/similarity.

For M3, learners need to prepare questions to be used in a job interview. This can be the same job for which the person specification has been produced. It is expected that a list of at least 10 questions is prepared.

For D1, learners must review a job application against a given person specification. This could be an application which has been produced by other learners for the purpose of meeting criterion P4, or it could be an example application form provided by the tutor.

To meet D2, learners will prepare a job advertisement. This will link in with the evidence required for P3 and M2 and could advertise the role for which the person is being sought in M1.

Programme of suggested assignments

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Pearson assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2, P3, M1, M2, D1, D2	Advertising a Job in the Land-based Sector	You work for an employer in the land-based sector and are in the position of taking on a new staff member. Your manager has asked you to see what other roles exist with other similar employing organisations and what sort of skills and qualifications they are looking for, by sourcing different advertisements and identifying common themes in them. Once you have found that out, it is then your responsibility to write a person specification for the role you will advertise, prepare an advertisement to attract applicants, review an application against your criteria, and plan the questions you would ask in an interview.	Verbal or written report.
P4, P5, P6, M3	Getting a Job in the Land-based Sector	You are looking for your first job in the land-based sector. You need to complete an application form for a job you would like to do, prepare for an interview by coming up with a list of questions you would want answered and having a job interview.	Application form. List of questions. Interview.
P7, P8, P9	Workplace Self-Development	To progress within any employment, self- development is an essential feature. This requires you to have a clear idea about what employers need from their employees and the skills and experience you have already got and those you need to build. You then need to prepare a plan to show how you might build the required skills and experience and to review this plan during and after work experience.	Report on what employers require of employees in the chosen sector. Self-development plan. Evidence of review of the plan during and after work experience.
P10, P11,	My Work Experience Placement	In order to inform other learners about your work experience placement, you need to provide them with information about it such as a description of the employer's business, a description of the other employees' roles, pictures of the organisation or site, a description of how the business makes income and a description of what you did while you were there.	Report on work experience placement.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit for ms part of the BTEC land-based sector suite. This unit has particular links with:

Level 2	Level 3
Environmental and Land-based Business	Management in the Land-based Sector

Essential resources

Learners require supervised access to suitable sites for work experience. Centres may need to provide transport to suitable sites. First aid facilities and appropriately trained staff are essential where practical activities are undertaken. For work placements away from the college, staff time must be made available as per individual college policies relating to work placements.

Employer engagement and vocational contexts

This unit focuses on skills and experience to be developed through preparing for, and undertaking, work experience. Centres are encouraged to create and develop links with local employers who can provide appropriate work experience.

Indicative reading for learners

James J – *You're Hired! Interview: Tips and Techniques for a Brilliant Interview* (Trotman, 2009) ISBN 9781844551781

Mills C – *You're Hired! CV: How to write a Brilliant CV* (Trotman, 2009) ISBN 9781844551774

Websites

www.countryside-jobs.com	Countryside Jobs Service
www.fwi.com	Farmers Weekly
www.growcareers.info	Horticultural Careers
www.land-force.org.uk/index.aspx	Land-based Jobs on-line
www.lantra.org.uk	Lantra Sector Skills Council
www.naturenet.net	UK Countryside and Nature Conservation
www.ruralslp.co.uk/index.aspx	Lantra on-line Competency Framework

Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit:

Skill	When learners are …
Independent enquirers	researching jobs within the sector researching job advertisements and evaluating their relevance completing a job application preparing for, and participating in, a job interview gathering and preparing evidence during work experience
Creative thinkers	describing the skills and qualifications required for a job in the land-based sector
Reflective learners	preparing and reviewing a self-development plan presenting information to others on their work experience reviewing their own skills and experience
Self-managers	carrying out research.

Although PLTS opportunities are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are …
Team workers	Working with others to carry out interviews.

Functional Skills – Level 2

Skill	When learners are …
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	researching roles within the sector researching job advertisements
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	researching roles within the sector researching job advertisements
ICT – Develop, present and communicate information	
Bring together information to suit content and purpose	developing a presentation about work experience
Present information in ways that are fit for purpose and audience	making the presentation about work experience
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	taking part in work experience making presentation about work experience
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	writing person specifications for job.

Unit 25: Environmental and Land-based Business

Unit code: F/600/9357

Level 2: BTEC First

Credit value: 10

Guided learning hours: 60

Aim and purpose

This unit aims to provide learners with an understanding of the principles of business within the environmental and land-based business, and how these can be applied in 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.

Unit introduction

Understanding how businesses and organisations fit into the land-based industry provides a foundation of knowledge from which more specialist study can follow. The environmental and land-based industries are wide-ranging, covering employment in many sectors.

Learners will investigate the different types of businesses and organisations in their specialist sector of the environmental and land-based industries, their characteristics and influences. Learners will look at current trends and issues affecting their industry.

All businesses operate within a framework of statutory legislation and other codes of practice. Learners will investigate a range of UK and EU legislation that impacts on their sector and employment within it.

To operate effectively, organisations need to perform a wide range of business and administrative tasks. Learners will develop skills in performing a range of tasks concerned with finance and banking, marketing and general administration. They will also consider how information technology can be used to perform a range of these tasks.

Learning outcomes

On completion of this unit a learner should:

1 Know an industry within the environmental and land-based sector

2 Know the relevant legislation and codes of practice within the environmental and land-based sector

3 Know common business operations

4 Know how to carry out simple administrative tasks.

Unit content

1 Know an industry within the environmental and land-based sector

Structure: features and characteristics of the industry – size, employment, main activities, geographical influence, economic contribution; different types of businesses and organisations and the type of goods and services they provide; size of these businesses/organisations eg numbers employed, area of land, size of enterprises; any regional differences; allied industries (what they are, the goods and services they supply and the role they play); trends and issues currently affecting the industry

Principal organisations and trade associations: roles and aims of key selected organisations in the industry – statutory eg Department for Environment Food and Rural Affairs (DEFRA), Health and Safety Executive, Department for Business Innovation and Skills, Environment Agency, Food Standards Agency; non-governmental, major land-owning or representative eg The Royal Society for the Prevention of Cruelty to Animals (RSPCA), British Veterinary Association, Royal Horticultural Society, Institute of Groundsmanship, Lantra Sector Skills Council, British Horse Society, National Farmers Union, National Trust

2 Know the relevant legislation and codes of practice within the environmental and land-based sector

Legislation and codes of practice: United Kingdom legislation – consideration of the main relevant current legislation relating to an industry in the land and environment sector eg Agriculture Tenancies Act 1995, Wildlife and Countryside Act 1981, Animal Health Act 2002, The Welfare of Animals (Transport) (Amendment) Order 1999, Environment Protection Act 1990, Environment Act 1995, Control of Pesticides Regulations 1986, Riding Establishments Act 1970, Horse Passports (England) Regulations 2004, Control of Dogs Order 1992, Dangerous Dogs Act 1991; codes of practice eg five freedoms welfare of farm or companion animals, Code of Good Agricultural Practice; European legislation – relevant European directives eg relating to employment, the environment and the specific industry in the land and environment sector

Employment law: the main relevant current legislation relating to employment eg Health and Safety at Work Act 1974, Control of Substances Hazardous to Health Regulations 1991, Working Time Regulations 1998, Disability Discrimination Acts 1995 and 2005, Employment Act 2002, National Minimum Wage Act 1998, Race Relations (Amendment) Act 2000, Sex Discrimination Act 1975

3 Know common business operations

Common IT software: examples of business uses of word processor (eg letters, notices), spreadsheets (eg records, timesheets), database (eg records), graphics (eg advertisements, posters), email; advantages and disadvantages of using IT for business tasks

Common business tasks: financial and banking – taking payments by cash and cheque, ordering procedure for supplies, invoices, types of bank account (current, savings, business) loans, overdraft, methods of payment (cheques, standing order, direct debit, electronic/internet); marketing – ways to promote a business (advertisements, promotional events, referral/word of mouth, importance of customer care), preparation of promotional materials; administrative tasks – file documents, complete simple records (eg production, customers), check stock levels and complete stock control records, complete simple single entry cash analysis book, communicate using written and electronic media; importance of accuracy, confidentiality, security and data back up of business records

4 Know how to carry out simple administrative tasks

Preparation, presentation, sorting and retrieval of information: use of IT and paper filing systems, completion of simple business records, preparation of business documents (eg letters, advertisements)

Accounting and administrative tasks: completion of orders, invoices, cheques, complete stock records, single entry cash analysis book; purpose of accounting and administrative tasks

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 describe the structure of one industry within the environmental and land-based sector covering: ◊ size ◊ employment ◊ main activities ◊ geographical influence ◊ economic contribution [IE]	**M1** explain the roles of principal organisations within an industry in the environmental and land-based sector	**D1** discuss how legislation and statutory and representative organisations affect a specified business in the environmental and land-based sector
P2 identify the principal organisations and trade associations within an industry in the environmental and land-based sector [IE]		
P3 identify the main United Kingdom or European legislation and codes of practice relating to one industry within the environmental and land-based sector [IE]	**M2** explain the objectives and purpose of important current United Kingdom or European legislation for the environmental and land-based industry	
P4 identify key requirements of current employment law on the environmental and land-based sector [IE]		

Assessment and grading criteria					
To achieve a pass grade the evidence must show that the learner is able to:		**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**		**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**	
P5	describe how common IT software can be used in everyday business operations	**M3**	explain the advantages and disadvantages of using IT for common business tasks	**D2**	discuss the importance of accuracy, security, confidentiality and data back up when completing business tasks.
P6	state the purpose and operation of common business tasks: ◊ financial and banking ◊ marketing ◊ administrative tasks				
P7	use appropriate methods to prepare, present, sort and retrieve information [CT]	**M4**	explain the purpose of specified administrative and accounting tasks.		
P8	carry out simple accounting and administrative tasks appropriate to the business. [SM]				

PLTS: This summary references where applicable in the pass criteria, in the square brackets, the elements of the personal, learning and thinking skills. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

Delivery of this unit will involve practical and written assessments, and will have links to industrial experience placements.

In outcome 1 learners will study the structure of their industry. They will require the opportunity to investigate the range of businesses and their products/services, and also the ancillary businesses on which the primary businesses depend. They could relate these ideas to a specific business, while also investigating the range of businesses found locally and nationally. They will need access to any published data on the size and economic importance of their industry. Learners will also find out about the principal organisations and trade associations concerned with their industry, and will investigate the roles and impact of selected organisations. They will need support in investigating some of the key trends and issues facing their industry and how it is responding. Delivery of this outcome would be enriched by speakers from selected organisations.

Learning outcome 2 examines the UK and European legal framework affecting businesses in the particular land-based industry. Learners are not expected to become legal experts, but to develop an awareness of the main pieces of legislation and how they impact on business in their industry. They will need to investigate their legal rights and responsibilities as employees within the workplace.

In learning outcome 3 learners will identify how common IT software can be used to perform a range of everyday business operations. Some of these are common to all businesses (for example sending emails), but tutors should ensure that examples are vocationally relevant to the subject area of the learners. It is anticipated that delivery will include the opportunity for learners to develop their IT skills so that they gain a better understanding of the use of IT software. Learners will benefit from completing tasks using the range of software, and, by careful planning, these tasks could provide evidence for P7 and P8, for example use of word processor and graphics programmes to produce a marketing poster, a spreadsheet for stock inventory and valuation. Learners will need to find out about day-to-day business activities involving finance and banking. It would help learners to have the opportunity to study a range of records (financial and non-financial) that are kept in a specific business, and how these are maintained and used.

Learning outcome 4 links closely with outcome 3, and gives learners opportunity to practically engage in business operations and tasks. This should include preparing a range of business outputs using the IT applications listed, which could relate to other items in the content, for example advertisements, posters, specific records appropriate to businesses in their industry. It will be important for learners to have the opportunity to practise completion of paper-based records and ensure that both IT and paper records are filed appropriately. The importance of accuracy, confidentiality, security and regular back up of data should be stressed.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan gives **an indication of the volume of learning it would take the average learner** to achieve the learning outcomes. It is **indicative and is one way of achieving the credit value**.

Learning time should address all learning (including assessment) relevant to the learning outcomes, regardless of where, when and how the learning has taken place.

Topic and suggested assignments/activities and/assessment
Introduction and overview of the unit.
Assignment 1: Industry Structure and Organisations (P1, P2, M1) Tutor introduces the assignment brief.
Classroom theory session and discussion: Structure of an industry in the environmental and land-based sector: activities and types of business, ancillary businesses, regional variations.
Theory session: size of the industry and economic data, development of the industry and current issues.
Classroom activity: use of industry magazines, publications and internet to identify principal organisations and trade associations.
Guest speaker: role of statutory and representative organisations.
Assessment completion and support.
Assignment 2: Legislation (P3, P4, M2, D1) Tutor introduces the assignment brief.
Theory session: UK and EU legislation and codes of practice relating to an environmental and land-based industry.
Classroom activity: importance of codes of practice.
Theory and supported research: Requirements of employment law.
Visit/guest speaker: how legislation and organisations affect a business in the sector.
Assessment completion and support.
Assignment 3: Business Tasks and Operations (P5, P6, P7, P8, M3, M4, D2) Tutor introduces the assignment brief.
Use of IT for common business tasks; application of word processor, email, spreadsheets, database and graphics software.
Financial and banking tasks – making and receiving payment, business bank accounts, ordering and invoicing.
Marketing – ways to advertise and promote a business, customer care and referral business.
Administrative – paper and electronic filing systems, stock check, business documents, simple business records, importance of confidentiality and security.
Assessment completion and support.
Unit review.

Assessment

For P1, learners need to describe the structure of one industry within the environmental and land-based sector. This must include the main activities and types of businesses that are found, including ancillary businesses, and regional variations. They should describe the size of the industry, making reference to any available data on employment and economic output. The evidence could be presented as a report or illustrated poster.

P2 requires learners to identify the principal organisations and trade associations within an industry in the environmental and land-based sector. Evidence should cover at least three different organisations, including one statutory, one non-governmental and one representative organisation. It should detail the name, contact details, aims and objectives of each organisation in relation to the land-based industry sector. Evidence could be a report, annotated poster, or verbal presentation.

For P3, learners need to identify the main United Kingdom or European legislation and codes of practice relating to one industry within the environmental and land-based sector. Evidence should include at least three important and relevant pieces of UK or EU legislation and/or codes of practice. It should provide the

full title and date, and briefly summarise the main requirements of the legislation in relation to the industry. Evidence may be a report or guidance booklet.

For P4, learners need to identify key requirements of current employment law on the environmental and land-based sector. Evidence should include at least two important and relevant pieces of UK and/or EU legislation. It should provide the full title and date, and briefly summarise the main requirements of the legislation in relation to the industry. Evidence may be a report or guidance booklet.

P5 requires learners to explain how common IT software can be used in everyday business operations. This must cover word processor, email, spreadsheet, database and graphics software. Evidence may be a verbal or written report, poster or leaflet.

For P6, learners must state the purpose and operation of common business tasks. For financial and banking this will include how businesses make and receive payments, order supplies and raise invoices. Marketing must include suitable ways to advertise and promote a business. Administrative tasks should include paper and electronic filing, simple records relevant to the industry sector, and stock control. Evidence may be in the same format as P5.

For P7 and P8, learners must carry out simple accounting and administrative tasks appropriate to the business and use appropriate methods to prepare, present, sort and retrieve information. Evidence must include all of the content listed; some of this could be IT generated.

For M1, learners need to extend work completed for P1 and P2 to explain the roles of principal organisations within one environmental and land-based industry. Evidence should include an explanation of the roles of at least three organisations (including at least one statutory and one non-governmental) presented in the same format as P1 or P2.

For M2, learners must explain the objectives and purpose of important current United Kingdom or European legislation for the land-based industry. Evidence should cover one piece of employment legislation and one other relevant piece of legislation. These could have been used for evidence towards P3 and P4 and presented in the same format.

For M3, learners are required to explain the advantages and disadvantages of using IT for common business tasks. Evidence could be a verbal or written report, poster or leaflet.

For M4, learners must explain the purpose of four of the tasks completed for P7 and P8. The tasks could be selected by the tutor, or agreed through discussion with the learner. Evidence could be in the same format as M3.

For D1, learners need to discuss the impact of legislation and statutory and representative organisations on the industry. Evidence should consider one piece of legislation and two organisations in detail, including positive or negative impacts and ways that the legislation and organisations affect working practices in the industry.

D2 requires learners to discuss the importance of accuracy, security, confidentiality and data back up when completing business tasks. Evidence should include legal as well as practical reasons, and describe ways in which accuracy can be checked and security and confidentiality ensured. Evidence may be in the same format as M3.

Programme of suggested assignments

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Pearson assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2, M1	Industry Structure and Organisations	You are taking part in marketing your industry sector to school leavers. You need to create a poster that gives an overview of your industry and the roles of the principal organisations and trade associations.	Poster.
P3, P4, M2, D1	Legislation	You need to produce a fact sheet for someone starting a business in the industry that informs them of some basic legal requirements. Include the effect of the legislation on the business operations, and the impact of statutory and representative organisations on their working practices.	Factsheet.
P5, P6, P7, P8, M3 M4, D2	Business Tasks and Operations	You need to assist a business manager in performing a range of tasks, making use of IT. Create a guidance leaflet for the work experience student who is helping you which includes the purpose of the tasks, the advantages and disadvantages of using IT, and the importance of accuracy, security, confidentiality and data back up.	Portfolio of practical tasks and underpinning knowledge, guidance leaflet.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC land-based sector suite. This unit has particular links with:

Level 2	Level 3
Undertake Work Related Experience in Land-based Industries	Business Management in the Land-based Sector

Essential resources

Learners will need to be able to access relevant information about their industry, through personal contacts, work experience or case study visits. They will also need access to IT, administrative and accounting records for completion.

Employer engagement and vocational contexts

This unit provides opportunity for learners to gain an overview of one industry within the environment and land-based sector. They will also gain valuable experience in completing administrative and accounting tasks, including using IT. Learners would benefit from a range of guest speakers and industry visits.

Indicative reading for learners

Textbooks

Canwell D and Sutherland J – *BTEC First Business 2nd edition.* (Nelson Thornes, 2006) ISBN 9780748783946

Carysforth C – *NVQ Level 2 Business and Administration* (Heinemann, 2006) ISBN 9780435463335

Carysforth C and Neild M – *BTEC First Business 2nd edition.* (Heinemann, 2006) ISBN 9780435499075

Fardon, Nuttall and Prokopiw – *GCSE Applied Business* (Osborne Books, 2002) ISBN 9781872962320

Gookin D – *Word 2007 for Dummies* (John Wiley & Sons, 2006) ISBN 9780470036587

Seliet H – *BTEC Introduction to Business* (Heinemann, 2005) ISBN 9780435401214

Wang W – *Office 2007 for Dummies* (John Wiley & Sons, 2006) ISBN 9780470009239

Websites

www.beta-uk.org	British Equestrian Trade Association
www.bhs.org.uk	British Horse Society
www.bized.co.uk	Business Studies Teaching Resources
www.businesslink.gov.uk	Business Link
www.cla.org.uk	Country Land and Business Association
www.defra.gov.uk	Department for Environment, Food and Rural Affairs
www.lantra.co.uk	Lantra Sector Skills Council
www.mlc.org.uk	Meat and Livestock Commission
www.netregs.gov.uk	Environmental regulations
www.nfuonline.com	National Farmers Union
www.the-hta.org.uk	Horticultural Trades Association
www.ukagriculture.com	UK Agriculture

Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit:

Skill	When learners are …
Independent enquirers	investigating the structure of an industry in the land-based sector researching organisations researching legislation affecting the sector investigating business bank accounts
Creative thinkers	presenting information about an industry using IT software to perform business operations preparing and presenting information
Reflective learners	discussing the importance of customer care discussing the importance of customer care
Self-managers	carrying out accounting and administrative tasks.

Although PLTS opportunities are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are …
Team workers	working with others to complete a stock check
Self-managers	completing assignment work to deadlines.

Functional Skills – Level 2

Skill	When learners are …
ICT – Use ICT systems	
Select, interact with and use ICT systems independently for a complex task to meet a variety of needs	using software to perform business operations
Use ICT to effectively plan work and evaluate the effectiveness of the ICT system they have used	
Manage information storage to enable efficient retrieval	filing electronic information
Follow and understand the need for safety and security practices	maintaining security and back-up copies of information
Troubleshoot	
ICT – Develop, present and communicate information	
Enter, develop and format information independently to suit its meaning and purpose including: • text and tables • images • numbers • records	preparing promotional material compiling a stock valuation preparing a database of business information
Bring together information to suit content and purpose	
Present information in ways that are fit for purpose and audience	writing a business letter
Evaluate the selection and use of ICT tools and facilities used to present information	
Select and use ICT to communicate and exchange information safely, responsibly and effectively including storage of messages and contact lists	

Skill	When learners are …
Mathematics	
Understand routine and non-routine problems in a wide range of familiar and unfamiliar contexts and situations	preparing invoices
Identify the situation or problem and the mathematical methods needed to tackle it	
Select and apply a range of skills to find solutions	
Use appropriate checking procedures and evaluate their effectiveness at each stage	preparing business records
Interpret and communicate solutions to practical problems in familiar and unfamiliar routine contexts and situations	
Draw conclusions and provide mathematical justifications	
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	researching legislation affecting the industry
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	completing assignments on the industry, trends and issues affecting it.

Unit 26: Introduction to Land-based Workshop Practice

Unit code: F/600/9794

Level 2: BTEC First

Credit value: 10

Guided learning hours: 60

Aim and purpose

The learner will cover the basic work requirements within land-based workshops. They will understand the importance of Health and Safety as an integral topic. They will learn how to safely use hand and power tools and basic welding equipment commonly found in a land-based setting. The skills associated with these will be integrated with the development and use of basic maintenance and repair techniques.

Unit introduction

The practical application of workshop skills plays a vital part in land-based business operations. Predominantly concerned with 'things mechanical' these skills, deployed in a safe and efficient manner, contribute greatly to the wellbeing of successful organisations and individuals. Workshop activities not only include both repair and servicing work, but also fabrication and re-fabrication of new and worn out or damaged components. The ability to return a broken machine to optimum working condition and so reduce down time and costs, is a skill much sought after by employers in land-based industries.

The scale and complexity of jobs undertaken in land-based workshops will depend on their size, level of equipment, the employees skills, tools available and the type of work the organisation is involved in. However there are basic principles that underpin any workshop activity. Foremost is the health, safety and wellbeing of employees, employers, visitors and customers of the organisation.

From basic principles the unit aims to develop good working practices in the use of hand and power tools and stresses the need for good maintenance and storage of these expensive assets. The most common forms of welding and cutting will be introduced allowing learners to apply the skills and knowledge gained in maintenance, servicing, repair and fabrication activities on land-based machines and equipment.

Learners will be directed to a range of information sources including operator and workshop manuals, standards organisations, maintenance and adjustment schedules, and will understand the importance of working to specifications where stated. Generally, workshop tidiness and the need to maintain a clean and uncluttered working environment will be embedded as supervised practical work is undertaken in either simulated or commercial workshop conditions.

Learning outcomes

On completion of this unit a learner should:

1 Be able to safely use commonly found hand and power tools for the maintenance and repair of land-based machinery and installations

2 Be able to safely use basic welding and cutting equipment

3 Be able to safely use basic maintenance and/or repair techniques on land-based machinery and installations

4 Understand land-based workshop health and safety requirements.

Unit content

1 Be able to safely use commonly found hand and power tools for the maintenance and repair of land-based machinery and installations

Safe use of hand and power tools: hand tools eg spanners, socket sets, screwdrivers, Allen keys, pliers, hammers; hand tools for measuring, marking out and cutting eg rules, squares, centre punches, hacksaws; power tools for drilling, grinding, cutting and soldering eg 240V, 110V and cordless tools as appropriate; correct uses of each type of tool listed; safe methods of use; tool storage and maintenance; tool transportation; health and safety

2 Be able to safely use basic welding and cutting equipment

Safe use of basic welding and cutting equipment: manual metal arc (MMA); metal inert gas (MIG); brazing; oxy-acetylene welding and cutting; advantages and limitations of each system; set up, use and maintenance of equipment and materials; methods used to produce basic fillet and butt joints; use of welding standards; health and safety; risk assessment

3 Be able to safely use basic maintenance and/or repair techniques on land-based machinery and installations

Techniques: construction and use of fasteners eg nuts, bolts, rivets, circlips; driveline maintenance eg belts, chains; cutting mechanism maintenance eg sharpening, adjusting; lubrication requirements eg grease, oil, 'anti rust' agents; service and maintenance schedules; manufacturers' handbooks; health and safety

4 Understand land-based workshop health and safety requirements

Health and safety procedures: personal protective equipment (PPE); relevant current legislation and codes of practice eg Health and Safety at Work Act 1974; role of welding standards; risk assessment; employee responsibilities; employer responsibilities; personnel cleaning requirements and facilities

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria					
To achieve a pass grade the evidence must show that the learner is able to:		**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**		**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**	
P1	select and safely use hand and power tools to meet given objectives maintaining or repairing land-based machinery or installations [IE, TW, EP]	**M1**	plan the work processes and tool requirements to carry out routine maintenance tasks on land-based machinery	**D1**	report on the activities undertaken and equipment and materials used to complete workshop maintenance and repair tasks on land-based machinery
P2	state reasons for the hand and power tools selected [RL]				
P3	safely use basic welding equipment and materials to produce a simple welded joint to meet given objectives [IE, TW]	**M2**	review a given simple welded fabrication task suggesting improvements		
P4	state reasons for the basic welding equipment and materials selected				
P5	safely use basic techniques to maintain or repair land-based machinery or installations to meet given objectives	**M3**	illustrate safe working procedures for an identified area of work in a land-based workshop environment.	**D2**	explain employee responsibilities under health and safety legislation when operating in a land based workshop environment.
P6	state reasons for the basic techniques selected				
P7	explain the importance of health and safety in the workshop [RL, CT, SM]				
P8	produce a suitable risk assessment for the use of hand and/or power tools to meet given objectives. [RL, CT, SM]				

PLTS: This summary references where applicable in the pass criteria, in the square brackets, the elements of the personal, learning and thinking skills. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

All centres must comply with the requirements of relevant current legislation and associated codes of practice, for example the *Prevention of Accidents to Children in Agriculture Regulations 1998*. Learners must be made aware of, and have access to, relevant health and safety legislation and know the importance of the use of risk assessment appropriate to each situation. Appropriate risk assessment must precede all practical machinery activities, learners must work in a safe manner at all times when using equipment or working with machinery. Learners must be supervised at all times and tutors must not request learners undertake tasks that are beyond their physical capabilities.

Delivery is likely to be a mixture of classroom learning and supervised practical sessions in a workshop. Assessment is likely to be in the form of a portfolio of evidence bringing together recorded and authenticated evidence.

Tutors have the opportunity to use as wide a range of techniques as possible. Lectures, discussions, seminar presentations, site visits, supervised land-based workshop practicals, internet and library research and the use of personal and/or industrial experience would all be suitable. Delivery should stimulate, motivate, educate and enthuse learners.

Work placements should be monitored regularly before to ensure the quality of the learning experience. It would be beneficial if learners and supervisors were made aware of the requirements of this unit before any work-related activities, so that naturally occurring evidence can be collected at the time. For example, learners may have the opportunity to contribute to the maintenance or repair of land-based machinery and installations and they should be encouraged to ask for observation records and/or witness statements to be provided as evidence. Guidance on the use of observation records and witness statements is provided on the Pearson website.

Whichever delivery methods are used, it is essential that tutors stress the importance of the principles and application of health and safety guidance, good workshop practice, environmental issues and the need to manage the resource using legal methods. Although stated in learning outcome 4, these principles should be embedded at all stages of delivery and throughout all learning activities. Tutors must consider the safety of those working or coming into contact with the machinery and equipment to be maintained and/or repaired. Risk assessments must be undertaken before practical activities.

Tutors should consider integrating the delivery, private study and assessment relating to this unit with any other relevant units and assessment instruments the learner may also be taking as part of their programme of study.

Learning outcome 1 is likely to be delivered using formal lectures, discussions, supervised land-based workshop practicals and independent learner research. Learners will be introduced to the common types of hand and power tools found in most workshop situations. They will look at the safe and correct use of these tools and the maintenance and storage requirements that ensure their continued availability and safe operation. The learning outcome seeks to develop a sense of 'good working practice' wherever tools are used, to control costs and prevent injury to users and damage to machinery. Visiting expert speakers could add to the relevance of the subject for learners. For example, a mechanic working with land-based machinery could talk about their work and the tools they use to maintain and repair appropriate machinery.

Learning outcome 2 is likely to be delivered through a series of formal lectures, demonstrations and supervised land-based workshop practicals. The ability to correctly set up and use basic welding and cutting equipment in a safe manner will be developed further with continued practise, in the fabrication and re-fabrication activities undertaken in many workshop situations. Again good working practices will be stressed as skill development progresses through an understanding of the various techniques, their advantages and limitations to their application in supervised repair and/or fabrication activity.

Tutors are required to cover the four methods listed in the unit content but it is accepted that learners may not become proficient in all of these during the learning time available. Tutors may concentrate practical delivery on one of the systems and, if time and learner development allow, move on to other methods. Learners must be given the background theory and practical demonstrations for all the systems. Visiting expert speakers could add to the relevance of the subject for the learner. For example, a mechanic working with land-based machinery could talk about their work and the welding systems they use to maintain and repair appropriate machinery and installations.

Learning outcome 3 is likely to be delivered using formal lectures, discussion, supervised land-based workshop sessions and independent learner research. Learners will become aware of the safe use of basic maintenance and/or repair techniques on land-based machinery and equipment. In particular, learners must be made aware of service and maintenance schedules and be able to undertake basic tasks related to these. Learning outcome 3 gives tutors an opportunities to help learners apply and embed the skills and knowledge covered in learning outcomes 1, 2 and 4, in conducting repair and maintenance activities on a range of land-based machinery and equipment. Here the need for the application of good working practices will be reinforced as learners look at typical exercises in machinery maintenance and investigate the various sources of information and standards commonly found in workshop situations. Visiting expert speakers could add to the relevance of the subject for learners as in learning outcomes 1 and 2.

Learning outcome 4 is likely to be delivered using formal lectures, discussion, supervised land-based workshop practicals and independent learner research. Learners will become aware of the health and safety requirements of working in land-based workshops. Learners should be made aware of the difference between 'hazard' and 'risk' and understand the controls or precautions that can be used to limit them. Visiting expert speakers could add to the relevance of the subject for the learners. For example, a safety adviser or environment officer could talk about their work and the implications for the relevant land-based industries. Tutors should maintain current knowledge of legislation and ensure that all practical work is carried out safely and legally. It is not expected that learners will be able to state the exact provisions of various Acts of Parliament. However, they should be able to understand how relevant legislation affects them whilst carrying out practical tasks in the centre and workplace.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan gives **an indication of the volume of learning it would take the average learner** to achieve the learning outcomes. It is **indicative and is one way of achieving the credit value**.

Learning time should address all learning (including assessment) relevant to the learning outcomes, regardless of where, when and how the learning has taken place.

Topic and suggested assignments/activities and/assessment
Introduce unit and assessment processes. **Issue Assignment 1: Workshop Skill Development** (P1, P2, P5, P6, M1, D1) and **Assignment 2: Welding Skill Development** (P3, P4, M2, D1)
Hazards in the workshop and controlling risk – workshop/work area cleanliness.
Basic hand tool kit contents and uses. Safety, storage and maintenance.
Special tools and applications. Safety, storage and maintenance.
Tools for measuring, marking out and cutting. Safety storage, maintenance and sharpening.
Practical tool use – mark out and cut, drill and grind. Simple component manufacture.

Topic and suggested assignments/activities and/assessment
Fusion welding process – safety and PPE.
Hazards in the welding workshop and controlling risk.
Joint types and terminology.
Welding standards introduction and use.
Materials and suitability for welding.
Oxy-acetylene gas welding (and cutting) introduction and set up.
Manual metal arc welding introduction and set up.
Metal inert gas welding introduction and set up.
Fasteners in common use – form recognition, application and associated tools.
Rivets and riveting – recognition, application and tool requirements.
Circlips – application and use – handling and tool requirements.
Driveline component maintenance – belts.
Driveline component maintenance – chains.
Driveline component maintenance – shafts and bearings.
Driveline component maintenance – gears and couplings.
Service and maintenance operations – tractor units.
Service and maintenance operations – machines.
Assignment 3: Investigate Health and Safety Implications (P7, P8, M3, D2)
Sources of information and relevance.
Legislation and application to the workplace.
Employer responsibilities formalised.
Employee responsibilities.
Unit review.

Assessment

For P1, they will be expected to select and use hand and power tools safely to meet given objectives, maintaining or repairing land-based machinery or installations. Tutors should identify the given objectives which may depend on the specific requirements of the centre at the time of assessment. Where possible, the size and complexity of these should be the same for each learner to ensure the fairness of assessment. This criterion could be assessed along directly by observation by the tutor during practical activities when learners are undertaking identified tasks and recording their activities. If this format is used suitable evidence from guided activities would be observation records completed by the learner and tutor and accompanied by appropriate work logs or other relevant learner notes. If assessed during a placement, witness statements should be provided by a suitable representative and verified by the tutor. Guidance on the use of observation records and witness statements is provided on the Pearson website.

P3 requires learners to demonstrate the safe use of basic welding equipment and materials to produce a simple welded joint to meet given objectives. Evidence could be in the form of a test piece. Evidence for P4 could be linked to the work being undertaken for P3 in the form of an oral examination or report. Learners will be expected to use at least one type of welding system to achieve these criteria. Tutors should identify the given objectives which may include basic quality tolerances.

For P5, learners are required to use basic techniques safely to maintain or repair land-based machinery or installations to meet given objectives. Evidence for this may be linked to that being provided for other grading criteria and may be in the form of a portfolio of evidence showing maintenance activities covering

the unit content. Where possible, the given objectives for this criterion should be the same for each learner. However, it is appreciated that this may be difficult to organise for larger learner groups, in which case tutors should try to ensure fairness of assessment for all learners. For P6, learners could include in their portfolio a statement describing the reason for their particular approach to the tasks undertaken

P7 requires learners to explain the importance of health and safety in the workshop. This could take the form of an annotated report, a presentation using suitable software or a poster campaign for a given site.

P8 requires learners to produce a suitable risk assessment for the use of hand and/or power tools to meet given objectives. Evidence for this may be linked directly to tasks being undertaken to provide evidence for P1 to P6 and included in learners' portfolio. Tutors should identify the given objectives and a risk assessment pro forma, which should be in a format that is acceptable in a real-work situation.

For M1, learners are required to plan the work processes and tool requirements to carry out routine maintenance tasks on land-based machinery. Evidence for this may be linked directly to tasks being undertaken for the P1, P2, P5 and/or P6 in this unit and could be in the form of a checklist of tools and equipment, work processes with accompanying notes, extracts from manufacturers' schedules and/or materials and quantities lists, drawn up before executing the task.

For M2, learners are required to review a given simple welded fabrication task to suggest improvements. Evidence for this criterion may be linked directly to tasks being undertaken for P4 and P5 and could be in the form of a checklist of tools and equipment, work processes with accompanying notes, extracts of welding standards and materials and quantities lists, drawn up prior to executing the task.

For M3, learners are required to illustrate safe working procedures for an identified area of work in a land-based workshop environment. Evidence should be linked to the range of activities undertaken for other criteria and could take the form of a poster presentation, illustrated report or a pictorial presentation using suitable software.

For D1, learners are required to report on the activities undertaken and equipment and materials used to complete workshop maintenance and repair tasks on land-based machinery. Evidence may be linked directly to work being undertaken for other criteria or tutors could ask learners to evaluate other work that meets the necessary objectives for this criterion. Evidence could take the form of a reflective log attached to the activities undertaken for P1 to P6, M1 and M2, where learners describe the activities undertaken and evaluate whether the work has met the given objectives and, if not, why this may be.

D2 requires learners to explain the employee responsibilities under health and safety legislation when operating in a land-based workshop environment. Evidence could take the form of a web-based research project with downloads and extracts populating an illustrated report or animated presentation. This lends itself to group working. If this method of assessment is applied tutors should satisfy themselves of each individual's contribution achieve to the distinction grade.

Programme of suggested assignments

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Pearson assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2, P5, P6, M1, D1	Workshop Skill Development	Learners set up systems to record workshop activities. Basic portfolio requirements to include risk assessments, information on tasks, toolage and material requirements. Work process statements and evaluative elements for each, providing evidence for merit and distinction criteria.	Observation. Course work portfolio. Presentation of work logs. Illustrated reports and/or AV presentations using suitable software.
P3, P4, M2, D1	Welding Skills Development	Learners to produce welded joint test pieces having selected and set up a welding system within the range of the unit content. Recording of risk assessments, work process statements and evaluative elements to provide evidence for merit and distinction criteria.	Observation and test pieces. Illustrated reports. Work logs.
P7, P8, M3, D2	Investigate Health and Safety Implications	Working in small groups, learners to review institutional approaches to health and safety and compare with legislative requirements to explain the importance to both employers and employees. Merit and distinction criteria could be evidenced through analysis.	Group work. AV/illustrated presentation. Poster campaign. Written reports.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC land-based sector suite. This unit has particular links with:

Level 2	Level 3
Introduction to Land-based Machinery Operations	Undertaking Land-based Workshop Practice
Participate in Providing Estate Maintenance	

Essential resources

Facilities required for this unit include regular and routine supervised access to appropriately resourced land-based workshops.

Sufficient equipment and materials should be available to allow learners to gain experience of a range of powered and non-powered tools for example powered drills, grinders, saws, MMA welders, MIG welders, brazing equipment and hand tools.

Access to resources should be sufficient to allow all learners adequate opportunity to develop practical competence and confidence over a period of time.

Employer engagement and vocational contexts

The unit has a very practical focus and in this respect employer engagement will provide the modern context into which workshop skills and employers and manufacturer requirements for land-based machinery and equipment can be placed.

Good employer links will also help secure a valuable resource which will benefit of learners. Work placement opportunities should be actively sought alongside visits by experienced practitioners to illustrate current equipment, trends and practice in maintenance and repair operations. Learners could be encouraged to develop links with employers and arrange visits and demonstrations.

Indicative reading for learners

Textbooks

Agate E – *Tool Care – A Maintenance and Workshop Manual* (British Trust for Conservation Volunteers, 2000) ISBN 0946752249

Bell B – *Farm Machinery* (Old Pond Publishing, 2005) ISBN 1903366682

Gibson S and Smith A – *Basic Welding* (Thomson Learning, 1993) ISBN 0333578538

Shippen J – *Basic Farm Machinery* (Butterworth-Heinemann, 1980) ISBN 00802491116

Journals

Farmers Guardian

Farmers Weekly

Profi International

Websites

www.defra.gov.uk	Department for Environment Food and Rural Affairs
www.environment-agency.gov.uk	Environment Agency
www.hse.gov.uk	Health and Safety Executive
www.lantra.co.uk	Lantra

Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit:

Skill	When learners are …
Independent enquirers	exploring the safe use of power tools
Creative thinkers	connecting with others' experiences of workshop hazards and safety
Reflective learners	considering the hazards and risks associated with workshops
Team workers	working with others to use basic welding equipment
Self-managers	organising safe and hazard free workshop activity.

Although PLTS opportunities are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are …
Independent enquirers	investigating tool use and maintenance reviewing specifications for welded joints
Creative thinkers	analysing health and safety poster information creating poster campaigns and risk assessments
Reflective learners	stating reasons for tool and equipment usage stating reasons for choice of techniques
Team workers	working on practical tasks researching health and safety information
Self-managers	stating personal reasons for tool and equipment usage stating personal reasons for choice of techniques
Effective participators	participating in practical activities participating in group-work.

Functional Skills – Level 2

Skill	When learners are …
ICT – Use ICT systems	
Select, interact with and use ICT systems independently for a complex task to meet a variety of needs	using web based research skills to obtain H&S information and guidance delivering AV presentations for assessment
Use ICT to effectively plan work and evaluate the effectiveness of the ICT system they have used	planning work processes for particular tasks preparing and submitting work for assessment
Manage information storage to enable efficient retrieval	using electronic storage mediums for planned and completed tasks recording risk assessments for later adaptation and use
Follow and understand the need for safety and security practices	
Troubleshoot	
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	researching tools and techniques for personal use reviewing tool supplier catalogues and price lists
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	accessing and using welding standards information accessing and using health and safety websites and information
ICT – Develop, present and communicate information	
Enter, develop and format information independently to suit its meaning and purpose including: • text and tables • images • numbers • records	preparing and delivering AV presentations using suitable software recording set up specifications (gas pressures, nozzle size, voltages, amps etc) measuring and recording compliance with standards compiling risk assessments to a pro forma
Bring together information to suit content and purpose	compiling risk assessments to a pro forma preparing and presenting poster information
Present information in ways that are fit for purpose and audience	compiling risk assessments to a pro forma preparing and presenting poster information
Evaluate the selection and use of ICT tools and facilities used to present information	
Select and use ICT to communicate and exchange information safely, responsibly and effectively including storage of messages and contact lists	

Skill	When learners are …
Mathematics	
Understand routine and non-routine problems in a wide range of familiar and unfamiliar contexts and situations	measuring, marking out, calculating and cutting to tolerances calculating material requirements calculating material and machine cutting and feed speeds
Identify the situation or problem and the mathematical methods needed to tackle it	measuring and marking out from a datum point using error reduction techniques
Select and apply a range of skills to find solutions	using tables and standards to work effectively
Use appropriate checking procedures and evaluate their effectiveness at each stage	using tables and standards to evaluate practical tasks
Interpret and communicate solutions to practical problems in familiar and unfamiliar routine contexts and situations	calculating material requirements calculating cutting and feed speeds interpreting engineering drawings and tolerances
Draw conclusions and provide mathematical justifications	self assessing fabricated components complying with specifications and standards
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	presenting assessed work and obtaining feedback working in groups to meet objectives requesting materials and tools for particular tasks
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	reviewing standards to enable compliance comparing workshop information with legislative requirements analysing content for completeness
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	compiling portfolios of evidence preparing risk assessments for practical activities reporting on particular work processes and general workshop activity.

Unit 27: Introduction to Land-based Machinery Operations

Unit code: T/600/9596

Level 2: BTEC First

Credit value: 10

Guided learning hours: 60

Aim and purpose

This unit aims to introduce learners to the skills and knowledge associated with land-based machinery operations and how these can be applied in practice. It is designed for learners in centre-based settings looking to progress into the sector or onto further/higher education.

Unit introduction

This unit is aimed at learners who may wish to take up a career in the land-based sector especially where skills are needed for using tractors or other similar powered vehicles together with the associated machinery and equipment. The unit emphasises practical skills using tractors, power units and machinery covering the essential skills of preparing, operating and maintaining tractors, equipment and machinery. Learners will firstly learn to recognise the different machinery that is available to use for a range of tasks. They will then learn how to prepare the machinery, use it in realistic situations and finally maintain it ready for use again. Learners will also learn the important legislative and environmental requirements that are increasingly important in the land-based industry of today.

Learning outcomes

On completion of this unit a learner should:

1 Understand safe working principles when using equipment and machinery

2 Be able to prepare land-based equipment and machinery for use

3 Be able to operate land-based equipment and machinery

4 Be able to maintain land-based equipment and machinery.

Unit content

1 Understand safe working principles when using equipment and machinery

Safe working principles: personal eg use of barrier cream; risk assessments; accident statistics; pre-start checks; mounting and dismounting; cold starting; fuelling procedures eg keep tank full overnight, bleeding air from pipes; power take off (PTO) procedures (eg guards, speeds, removal of shaft); hydraulics eg couplings, hoses, spool valves; interpret Decals; interpret odometer; locate main controls eg gauges, levers, buttons for electronics, pedals, dipsticks; ground conditions eg hard, soft, slope; use of gears and speed; use of manufacturers' handbooks

Machinery selection: identification and justification of machinery and equipment suitable to operations eg crop production, groundcare; pesticide application equipment

Legal and environmental considerations: current relevant legislation eg Health and Safety at Work Act 1974 (HASAWA), Control of substances hazardous to health 1989 (COSHH), Manual Handling Operations Regulations (1992); Personal Protective Equipment (PPE); age to drive on road; transport widths; transport loads (eg height, ropes and ratchet straps); mud on road

2 Be able to prepare land-based equipment and machinery for use

Tractor/power unit preparation: pre-start checks eg oil, coolant, diesel; tyres; battery; maintenance schedule eg handbook; wheels eg check wheel nuts, wheel widths to match machine; fore-loader (where applicable); drawbar

Equipment and machinery preparation: appropriate connections for attachment eg top link, PTO, hydraulic pipes, drawbar, linch pins and clips; check working parts eg nuts and bolts, shear bolts, tines, discs, bearings, coulters, blades, belts, gearbox oil, grease points, electrical connections

3 Be able to operate land-based equipment and machinery

Tractor/power unit operation: selection of appropriate gear to match ground/road conditions; transport safely to site; warning signals

Equipment and machinery operation: lift in and out of work; use of headlands; carry out adjustments in work (eg forward speed, top link, stabiliser bars, PTO speed, depth control, differential lock)

4 Be able to maintain land-based equipment and machinery

Maintenance: interpretation of operator handbook for service/maintenance schedules eg oil, fuel, filters, tyre pressures, coolant, lubrication; check and replacement of worn parts; cleaning; workshop safety eg axle stands, PPE, blocks; storage; waste disposal; record keeping; costs (parts, labour)

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria					
To achieve a pass grade the evidence must show that the learner is able to:		**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**		**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**	
P1	select appropriate equipment for land-based tasks	**M1**	explain appropriate legal and environmental considerations when using a given machine	**D1**	justify the selection of machinery for a specified task
P2	explain why manufacturers' instructions should be followed when working with land-based equipment and machines [IE]				
P3	explain the legal and environmental requirements associated with specific machines				
P4	identify the controls/devices/ instruments and other health and safety requirements for machinery and equipment				
P5	carry out adjustments on land-based equipment and machines to meet specific requirements prior to use	**M2**	present maintenance requirements for a specified machine		
P6	explain the benefits of correct adjustment of equipment and machines				
P7	carry out pre-start checks, including fuelling				

Assessment and grading criteria					
To achieve a pass grade the evidence must show that the learner is able to:		**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**		**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**	
P8	operate equipment and machines safely and efficiently for different land-based activities	**M3**	monitor the use of machinery and equipment for a specified task	**D2**	evaluate the use of machinery and equipment for a specified task.
P9	carry out activities to achieve the desired results when operating land-based equipment and machines				
P10	identify routine maintenance for land-based equipment and machines using manufacturers' instructions [EP]	**M4**	produce a cost breakdown for replacing worn parts for a specified machine.		
P11	identify hazards and comply with risk assessments during maintenance activities [SM]				
P12	carry out different routine maintenance activities safely on a range of equipment and machines [TW]				
P13	record maintenance activities in an appropriate format.				

PLTS: This summary references where applicable in the pass criteria, in the square brackets, the elements of the personal, learning and thinking skills. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

All centres must comply with the requirements of relevant current legislation and associated codes of practice, for example the *Prevention of Accidents to Children in Agriculture Regulations 1998*. Learners must be made aware of, and have access to, relevant health and safety legislation and know the importance of the use of risk assessment appropriate to each situation. Appropriate risk assessment must precede all practical machinery activities, learners must work in a safe manner at all times when using equipment or working with machinery. Learners must be supervised at all times and tutors must not request learners undertake tasks that are beyond their physical capabilities.

Delivery of this unit will involve both practical assessment and written assessment, visits to suitable collections and will have links to industrial experience placements.

The unit focuses on learners being able to identify, prepare, use and maintain a wide range of machinery and equipment as found on today's farms, countryside and horticultural units. Tutors should therefore endeavour to offer learners this wide range, even though in their specific locality such a range may not be seen so easily. Where there is a shortfall, tutors should aim to offer the learner the experience of recognising and using other machinery through visits to demonstrations, dealers, talks and work experience.

The tutor might wish to bear in mind the seasonality of tractor, power unit and machinery use. Tutors must therefore plan carefully the whole programme according to both seasonality and machinery in their locality. Tutors need to plan their assessment schedule carefully so that it covers not just learners operating machinery at a certain time of year, but throughout the course duration and to include, where appropriate, any work experience.

Learners will be preparing and maintaining various machinery in a workshop setting and so tutors must adhere to all health and safety procedures throughout the course duration. A strict policy of appropriate PPE must be enforced. This will obviously need to be repeated when learners are in working situations in the field and on visits. Learners should experience how workshops are organised, the range of tools and equipment available for machinery maintenance as well as consumables such as lubricants, filters and other items needed.

Learning outcome 1 covers the recognition of a wide range of machinery and equipment. Tutors will need to plan how they will offer learners the wide choice of machinery available. They might at this stage plan a visit to a local dealer, or to a working demonstrations. Tutors need to emphasise the important environmental aspects of using machinery such as soil structure damage.

Learning outcome 2 is about preparing machinery and equipment and therefore will have an element of workshop experience to offer. Tutors must ensure that learners become familiar with using the wide variety of tools available in a modern workshop. Learners need to experience a variety of tractors and powered vehicles and be able to recognise and locate the different instruments, controls and signs or decals such as found on machinery. There is an increasing use of electronic instruments and controls in modern tractors and machinery, and so tutors need to be able to offer learners this choice.

Learning outcome 3 involves learners using machinery and equipment in the field. The ideal setting is either through work experience or at a centre's farm, horticultural unit or estate. Tutors should endeavour to allow learners maximum experience of a range of machinery. Tutors might be in a position to integrate learner experience with a centre's farm or with a local farmer, horticultural unit or countryside/nature park that can complement the range of machinery offered. Where possible learners should be in a position to use the machinery that they helped prepare in outcome 2.

Learning outcome 4 is a logical follow on to the previous outcome. Where possible, tutors should involve

learners to maintain equipment that has been experienced, such as that in learning outcome 1 or 3. Tutors need to plan the timing of this outcome so that learners can complete all relevant assessments. It may be necessary for tutors to plan for this outcome to be done after equipment and machine use in order that there are real maintenance tasks to be undertaken.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan gives **an indication of the volume of learning it would take the average learner** to achieve the learning outcomes. It is **indicative and is one way of achieving the credit value**.

Learning time should address all learning (including assessment) relevant to the learning outcomes, regardless of where, when and how the learning has taken place.

Topic and suggested assignments/activities and/assessment
Introduction to unit and unit overview.
Assignment 1: Machinery Selection (P1, P2, P3, P4, M1, D1) and briefing
Practical session: identify machinery, equipment, decals, instruments and gauges, pedals, levers, interpret handbook where relevant, observe/assist in using machinery for cultivations.
Theory session: identify and describe machinery for different purposes, interpret handbook, explain legal and environmental requirements when using machinery and equipment.
Assignment 2: Safe Machinery and Equipment Preparation (P5, P6, P7, M2) and briefing
Practical session: prepare machinery and equipment for specified tasks safely, check parts for wear, interpret manufacturers' instructions, workshop safety, workshop tools, lubricate and fuel ready for use.
Theory session: legislation and environmental considerations for using machinery and equipment.
Theory session: recognise working parts of a range of machinery and equipment, reasons for correct preparation of machinery and equipment, fuel and lubricants.
Assignment 3: Safe Machinery and Equipment Operation (P8, P9, M3, D2) and briefing
Practical session: carry out specified practical operations with machinery and equipment safely.
Theory session: working parts of machinery and equipment, ground/soil conditions needed for efficient working of machinery, efficient operation, safety, necessary field adjustments.
Assignment 4: Safe Machinery Maintenance (P10, P11, P12, P13, M4) and briefing
Practical session: workshop safety, maintain specified machinery, identify and replace worn parts, use workshop tools safely.
Theory session: interpret manufacturers' handbook, workshop tools and equipment, health and safety, maintenance schedules, records and job cards.
Unit review.

Assessment

For P1, learners need to select appropriate equipment for given land-based tasks. Learners must cover a minimum of three different tasks. For agricultural learners, machines selected could cover machinery for cultivations, drilling/planting, crop health, fertiliser manure application, harvesting and storage. For horticulture and countryside learners, machines could include mowers, strimmers and ground care equipment. Evidence could be captured through direct observation.

For P2, learners need to be able to explain reasons for following relevant manufacturers' instructions in relation to a minimum of two given pieces of equipment and/or machine.

For P3, learners must explain legal and environmental requirements, this must include relevant legislation covering age restriction, roadworthiness, health and safety issues and environmental issues associated with a minimum of two specific machines.

For P4, learners must be able to identify correctly a range of commonly used instruments, levers, pedals and decals found on machinery. They must state specific health and safety issues relevant to a minimum of two specified machines. Evidence for P2, P3 and P4 could be through an assignment or recorded observation using practical activities.

Health and safety must be paramount in any practical assessment.

For P5, learners need to be able to adjust parts of a given piece of machinery that need specific preparation prior to use. This should include use of lubricants such as grease and oils, nuts and bolts for tightness.

For P6, learners need to explain reasons for correct adjustment and preparation of machinery.

For P7, learners must be able to carry out pre-start checks on oil reservoirs (both engine and hydraulic oil), coolant, fuel, tyres and battery as well as re-fuel a machine as a minimum.

For P8 and P9, learners must be able to operate machinery safely, carry out necessary adjustments. For example if they are creating a seedbed, they should be able to use the relevant machinery and comment on the work produced as to whether the ground is suitable for drilling/planting. For horticulture this might cover the setting up and use of a potting machine. Countryside learners might use a post hole rammer for fencing. Evidence for P5 through P9 is likely to be through the use of observation records during practical assessments. As a minimum learners should operate two different machines.

For P10, learners need to recognise when machinery or equipment needs maintenance, such as oil and filter changes on a tractor or power unit, replacing worn cultivator or mower parts.

P11, could be assessed at the same time as P10 and be evidenced through completed risk assessments.

P12, can be assessed as an on-going exercise that learners perform during the year.

P13, could form part of a learners' workshop diary, recording maintenance activities that are carried out at specific times of year.

For M1, learners must explain legislative and environmental reasons for specifying use of machinery. For example, for agriculture, tutors could select either manure or fertiliser applicators for learners, who then need to describe NVZ and field margin requirements such as deflectors that avoid fertiliser in the hedgerow. Tutors need to ensure that learners are given the same machinery in order to have fairness of assessment. For horticulture and countryside relevant equipment should be chosen, this may include chose of power units to reduce environmental impact.

For M2, learners are required to show that they can organise the maintenance requirements of a specified machine including a list of all the necessary replacement parts needed.

For M3, learners need to monitor machinery use over a specified period of time, which must be the same for all learners. Evidence for M2 and M3 could be through a completed monitoring and maintenance record.

For M4, learners could use the same machinery as that selected for M2. Costs should include parts, allocation of labour and time needed for the machine repair.

For D1, in order to justify the selection of machinery for a specified task learners are expected to be able to present clear, logical and cogent reasons for using machinery. They must show evidence that they have compared other machinery and evaluated all considerations including environmental impacts.

For D2, learners are to evaluate how machinery and equipment was used for a specified task. For agriculture, for example, learners might evaluate the use of machinery for forage harvesting grass, planting potatoes, or producing a seedbed for a spring planted crop. For horticulture this might include compost preparation and potting equipment. Countryside might use equipment for preparing a surface, planting,

fencing or grounds maintenance. They must include all the machinery used, including any associated machinery, and to evidence understanding of the need to match capacities and work rates of the machinery used.

Programme of suggested assignments

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Pearson assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2, P3, P4, M1, D1	Machinery Selection	You are employed at a dealership as an machinery apprentice. You need to select appropriate machinery for three separate purposes and justify your selection. You must identify instruments and health and safety requirements for two of these machines including appropriate legal and environmental considerations.	Practical observation. Written evidence.
P5, P6, P7, M2	Safe Machinery and Equipment Preparation	For a given machine you have been asked to prepare the machinery according to manufacturers' instructions. You need to make adjustments prior to use and explain the reasons for these and carry out all necessary pre-start checks.	Practical observation. Written evidence.
P8, P9, M3, D2	Safe Machinery and Equipment Operation	You must carry out practical operations for specified tasks using machinery safely and efficiently.	Practical observation. Written evidence.
P10, P11, P12, P13, M4	Safe Machinery Maintenance	Carry out maintenance of machinery. Interpret manufacturers' instructions. Identify and replace worn parts. Produce a list of parts needed. Produce a cost of both replacement parts and labour.	Practical observation. Written evidence.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC land-based sector suite. This unit has particular links with:

Level 2	Level 3
Element CU27.1 Prepare equipment and machines for maintenance Element CU27.2 Carry out maintenance procedures	Undertaking Land-based Machinery Operations
Participate in Providing Estate Maintenance	Undertake Estate Skills
Undertake Specialist Land-based Machinery Operations	
Tractor Driving	

Essential resources

Learners will need access to a variety of machinery and equipment, a workshop or suitable work area with the necessary safety equipment and fields or similar where they can gain practice and be assessed. Instruction books and relevant workshop tools will be essential. Workshop areas should also include all the relevant consumables such as oil, filters, belts, nuts and bolts that will be needed for the course duration. Access to and use of all of these resources should form part of the learners' experience. Tutors must ensure that the working areas provide a safe environment for learners. An area for washing hands and storage of clothes/PPE should also be on hand.

Employer engagement and vocational contexts

Tutors should endeavour to promote links with their own centre's farm, with other local dealers and farmers who are willing to cooperate with offering work experience or visits to learners. Where there are local employers involved, tutors must ensure that strict adherence to health and safety is carried out so that learners can work in safety. Learners should also be given opportunities to do national proficiency training and assessment as relevant to their age and experience, such as telescopic forklift, tractor driving and handling, quad bike handling, Pesticide Applications 1 and 2 as well as any other opportunities for further training.

Indicative reading for learners

Textbooks

Bell B – *Farm Machinery* (Old Pond Publishing, 2008) ISBN 978-1903366684

Bell B and Cousins S – *Machinery for Horticulture; 2nd edition* (Old Pond Publishing, 1997) ISBN 978-0852363690

Culpin C – *Farm Machinery* (Blackwell Science, 1992) ISBN 978-0632031597

Journals

Farm Contractor

Farmers Weekly

Horticultural Week

Profi

Websites

www.defra.gov.uk	Department for Environment Farming and Rural Affairs
www.environment-agency.org.uk	Environment Agency
www.fwi.co.uk	Farmers Weekly
www.hse.gov.uk	Health and Safety Executive
www.rbi.co.uk.lantra.co.uk	Lantra Sector Skills Council
www.reedbusiness.co.uk	Reed Business Information

Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit:

Skill	When learners are …
Independent enquirers	identifying questions to answer relating to the importance of manufacturers' instructions
Team workers	collaborating with others when carrying out routine maintenance activities
Self-managers	identifying hazards and complying with risk assessments showing flexibility when priorities change
Effective participators	proposing practical ways forward for the maintenance of machinery.

Although PLTS opportunities are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are …
Independent enquirers	monitoring use of machinery
Creative thinkers	carrying out their own research and monitoring
Reflective learners	carrying out their own research and monitoring
Team workers	involved in work experience, visits
Self-managers	involved in work experience, national proficiency tests
Effective participators	on work experience.

Functional Skills – Level 2

Skill	When learners are …
ICT – Use ICT systems	
Select, interact with and use ICT systems independently for a complex task to meet a variety of needs	engaged in using the internet for presentation purposes
Use ICT to effectively plan work and evaluate the effectiveness of the ICT system they have used	
Manage information storage to enable efficient retrieval	
Follow and understand the need for safety and security practices	
Troubleshoot	
Mathematics	
Understand routine and non-routine problems in a wide range of familiar and unfamiliar contexts and situations	calculating speeds, distances, areas covered for a variety of machinery calibrating specific machinery for quantities of fertiliser to be used in the field calculating amounts of manure spread over given areas
Identify the situation or problem and the mathematical methods needed to tackle it	
Select and apply a range of skills to find solutions	
Use appropriate checking procedures and evaluate their effectiveness at each stage	
Interpret and communicate solutions to practical problems in familiar and unfamiliar routine contexts and situations	
Draw conclusions and provide mathematical justifications	
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	engaged in group and independent discussions involving the selection, planning, using and maintaining machinery.
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	

Further information

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Related information and publications include:

- Functional Skills publications – specifications, tutor support materials and question papers
- the current publications catalogue and update catalogue.

Pearson publications concerning the Quality Assurance System and the internal and external verification of vocationally related programmes can be found on the Pearson website and in the Pearson publications catalogue.

NB: Most of our publications are priced. There is also a charge for postage and packing. Please check the cost when you order.

How to obtain National Occupational Standards

Lantra
Lantra House
Stoneleigh Park
Coventry CV8 2LG

Telephone 0845 707 8007

Email: connect@lantra.co.uk

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- building Functional Skills into your programme
- building in effective and efficient quality assurance systems.

The national programme of training we offer can be viewed on our website (www.pearson.com/training). You can request customised training through the website or by contacting one of our advisers in the Training from Pearson UK to discuss your training needs.

Calls may be recorded for training purposes.

The training we provide:

- is active – ideas are developed and applied
- is designed to be supportive and thought provoking
- builds on best practice.

Our training is underpinned by the LLUK standards for those preparing to teach and for those seeking evidence for their continuing professional development.

Annexe A

The Pearson BTEC qualification framework for the environmental and land-based sector

Progression opportunities within the framework.

Level	General qualifications	BTEC full vocationally-related qualifications	BTEC Short Courses	NVQ/occupational
5		Pearson BTEC Level 5 HND Diplomas in Animal Management, Environmental Conservation, Horse Management, Horticulture		
4		Pearson BTEC Level 4 HNC Diplomas in Animal Management, Environmental Conservation, Horse Management, Horticulture		
3	Pearson Level 3 Diploma in Environmental and Land-based Studies	Pearson BTEC Level 3 Certificates, Subsidiary Diplomas, Diploma and Extended Diplomas in Land-based Technology, Animal Management, Blacksmithing and Metalworking, Countryside Management, Fish Management, Floristry, Forestry and Arboriculture, Horse Management, Horticulture, Land-based Technology		Diploma in Work Based Environmental Conservation
2	Pearson Level 2 Diploma in Environmental and Land-based Studies	Pearson BTEC Level 2 Certificate, Extended Certificate and Diploma in Agriculture, Animal Care, Blacksmithing and Metalworking, Countryside and Environment, Fish Husbandry, Floristry, Horse Care, Horticulture, Land-based Technology		Diploma in Work Based Environmental Conservation
1	Pearson Level 1 Diploma in Environmental and Land-based Studies	BTEC Foundation Learning in Land-based Studies	Pearson qualifications in Caring for Horses	
Entry		BTEC Foundation Learning in Land-based Studies		

Annexe B

Grading domains: BTEC Level 2 generic grading domains

Grading domain 1	Indicative characteristics – merit	Indicative characteristics – distinction
Application of knowledge and understanding (Learning outcome stem *understand* or *know*)	• Show depth of knowledge and development of understanding in given situations (for example explain why, make judgements based on analysis). • Apply and/or select relevant concepts. • Apply knowledge to different contexts. • Apply knowledge to non-routine contexts (ie assessor selection). • Make comparisons. • Show relationships between pass criteria.	• Synthesise knowledge and understanding across pass/merit criteria. • Evaluate concepts/ideas/actions. • Analyse/research and make recommendations. • Judges implications of application of knowledge/understanding. • Applies knowledge and understanding to complex activities/contexts.
Grading domain 2	**Indicative characteristics – merit**	**Indicative characteristics – distinction**
Development of practical and technical skills (Learning outcome stem *be able to*)	• Use advanced techniques/processes/ skills successfully. • Act under limited supervision/ demonstrate independence (note: pass cannot require support). • Apply to non-routine activities. • Demonstrate within time and/or resource constraints. • Produce varied solutions (including non-routine). • Modify techniques/processes to situations.	• Demonstrate creativity/originality/own ideas. • Apply skill(s) to achieve higher order outcome. • Select and use successfully from a range of advanced techniques/ processes/skills. • Reflects on skill acquisition and application. • Justifies application of skills/methods. • Makes judgements about risks and limitations of techniques/processes. • Innovates or generates of application of techniques/processes for new situations.

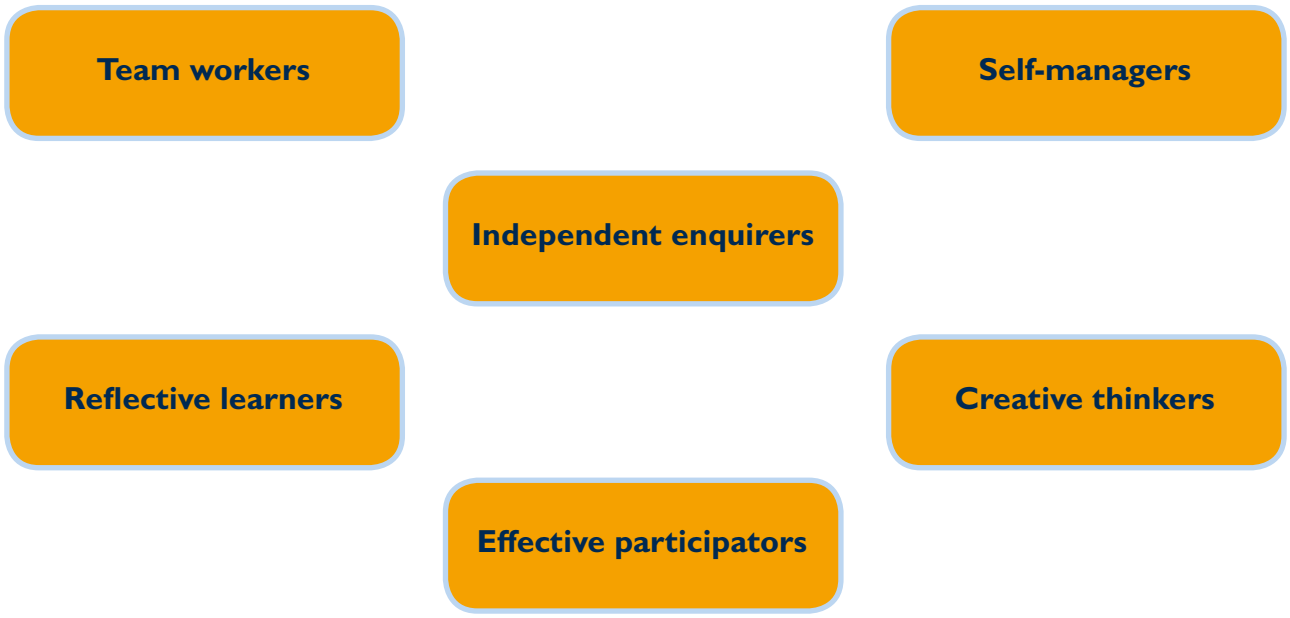
Grading domain 3	Indicative characteristics – merit	Indicative characteristics – distinction
Personal development for occupational roles (Any learning outcome stem)	• Takes responsibility in planning and undertaking activities. • Reviews own development needs. • Finds and uses relevant information sources. • Acts within a given work-related context showing understanding of responsibilities. • Identifies responsibilities of employers to the community and the environment. • Applies qualities related to the vocational sector. • Internalises skills/attributes (creating confidence).	• Manages self to achieve outcomes successfully. • Plans for own learning and development through the activities. • Analyses and manipulates information to draw conclusions. • Applies initiative appropriately. • Assesses how different work-related contexts or constraints would change performance. • Takes decisions related to work contexts. • Applies divergent and lateral thinking in work-related contexts. • Understands interdependence.
Grading domain 4	**Indicative characteristics – merit**	**Indicative characteristics – distinction**
Application of generic skills (Any learning outcome stem)	• Communicates using appropriate technical/professional language. • Makes judgements in contexts with explanations. • Explains how to contribute within a team. • Makes adjustments to meet the needs/ expectations of others (negotiation skills). • Select and justify solutions for specified problems.	• Presents self and communicates information to meet the needs of a typical audience. • Takes decisions in contexts with justifications. • Produces outputs subject to time/ resource constraints. • Reflects on own contribution to working within a team. • Generate new or alternative solutions to specified problems.

Annexe C

Personal, learning and thinking skills

A FRAMEWORK OF PERSONAL, LEARNING AND THINKING SKILLS 11-19 IN ENGLAND

The framework comprises six groups of skills that, together with the Functional Skills of English, mathematics and ICT, are essential to success in learning, life and work. In essence the framework captures the essential skills of: managing self; managing relationships with others; and managing own learning, performance and work. It is these skills that will enable young people to enter work and adult life confident and capable.



The titles of the six groups of skills are set out below.

For each group there is a focus statement that sums up the range of skills. This is followed by a set of outcome statements that are indicative of the skills, behaviours and personal qualities associated with each group.

Each group is distinctive and coherent. The groups are also inter-connected. Young people are likely to encounter skills from several groups in any one learning experience. For example an independent enquirer would set goals for their research with clear success criteria (reflective learner) and organise and manage their time and resources effectively to achieve these (self-manager). In order to acquire and develop fundamental concepts such as organising oneself, managing change, taking responsibility and perseverance, learners will need to apply skills from all six groups in a wide range of learning contexts 11-19.

PLTS performance indicator (suggested recording sheet)

Name:	Date:				
	Level of success 1 = low, 5 = high				
Independent enquirers					
Identify questions to answer and problems to resolve	1	2	3	4	5
Plan and carry out research, appreciating the consequences of decisions	1	2	3	4	5
Explore issues, events or problems from different perspectives	1	2	3	4	5
Analyse and evaluate information, judging its relevance and value	1	2	3	4	5
Consider the influence of circumstances, beliefs and feelings on decisions and events	1	2	3	4	5
Support conclusions, using reasoned arguments and evidence	1	2	3	4	5
Creative thinkers					
Generate ideas and explore possibilities	1	2	3	4	5
Ask questions to extend their thinking	1	2	3	4	5
Connect their own and others' ideas and experiences in inventive ways	1	2	3	4	5
Question their own and others' assumptions	1	2	3	4	5
Try out alternatives or new solutions and follow ideas through	1	2	3	4	5
Adapt ideas as circumstances change	1	2	3	4	5
Reflective learners					
Assess themselves and others, identifying opportunities and achievements	1	2	3	4	5
Set goals with success criteria for their development and work	1	2	3	4	5
Review progress, acting on the outcomes	1	2	3	4	5
Invite feedback and deal positively with praise, setbacks and criticism	1	2	3	4	5
Evaluate experiences and learning to inform future progress	1	2	3	4	5
Communicate their learning in relevant ways for different audiences	1	2	3	4	5

Team workers					
Collaborate with others to work towards common goals	1	2	3	4	5
Reach agreements, managing discussions to achieve results	1	2	3	4	5
Adapt behaviour to suit different roles and situations, including leadership roles	1	2	3	4	5
Show fairness and consideration to others	1	2	3	4	5
Take responsibility, showing confidence in themselves and their contribution	1	2	3	4	5
Provide constructive support and feedback to others	1	2	3	4	5
Self-managers					
Seek out challenges or new responsibilities and show flexibility when priorities change	1	2	3	4	5
Work towards goals, showing initiative, commitment and perseverance	1	2	3	4	5
Organise time and resources, prioritising actions	1	2	3	4	5
Anticipate, take and manage risks	1	2	3	4	5
Deal with competing pressures, including personal and work-related demands	1	2	3	4	5
Respond positively to change, seeking advice and support when needed	1	2	3	4	5
Manage their emotions, and build and maintain relationships.	1	2	3	4	5
Effective participators					
Discuss issues of concern, seeking resolution where needed	1	2	3	4	5
Present a persuasive case for action	1	2	3	4	5
Propose practical ways forward, breaking these down into manageable steps	1	2	3	4	5
Identify improvements that would benefit others as well as themselves	1	2	3	4	5
Try to influence others, negotiating and balancing diverse views to reach workable solutions	1	2	3	4	5
Act as an advocate for views and beliefs that may differ from their own	1	2	3	4	5

Note to learner: The circled number represents an indication of your PLTS performance so far.

Note to tutor: Indicate the level of success by circling the appropriate number during your feedback with the learner.

Summary of the PLTS coverage throughout the programme

Personal, learning and thinking skills	Unit								
	1	2	3	4	5	6	7	8	9
Independent enquirers	✓	✓	✓	✓	✓	✓	✓	✓	✓
Creative thinkers	✓	✓		✓	✓	✓		✓	✓
Reflective learners	✓		✓	✓	✓	✓	✓	✓	✓
Team workers	✓			✓	✓	✓		✓	
Self-managers	✓	✓	✓	✓	✓	✓	✓		✓
Effective participators	✓			✓	✓	✓		✓	
✓ – opportunities for development									

Personal, learning and thinking skills	Unit								
	10	11	12	13	14	15	16	17	18
Independent enquirers	✓	✓	✓	✓		✓	✓	✓	✓
Creative thinkers	✓	✓	✓	✓	✓	✓	✓	✓	✓
Reflective learners	✓	✓	✓	✓	✓	✓	✓	✓	✓
Team workers	✓	✓	✓	✓		✓	✓		
Self-managers	✓	✓	✓	✓	✓	✓	✓	✓	✓
Effective participators	✓	✓	✓	✓	✓	✓	✓	✓	✓
✓ – opportunities for development									

Personal, learning and thinking skills	Unit								
	19	20	21	22	23	24	25	26	27
Independent enquirers	✓		✓	✓	✓	✓	✓	✓	✓
Creative thinkers	✓		✓	✓	✓	✓	✓	✓	
Reflective learners	✓	✓	✓	✓	✓	✓		✓	
Team workers			✓	✓	✓			✓	✓
Self-managers	✓	✓	✓	✓	✓	✓	✓	✓	✓
Effective participators		✓	✓	✓	✓			✓	✓
✓ – opportunities for development									

Annexe D

Wider curriculum mapping

Study of the Pearson BTEC Level 2 Firsts in Land-based Technology gives learners opportunities to develop an understanding of spiritual, moral, ethical, social and cultural issues as well as an awareness of citizenship, environmental issues, European developments, health and safety considerations and equal opportunities issues.

The Pearson BTEC Level 2 Firsts in Land-based Technology makes a positive contribution to wider curricular areas as appropriate.

Moral, ethical, social and cultural issues

The qualification contributes to an understanding of, for example, moral and ethical issues involved in customer service; and social and cultural issues – for example issues around working with others in the workshop.

Environmental issues

Learners undertaking the Pearson BTEC Level 2 Firsts in Land-based Technology will have the opportunity to develop their understanding of environmental issues throughout the units.

European developments

Much of the content of the Pearson BTEC Level 2 Firsts in Land-based Technology applies throughout Europe even though delivery is in a UK context.

Health and safety considerations

The Pearson BTEC Level 2 Firsts in Land-based Technology are practically based and health and safety issues are encountered throughout the units.

Equal opportunities issues

Equal opportunities issues are implicit throughout the Pearson BTEC Level 2 Firsts in Land-based Technology.

Wider curriculum mapping

Level 2

	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8	Unit 9	Unit 10	Unit 11	Unit 12	Unit 13
Spiritual													
Moral and ethical													
Social and cultural							✓	✓					
Citizenship issues								✓					
Environmental issues													
European developments													
Health and safety considerations	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
Equal opportunities issues													

	Unit 14	Unit 15	Unit 16	Unit 17	Unit 18	Unit 19	Unit 20	Unit 21	Unit 22	Unit 23	Unit 24	Unit 25	Unit 26	Unit 27
Spiritual														
Moral and ethical											✓			
Social and cultural											✓	✓		
Citizenship issues											✓			
Environmental issues											✓			
European developments											✓			
Health and safety considerations	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Equal opportunities issues											✓			

Annexe E

National Occupational Standards/mapping with NVQs

The grid below maps the knowledge covered in the Pearson BTEC Level 2 Certificate, Extended Certificate and Diploma in Land-based Technology against the underpinning knowledge of the Level 2 NVQ in Land-based Engineering Operations.

KEY

✓ indicates that the Pearson BTEC Level 2 Firsts cover all of the underpinning knowledge of the NVQ unit

# indicates partial coverage of the NVQ unit

a blank space indicates no coverage of the underpinning knowledge

NVQs	Units																		
	1	2	3	4	5	6	7	8	9	11	12	13	14	15	16	17	18	19	20
Level 2 NVQ in Land-based Engineering Operations																			
LEO1	#																		
LEO2							#												
LEO3								#											
LEO4		#																	
LEO5			#																
LEO6				#															
LEO7						#													
LEO8					#														
LEO9									#										
LEO10																			
LEO11										#									
LEO12											#								
LEO13												#							
LEO14													#						
LEO15														#					
LEO16															#				
LEO17																#			
LEO18																	#		
LEO19																		#	
LEO20																			#

NVQs	21	22	23	24	25	26	27
Level 2 NVQ in Land-based Engineering Operations							
LEO22	#						
LEO24		#					
LEO26			#				

Annexe F

Unit mapping overview

BTEC First in Land-based Technology legacy (specification end date 31/08/2010)/new versions of the BTEC First qualifications in Land-based Technology (specification start date 01/09/2010) – the BTEC Level 2 Certificate in Land-based Technology, BTEC Level 2 Extended Certificate in Land-based Technology and the BTEC Level 2 Diploma in Land-based Technology.

Old units \ New units	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8	Unit 9	Unit 10	Unit 11	Unit 12	Unit 13	Unit 14	Unit 15	Unit 16	Unit 17	Unit 18	Unit 19	Unit 20	Unit 24	Unit 25	Unit 26	Unit 27
Unit 1	P						P														F			
Unit 2	P	P	P				P																	
Unit 3																						P		
Unit 4	P		P				P																F	
Unit 5	P		P				P																	F
Unit 6	P		P	P			P										P	P	P	P				
Unit 7						P																		
Unit 8	P		P		P		P			P	P	P	P	P	P	P								
Unit 9	P		P				P				P	P	P	P		P								
Unit 10	P		P				P								P	P								
Unit 11	P		P	P			P			P	P	P												
Unit 12	P		P				P				P													
Unit 13	P		P				P																	
Unit 14	P	P	P				P																	

KEY

P – Partial mapping (some topics from the old unit appear in the new unit)

F – Full mapping (topics in old unit match new unit exactly or almost exactly)

X – Full mapping + new (all the topics from the old unit appear in the new unit, but new unit also contains new topic(s))

Unit mapping in depth

BTEC First in Land-based Technology legacy (specification end date 31/08/2010)/new versions of the BTEC First qualifications in Land-based Technology (specification start date 01/09/2010) – the BTEC Level 2 Certificate in Land-based Technology, BTEC Level 2 Extended Certificate in Land-based Technology and the BTEC Level 2 Diploma in Land-based Technology.

New units		Old units		Mapping/comments (new topics in italics)
Number	**Name**	**Number**	**Name**	
Unit 1	Monitor and Maintain Health and Safety in a Land-based Engineering Work Area	–	Various	Knowledge and skills available in most old units.
Unit 2	Land-based Engineering Operations – Applying Mechanical Principles	**Unit 2** **Unit 14**	Introduction to the Principles of Land-based Machinery Vehicle Engine System Principles	Be able to apply mechanical engineering principles. Know how to apply mechanical engineering principles.
Unit 3	Land-based Engineering Operations – Understand How to Use, Service and maintain Tools and Equipment	–	Various	Knowledge and skills available in most old units.
Unit 4	Land-based Engineering Operations – Material Preparation, Shaping and Assembling	–	Various	Knowledge and skills available in most old units.
Unit 5	Land-based Engineering Operations – Carry out Servicing and Maintenance on Land-based Equipment	**Unit 8**	Vehicle Fault Diagnosis	Unit now consists of 2 Learning outcomes taking an in-depth look at land-based engineering operations. Be able to perform servicing and maintenance operations on land-based equipment. Know how to perform service and maintenance operations on land-based equipment.

New units		Old units		Mapping/comments (new topics in italics)
Number	**Name**	**Number**	**Name**	
Unit 6	Land-based Engineering Operations – Use Calculations	**Unit 7**	Vehicle Science and Applied Mathematics	Be able to use an electronic scientific calculator removed from unit. Unit focus on calculations for engineering principles. Be able to use calculations to support engineering principles. Know how to use calculations to support engineering principles.
Unit 7	Understand and Follow Organisational Procedures within Land-based Engineering Establishments	–	N/A	N/A
Unit 8	Provide Customer Care within Land-based Engineering Operations	–	N/A	N/A
Unit 9	Land-based Engineering Operations – Perform Thermal Joining and Cutting Processes	–	N/A	N/A
Unit 10	Land-based Engineering Operations – Service and Repair Cooling and Lubrication Systems	**Unit 8** **Unit 11**	Vehicle Fault Diagnosis Vehicle Component Removal and Refitting Techniques	Focus of unit on cooling and lubrication systems. Be able to perform service and repair operations on cooling and lubrication systems. Know the construction and function of cooling and lubrication systems and their components.
Unit 11	Land-based engineering Operations – Service and Repair Engines and Components	**Unit 8** **Unit 9** **Unit 11** **Unit 12**	Vehicle Fault Diagnosis Routine Vehicle Maintenance Vehicle Component Removal and Refitting Techniques Land-based Vehicle Layout and Operation of Vehicle Systems	Combines parts of a number of units to create one new unit.

New units		Old units		Mapping/comments (new topics in italics)
Number	**Name**	**Number**	**Name**	
Unit 12	Service and Repair Clutches, Fluid flywheels and/or Torque Convertors	**Unit 8** **Unit 9** **Unit 11**	Vehicle Fault Diagnosis Routine Vehicle Maintenance Vehicle Component Removal and Refitting Techniques	Combines parts of a number of units to create one new unit.
Unit 13	Service and Repair Mechanical Transmissions on Land-based Equipment	**Unit 8** **Unit 9**	Vehicle Fault Diagnosis Routine Vehicle Maintenance	Combines parts two units to create a new unit focusing on mechanical transmissions.
Unit 14	Service and Repair Braking Systems on Land-based Equipment	**Unit 8** **Unit 9**	Vehicle Fault Diagnosis Routine Vehicle Maintenance	Combines parts two units to create a new unit focusing on repair breaking systems.
Unit 15	Service and Repair Wheeled and Tracked Steering Systems on Land-based Equipment	**Unit 8** **Unit 10**	Vehicle Fault Diagnosis Vehicle Wheels, Tyres, Steering and Suspension Systems – Principles and Maintenance Systems	Combines parts of two units to create a new unit focusing on wheeled and tracked steering systems.
Unit 16	Service and Repair Tyres and Tracks on Land-based Equipment	**Unit 8** **Unit 9** **Unit 10**	Vehicle Fault Diagnosis Routine Vehicle Maintenance Vehicle Wheels, Tyres, Steering and Suspension Systems – Principles and Maintenance Systems	Combines parts of three units to create a new unit focusing on repairing tyres and tracks on land-based equipment.
Unit 17	Service and Repair Land-based Cutting and Mowing Equipment	**Unit 6**	Introduction to Specialist Land-based Machinery	Focus of unit specifically on repairing cutting and mowing equipment. Be able to service cutting or mowing equipment. Know the construction, function and operation of cutting and mowing equipment. Know how the performance of cutting/mowing equipment is affected by conditions.

New units		Old units		Mapping/comments (new topics in italics)
Number	**Name**	**Number**	**Name**	
Unit 18	Service and Repair Land-based Harvesting and Processing Equipment	**Unit 6**	Introduction to Specialist Land-based Machinery	Focus of unit specifically on repairing Land-based Harvesting and Processing Equipment. Be able to perform service and repair operations on harvesting or processing equipment. Know how to service and repair harvesting and processing equipment.
Unit 19	Service and Repair Land-based Soil Preparation and Plant Establishment Equipment	**Unit 6**	Introduction to Specialist Land-based Machinery	Focus of unit specifically on repairing Land-based Soil Preparation and Plant Establishment Equipment. Be able to service and set up soil preparation equipment. Know the construction, function and operation of soil preparation, cultivation and plant establishment equipment. Know the factors which affect equipment and performance.
Unit 20	Service and Repair Land-based Transport Handling and Storage Equipment	**Unit 6**	Introduction to Specialist Land-based Machinery	Focus of unit specifically on repairing Land-based Transport Handling and Storage Equipment. Be able to service and repair transport, handling and storage equipment. Know the construction, function and operation of transport, handling and storage equipment.
Unit 21	Service and Repair Electrical Systems on Land-based Equipment	–	N/A	N/A
Unit 22	Service and Repair Hydraulic Systems and Components on Land-based Equipment	–	N/A	N/A
Unit 23	Service and Repair Pneumatic Systems and Components for Land-based Equipment	–	N/A	N/A

New units		Old units		Mapping/comments (new topics in italics)
Number	**Name**	**Number**	**Name**	
Unit 24	Undertake Work-related Experience in the Land-based Industries	**Unit 1**	Work-related Experience in Land-based Technology	Focus on undertaking and documenting work experience. Purpose and structure of a business or organisation removed from unit.
Unit 25	Environmental and Land-based Business	**Unit 3**	Land-based Technology Industry and Organisations	Principles of sustainable development removed from unit. Know common business operations. Know how to carry out simple administrative tasks.
Unit 26	Introduction to Land-based Workshop Practice	**Unit 4**	Introduction to Land-based Workshop Practice	N/A
Unit 27	Introduction to Land-based Machinery Operations	**Unit 5**	Land-based Machinery Operation	Be able to maintain land-based equipment and machinery.

Annexe G

Examples of calculation of qualification grade above pass grade

Pearson will automatically calculate the qualification grade for your learners when your learner unit grades are submitted.

The generic examples below demonstrate how the qualification grade above pass is calculated using the following two tables which are also shown in the section earlier on in the specification *Calculation of the qualification grades above pass grade*.

Points available for credits achieved at different levels and unit grades

The table below shows the **number of points scored per credit** at the unit level and grade.

Unit level	Points per credit		
	Pass	Merit	Distinction
Level 1	3	4	5
Level 2	**5**	**6**	**7**
Level 3	7	8	9

Learners who achieve the correct number of points within the ranges shown in the 'qualification grade' table below will achieve the qualification merit or distinction or distinction* grade.

Qualification	Points range above pass grade		
	Merit	Distinction	Distinction*
BTEC Level 2 Certificate	85–94	95–99	100 and above
BTEC Level 2 Extended Certificate	170–189	190–199	200 and above
BTEC Level 2 Diploma	340–379	380–399	400 and above

Example 1

Achievement of pass qualification grade

A learner completing a 15-credit Pearson BTEC Level 2 Certificate achieves the credit required to gain a pass qualification grade and does not achieve the points to gain a merit grade.

	Level	Credit	Grade	Grade points	Points per unit = credit x grade
Unit 1	2	5	Pass	5	5 × 5 = 25
Unit 2	2	5	Pass	5	5 × 5 = 25
Unit 3	2	5	Merit	6	5 × 6 = 30
Qualification grade totals		**15**	**Pass**		**80**

Example 2

Achievement of merit qualification grade

A learner completing a 15-credit Pearson BTEC Level 2 Certificate achieves the points required to gain a merit qualification grade.

	Level	Credit	Grade	Grade points	Points per unit = credit x grade
Unit 1	2	5	Pass	5	5 × 5 = 25
Unit 2	2	5	Merit	6	5 × 6 = 30
Unit 3	2	5	Merit	6	5 × 6 = 30
Qualification grade totals		**15**	**Merit**		**85**

Example 3

Achievement of distinction qualification grade

A learner completing a 15-credit Pearson BTEC Level 2 Certificate achieves the points required to gain a distinction qualification grade.

	Level	Credit	Grade	Grade points	Points per unit = credit x grade
Unit 1	2	5	Merit	6	5 × 6 = 30
Unit 2	2	5	Merit	6	5 × 6 = 30
Unit 3	2	5	Distinction	7	5 × 7 = 35
Qualification grade totals		**15**	**Distinction**		**95**

Example 4

Achievement of merit qualification grade

A learner completing a 30-credit Pearson BTEC Level 2 Extended Certificate achieves the points required to gain a merit qualification grade.

	Level	Credit	Grade	Grade points	Points per unit = credit x grade
Unit 1	2	5	Merit	6	5 × 6 = 30
Unit 2	2	5	Pass	5	5 × 5 = 25
Unit 3	2	5	Distinction	7	5 × 7 = 35
Unit 6	2	10	Pass	5	10 × 5 = 50
Unit 8	3	5	Pass	7	5 × 7 = 35
Qualification grade totals		**30**	**Merit**		**175**

Example 5

Achievement of merit qualification grade

A learner completing a 60-credit Pearson BTEC Level 2 Diploma achieves the points required to gain a merit qualification grade.

	Level	Credit	Grade	Grade points	Points per unit = credit x grade
Unit 1	2	5	Merit	6	5 × 6 = 30
Unit 2	2	5	Pass	5	5 × 5 = 25
Unit 3	2	5	Distinction	7	5 × 7 = 35
Unit 6	2	10	Merit	6	10 × 6 = 60
Unit 9	1	5	Merit	4	5 × 4 = 20
Unit 10	2	10	Distinction	7	10 × 7 = 70
Unit 11	2	10	Merit	6	10 × 6 = 60
Unit 14	2	10	Merit	6	10 × 6 = 60
Qualification grade totals		**60**	**Merit**		**360**

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