



Level 3 Apprenticeship Delivery Scoping

**Guidance for Training Providers,
Assessment Organisations and
Employers**

Foreword

To assist training providers, assessment organisations and employers LE-TEC's land-based engineering apprenticeship working group have scoped the knowledge that is to be delivered within the Land-based Engineering Technician apprenticeship.

This information is to be used in conjunction with the land-based engineering apprenticeship standard ST0243 which details the knowledge, skills and behaviours that together prepare the apprentice to achieve occupational competency

The intention is to ensure that: -

- Training providers have greater clarity of the content required to be delivered.
- Assessment organisations base assessments on documented learning outcomes.
- Employers have a clearer picture of the knowledge gained during the apprenticeship process.

Employers may also find this information useful when mentoring and planning the development of apprentices in the workplace.

The ultimate outcome being to promote consistency in the interpretation of the occupational standard. This will help to ensure that apprentices learn and are assessed on the content required across the sector.

Whilst every effort has been made to ensure that the scoping encompasses the apprenticeship standard some adjustment may be required for advances in products, technology and changing working practices

Should you experience or observe any omissions please forward your comments to info@letec.co.uk

Land-based Engineering

Level 3 ST0243

Delivery Scoping

Module 1

Application of land-based technology

KSBs which are typically trained within this module

Knowledge	Skills	Behaviours
K9 / K16 / K18	S11 / S14 / S16 / S17 / S18 / S27 / S31	B1 / B3 / B4 / B5 / B7 / B8

- Knows the fundamentals of precision technology to include;
The principles and application of GPS
How the technology works together with correction levels/solutions
- Knows the components used in precision technology systems
- Has knowledge of data management between machine and office e.g.
Yield mapping
Quality mapping
Section control
Variable rate application
Targeted application
- Has knowledge of the construction and operation of:
GNSS technology
Auto guidance receivers
RTK DOP and signal strength
EGNOS Integration of the receiver with the machine's operation systems
- Knows telemetry and its capabilities
- Has knowledge of autonomous machinery and the technology and operating principles applied within them
- Knows the components used to make precision technology and electronic management systems work and understands their function
- Knows the limitations of the equipment and its impact on effective operation
- Knows the interconnectivity of electronic management systems and methods of communicating data

Module 2

CPD, mentoring and support.

KSBs which are typically trained within this module

Knowledge	Skills	Behaviours
K5 / K25	S20 / S30	B1 / B2 / B3 / B4 / B5 / B6 / B8 / B10

- Knows the meaning of CPD and why it is necessary
- Knows how to identify personal and the training needs of others
- Knows where to source CPD
- Knows the value of sharing knowledge with the team and how this aids the business
- Knows how to project professionalism when mentoring & supporting
- Knows the methods employed to mentor and encourage those developing land-based engineering KSBs
- Knows the fundamentals of instructional techniques
- Knows how to demonstrate practical skills to encourage understanding
- Knows how to encourage positive attitudes, learning and growth in confidence and ability
- Knows how to recognise areas of concern and the actions required to manage them
- Knows the methods used to establish understanding
- Can adapt communication to a level appropriate for those being mentored"

Module 3

Customer interaction, handover and installation

KSBs which are typically trained within this module

Knowledge	Skills	Behaviours
K23 / K24	S3 / S4 / S6 / S9 / S11 / S19 / S25 / S26 / S27	B1 / B2 / B3 / B4 / B5 / B6 / B7 / B8 / B9 / B10

- Knows the different types of customers and their contribution to the business e.g.
Key customers
Core customers
Occasional Customers

- Knows the impact of faulty workmanship / negligence
- Knows the liabilities that employees can impose upon their employer
- Knows how to act as an ambassador for the organisation and brand
- Knows the importance of first impressions
- Knows how to establish customer expectations
- Knows how to handle unrealistic expectations
- Knows how to establish and monitor customer satisfaction
- Knows how to handle conflicts and aggressive behaviour
- Knows how to document agreed actions / recommendations
- Knows the importance of keeping the customer updated
- Knows how to document actions relating to disputes and the importance of doing so
- Knows how to explain to a customer the conclusion of work using appropriate language
- Knows legislation relating to customer rights
- Knows the actions to take when confronted with complaints of not as described, unfit for purpose and not of merchantable quality
- Knows the importance of maintaining a positive company reputation
- Knows the impact of negative attitudes on customer confidence and the business
- Knows the cost to the business of losing a customer
- Knows how to project a positive confident impression
- Knows the importance of confidentiality and integrity to the customer and the business
- Knows the difference between empathy and sympathy
- Knows and embraces equality diversity and inclusion protocols
- Understands the under promise over deliver approach to meeting customer expectations

Handover and installation

- Knows the criteria to be considered when selecting a site to conduct handover and installation activities
- Knows the procedures used to handover and install machinery and equipment
- Knows the safe operating practices when operating machines and equipment
- Knows how to establish the levels of operator comprehension.
- Knows how to meet the legal requirements when handing over and installing machinery and equipment
- Knows and can explain the different types of warranty and their terms and conditions.
- Knows how to use the operator's handbook
- Can explain the service and maintenance requirements of machinery and equipment
- Knows the importance of follow up calls to establish customer satisfaction"

Module 4

Diagnostics, inspection, evaluation and root cause analysis

KSBs which are typically trained within this module

Knowledge	Skills	Behaviours
K6 / K7 / K8 / K9 / K10 / K20 /	S3 / S4 / S5 / S8 / S9 / S11 / S12 / S13 / S14 / S15	B1 / B2 / B3 / B4 / B5 / B6 / B7 / B8 / B9 / B10

- Knows how to apply a logical diagnostic procedure
- Knows the importance and how to maintain an audit trail and keeping accurate records
- Knows the methods used to diagnose intermittent faults
- Can determine the root cause of a failure e.g.
 - Overload*
 - Overheat*
 - Lack of lubrication*
 - Lack of maintenance*
 - Incorrect operation / application*
 - Short circuit*
 - Manufacturing defect*
 - Contamination*
 - Cavitation / open circuit*
 - Unauthorised modification*
 - Forced breakage*
 - Sabotage*
- Knows how to gather and benchmark data and the appropriate tooling / equipment to give the accuracy required
- Knows how to verify test data
- Knows how to verify system and component and sub assembly performance
- Knows the factors that influence system, component and sub assembly performance
- Knows how to apply a range of diagnostic tooling and interpret the results
- Can apply a range of techniques to confirm a fault e.g.
 - Isolation*
 - Substitution*
 - Comparison*
 - Observation*
 - Pressure testing*
 - Flow testing*
 - Calibration*
 - Electrical testing*

Power testing
Field operation
Simulation

- Knows how to perform a multi-step diagnosis
- Knows the importance of listening to the customer when gathering information
- Knows the difference between open and closed questioning
- Can establishing the customer's expectations
- Knows how to separate opinion from fact
- Knows how to evaluate service and warranty histories
- Knows when fuel and oil sampling is required
- Knows how to plan a visit to give best chance of first-time fix
- Knows how to develop a test routine to eliminate potential root causes
- Can determine the difference between the cause and effect of a fault
- Knows how to gather the information required to create a simulation
- Knows how to prepare prime movers, machinery and equipment to recreate the incident causing concern
- Knows the factors to consider when producing like for like simulation
- Knows the influence of operating techniques, machine settings and operating conditions on machine performance
- Can determine the difference between an operational characteristic and a fault

Inspection and evaluation

- Knows how to conduct a machinery evaluation inspection for e.g.

Repair
Accidental damage assessment
Out of season service
Operational viability
Compilation of condition report
Sales department valuation

- Understands the implication of down time of machinery to the customer
- Knows how to consider the economic implications of repairs
- Knows how to compile repair options for the customer's information
- Knows how to consider the economic implications of repairs
- Can determine the difference between a safety critical and non-safety critical faults
- Knows when it is unsafe to continue operation of a machine
- Knows the actions to take when confronted with a machine that is unsafe to continue in use
- Knows the difference between an estimate and quotation
- Knows the warranty terms and conditions of machines
- Can determine whether the repair is chargeable or covered by the terms of warranty

- Knows the implications of using spurious non-genuine parts
- Knows the implications of making unauthorised, unapproved modifications /repairs
- Knows how to upsell parts
- Can determine serviceability of parts
- Knows how service, maintenance and repairs impact on performance, operating costs and retail values

Root cause analysis

- Knows the how to formulate and use a 5 W1H cause and effect analysis
- Knows how to determine e.g.
 - Manufacturing defect*
 - Material defect*
 - Operator abuse*
 - Lack of lubrication*
 - Incorrect lubricant*
 - Incorrect application*
 - Overload*
 - Inadequate maintenance*
 - Wear and tear*
 - Sabotage*
 - Shock loading*
 - Forced breakage*
 - Mis alignment and imbalance*
 - Unauthorised modification*
 - Sabotage*
 - Contamination*
 - Cavitation*
 - Faulty repair*
 - Poor filtration*
 - Water ingress*
 - Incorrect / sub-standard / faulty parts*

Module 5

Environmental & sustainability

KSBs which are typically trained within this module

Knowledge	Skill	Behaviours
K4	S28 / S29 / S31	B1 / B3 / B4 / B5 / B7 / B9

- Knows how to determine environmentally friendly products e.g.
 - Bio degradable*

Recyclable
Re-manufactured
Extended life cycle

- Knows operating techniques and settings that reduce fuel consumption and emissions
- Knows measures to be taken to reduce ground pressure and compaction
- Knows the factors influencing machinery and equipment work rate and the measures to take to achieve optimum work rate
- Knows how to calibrate machinery to give optimum accuracy
- Knows the work practices required to eliminate un-necessary waste
- Knows the precautions to be taken to prevent the spread of diseases when visiting customers sites
- Knows the importance of cleanliness and hygiene in workplace activities
- Knows precautions necessary to avoid contamination of the food chain when working on customer sites
- Knows the control measures to protect against cross contamination of crops
- Knows the control measures to avoid contamination when working in public spaces
- Knows the measures to be employed when handling irritants, toxic, and corrosive products

Module 6

Health and Safety

KSBs which are typically trained within this module

Knowledge	Skills	Behaviours
K1 / K2 / K3	S2 / S28 / S29	B1 / B2 / B3 / B4 / B5 / B6 / B7 / B8

- Knows how to complete a risk assessment
- Knows the spectrum of hazards encountered in the land-based sector e.g.

Bio security
Stored energy
Livestock
Diseases / infections
Chemicals
Toxic working environments
Lone working
Working at height
Workplace risks
Suffocation

- Knows how to identify a hazard in the workplace
- Knows how to identify the risk associated with the workplace hazard
- Knows the measures required to mitigate a workplace risk
- Knows how to document the risk assessment process
- Knows how to monitor and review the risk.
- Knows the difference between static and dynamic risk assessment
- Knows the customers H&S obligations when working on their site.
- Knows own responsibilities for H&S when working on customer's sites.
- Knows H&S responsibilities when working on public highways or public places
- Knows the actions to take in an emergency when working on site
- Knows how to manage the risks of working with subordinates
- Knows how to administer emergency first aid
- Knows the location and application of first aid equipment
- Knows how the risk of fire is controlled
- Knows evacuation procedures
- Knows the fire procedures when working on site

Module 7

Hydraulic, pneumatic repairs and repair electrical and electronic systems

KSBs which are typically trained within this module

Knowledge	Skills	Behaviours
K13 / K15 / K17 / K19	S9 / S10 / S14 / S21 / S32	B1 / B3 / B4 / B7 / B8 / B9

Hydraulic, pneumatic repairs

- Knows the construction, operation and repair procedures of advanced hydraulic and pneumatic systems and their components
- Knows how to identify advanced hydraulic system components
- Knows the operating principles of advanced hydraulic systems and their components
- Knows how to establish the serviceability of hydraulic and pneumatic components
- Knows how complex hydraulic systems interact with one another, e.g.
 - High- and low-pressure circuits*
 - Pressure differentials*
 - Variable flow rates*
- Knows the effects that contamination and heat have on hydraulic and pneumatic circuits and their components
- Knows how to remove contamination from hydraulic and pneumatic circuits

- Knows how to rectify excessive heat in hydraulic and pneumatic systems and how heat is dissipated
- Understands how to rectify cavitation in hydraulic circuits
- Knows how flow rates and pressure variances are created
- Knows what influences pressure and flow in hydraulic and pneumatic circuits
- Knows how to rectify sticking hydraulic valves
- Knows how draft sensing systems work
- Knows how anti pitch systems operate
- Knows what causes resonance in hydraulic circuits and how to cure it

Repair electrical and electronic systems

- Knows the methods and methodology of repairing complex electrical and electronic systems
- Knows how to test advanced electronic and electrical components
- Knows network and communication systems
- Knows CAN bus and ISO bus systems
- Can determine input and output measurement points
- Knows how to use diagnostic equipment to interact with network systems
- Knows when to delete stored data and the consequences of losing data
- Knows how to interpret fault register information
- Knows how to determine if a fault is electronic, electrical, hydraulic or mechanical
- Knows the capabilities and limitations of diagnostic platforms
- Knows how to verify the integrity of test equipment
- Knows the procedures for repairing battery powered, electric motors and high voltage machinery and equipment
- Knows ECU operations and control logic
- Knows the cause, effect and rectification of electronic interference
- Knows how to screen components against interference
- Knows the methods used to safeguard electrical components and connection integrity
- Can determine the appropriate methods for repair wiring harnesses.
- Knows how to safeguard electrical components against corrosion and water ingress
- Understands the need to ensure that software in diagnostic platforms and ECU's is current
- Knows to recording current software levels and configs before download

Module 8

Interpret and apply data, data management and technical reporting

KSBs which are typically trained within this module

Knowledge	Skills	Behaviours
K12 / K18	S1 / S3 / S6 / S12 / S22 / S24 / S27 / S31	B2 / B3 / B4 / B6 / B8

Interpret and apply data

- Knows how to locate, interpret and follow manufacturer's instructions.
- Can determine from a transmission schematic drawing:
 - Transmission components*
 - When components are engaged*
 - When components are rotating and at rest*
 - The direction of rotation*
- Knows how to interpret hydraulic, pneumatic and electrical / electronic schematics and can determine: -
 - System components*
 - Can identify circuits*
 - Can determine the relationship and influence that components have upon one another*
- Knows how to analyse and digital data
- Knows how to benchmark and compare data
- Knows the principles of analysing oil sample results
- Knows how to develop a test plan
- Knows Pascal's law and Ohm's Law
- Can use reference data to establish serviceability of parts

Data Management

- Knows the GDPR regulations. Their role in the protection of customer data.
 - Knows the different data governance roles e.g.
 - Data ownership*
 - Data Stewardship*
 - Data Custodianship*
 - Knows the legal implications and limitations of data sharing
 - Knows what big data is in relationship to land-based activities
 - Knows how big data is captured, stored and utilised
 - Knows the purpose of software licences
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Technical reporting

- Knows the significance of recording information, photographic images and written statements their use and implications
- Knows the purposes of written reports e.g.
 - Incident reports*
 - Machinery evaluation reports*
 - Technical disputes*
 - Repair recommendations*
 - Determining intermittent faults*
 - Recording information to support emerging technical trends*
- Knows how to report substantiated fact that will withstand scrutiny
- Knows the difference between opinion and fact
- Knows how to record accurate verified data and information
- Knows the range of data and information to be recorded and why it is important
- Knows how to pass information to the team
- Knows how to tailor the report to suit the audience
- Knows how to store and archive reports

Module 9

Machinery setting and field operations

KSBs which are typically trained within this module

Knowledge	Skills	Behaviours
K9 / K20 / K21 / K22	S13 / S14 / S16 / S17 / S18 / S24 /	B1 / B2 / B3 / B4 / B5 / B6 / B7 / B8 / B9 / B10

- Knows of the land-based practices conducted by their employer's customer base.
- Knows the principles of land-based operations: -
 - Cultivation / site preparation*
 - Crop establishment and care*
 - Lifting / separating / cleaning*
 - Cutting / harvesting and processing*
 - Application & placement*
 - Transportation*
- Knows the agricultural seasons and how agricultural machinery requirements interact with these
- Knows how the weather impacts on land-based machinery & equipment operational performance

- Knows how crop conditions affect field-based performance e.g.
Over ripe / under ripe
Light / Heavy / Laid crops
Damp / brittle
- Knows how soil types and conditions affect tractive effort, output performance and wear characteristics
- Knows how the presentation of the crop to the machine affects performance
- Knows the effect of uneven material flow through land-based machinery and equipment
- Knows how working on inclined surfaces impacts on machine performance and stability
- Knows the causes of crop damage and loss
- Knows how the variations of crop types and variety's effects machinery performance and output
- Knows soil structure and how it becomes damaged.
- Knows how to optimise machinery & equipment performance
- Knows how to establish if a machine is working outside its design capability
- Knows how to field set land-based machinery & equipment supplied & used in the employer's area of influence
- Knows how poor operational techniques can adversely affect field performance
- Knows the factors that influence performance in the field e.g.
Tyre pressures
Tyre size
Wheel slip
Ballast
Overload / underload
Overspeed / under speed, PTO, engine, forward speed
Working depths / heights
Calibration
- Knows how to operate land-based machines and equipment utilised within the employer's area of influence
- Knows how prime-movers, machinery and equipment performance levels
- Knows how to source and interpret manufacturers performance figures
- Knows the methods used to validate machinery and equipment performance
- Knows how to set up machines to give optimum performance
- Knows the factors that influence optimum performance e.g.
Crop condition
Crop types
Weather conditions
Soil and surface types
Maintenance
Operating settings & techniques
- Can determine the customer's expectations regarding optimum performance and set machines to achieve e.g.

Optimum economy
Optimum accuracy
Optimum work rate
Optimum work sample

- Knows the actions to take to achieve the customer's expectations e.g.

Crop loss
Crop damage
Work rate
Fuel consumption
Traction
Speed
Quality of cut
Deceleration / braking
Power output

- Knows how to establish like for like performance comparisons
- Knows how to recognise overload and application beyond design parameters
- Knows how to establish the customer's commercial priorities
- Knows the limit of authority when dealing with customers and their machines
- Knows precision farming methods
- The prime-movers machinery and equipment types and their contribution to optimum operational efficiency
- The specification of machines required to achieve optimum performance
- Knows whole life operating costs, regional variations, soil types crop types and the terrain in the businesses area of influence
- Knows how to determine whether machine combinations and prime movers are:

Compatible
Mismatched
Unstable
Overloaded
Dangerous
Beyond design capabilities

- Knows how to establish prime mover carrying capacities
- Knows the meaning of maximum /gross all up weight
- Knows how to determine e.g.

Tyre carrying capacity
Inflation pressures
Ground pressure
Tyre slip / rim slip
Inter axle ratios and tyre combinations

- Knows the methods used to achieve e.g.

Maximum traction
Machine stability
Low ground pressure

Maximum lift capacity

- Knows the principles of weight transference
- Knows how to make ISO bus connections between prime movers and machines
- Knows how to set lift linkage geometry to achieve maximum mechanical advantage
- Knows how to use calculations to determine e.g.

Inter axle ratios

Hydraulic outputs

PTO & forward speeds

Areas, capacities,

- Knows how to align machinery, drive shafts, wheel track settings and adjust headland management systems

Module 10

Complex Repairs of prime movers, machinery and equipment

KSBs which are typically trained within this module

Knowledge	Skills	Behaviours
K11 / K13 / K14	S7 / S8 / S9 / S10 / S21	B1 / B2 / B3 / B4 / B5 / B6 / B7 / B9

Repair prime movers

- Knows and can apply the advanced knowledge required to repair complex prime movers their component parts and systems
- Knows how to carry out complex repairs to engines and their components
- Knows how to set up engines and their components and component parts
- Knows how to carry out complex repairs to CVT IVT and hydrostatic transmissions and their associated drive lines
- Knows how to set up complex transmissions and their components and component parts e.g.

Front and rear axles (fixed and suspended)

Drop boxes / Reduction boxes / transfer boxes

Tracks and under carriages

Drive shafts

Clutches, torque limiting devices, fluid flywheels, electro magnetic

PTO

- Knows how to determine the serviceability and wear of parts
- Knows how to carry out complex repairs to pneumatic systems

- Knows how to carry out advanced repairs to e.g.: -
Air conditioning systems
Cooling systems
Lubricating systems
Fuel systems
Suspension system
Steering systems
Braking systems
Clutch and fluid couplings
- Knows the F gas regulations
- Knows mechatronics and how to test and repair mechatronic systems & components
- Knows how to apply the precision measuring equipment and instruments in complex repairs
- Knows the tooling used in complex repairs
- Knows when it is acceptable to use service exchange and spurious replacement components.
- Know how to apply upgrades, supersessions and modifications

Repair machinery and equipment

- Knows the range of machinery used by the employer's land-based customers
- Knows the methods used to make advanced repairs to the machinery and equipment used by the employer's customer base. E.g.
Harvesting and processing machinery
Cutting conditioning machinery
Placement and application machinery
Material handling equipment
Cultivation and preparation machinery
Autonomous machinery
Leisure and amenity machinery
- Knows the repair action sequences
- Knows when and how to disable the machine
- Knows how to determine parts to be replaced or repaired
- Knows the benefits of using genuine replacement parts