Unit 2: Communications for Engineering Technicians

Unit code: M/600/0251

QCF Level 3: BTEC National

Credit value: 10

Guided learning hours: 60

Aim and purpose

This unit gives learners the opportunity to apply the wide range of communication methods used within engineering. These methods include visual representation, verbal and written skills, obtaining and using information and the use of information and communications technology.

Unit introduction

The ability to communicate effectively is an essential skill in all aspects of life. The usual methods of communication – speaking, reading and writing – receive considerable attention and learning time during all stages of education. For engineers, these skills are of no less importance, but there are further complications with the need to also convey technical information such as scale, perspective and standards of working.

The drive towards greater use of information and communication technology (ICT) is also very much a part of modern life and this again is certainly the case for engineering. The engineering industry is in the front line of working towards paperless communication methods, for example the electronic transfer of data from the concept designer straight to the point of manufacture.

This unit will provide a foundation for employment in a wide range of engineering disciplines (for example manufacturing, maintenance, communications technology) in addition to providing a foundation for further study. It aims to develop learners' ability to communicate using a diverse range of methods. These include visual methods, such as drawing and sketching, and computer-based methods, such as two-dimensional (2D) computer aided drawing (CAD) and graphical illustration packages. It will also develop learners' ability to write and speak within a framework of technology-based activities using relevant and accurate technical language appropriate to the task and the audience.

The unit will also introduce learners to a variety of skills and techniques to obtain and use information, for example the presentation of technical reports, business and technical data and the use of visual aids for presentations. Learners will also consider how to make best use of ICT within technological settings that are relevant to their programme of study or area of employment.

Learning outcomes

On completion of this unit a learner should:

1 Be able to interpret and use engineering sketches/circuit/network diagrams to communicate technical information

2 Be able to use verbal and written communication skills in engineering settings

3 Be able to obtain and use engineering information

4 Be able to use information and communication technology (ICT) to present information in engineering settings.

Unit content

1 Be able to interpret and use engineering sketches/circuit/network diagrams to communicate technical information

Interpret: obtain information and describe features eg component features, dimensions and tolerances, surface finish; identify manufacturing/assembly/process instructions eg cutting lists, assembly arrangements, plant/process layout or operating procedures, electrical/electronic/communication circuit requirements; graphical information used to aid understanding of written or verbal communication eg illustrations, technical diagrams, sketches

Engineering sketches/circuit/network diagrams: freehand sketches of engineering arrangements using 2D and 3D techniques eg components, engineering plant or equipment layout, designs or installations; electrical/electronic circuit diagrams, system/network diagrams; use of common drawing/circuit/network diagram conventions and standards eg layout and presentation, line types, hatching, dimensions and tolerances, surface finish, symbols, parts lists, circuit/component symbols, use of appropriate standards (British (BSI), International (ISO))

2 Be able to use verbal and written communication skills in engineering settings

Written work: note taking eg lists, mind mapping/flow diagrams; writing style eg business letter, memo writing, report styles and format, email, fax; proofreading and amending text; use of diary/logbook for planning and prioritising work schedules; graphical presentation techniques eg use of graphs, charts and diagrams

Verbal methods: speaking eg with peers, supervisors, use of appropriate technical language, tone and manner; listening eg use of paraphrasing and note taking to clarify meaning; impact and use of body language in verbal communication

3 Be able to obtain and use engineering information

Information sources: non-computer-based sources eg books, technical reports, institute and trade journals, data sheets and test/experimental results data, manufacturers' catalogues; computer-based sources eg inter/intranet, CD ROM-based information (manuals, data, analytical software, manufacturers' catalogues), spreadsheets, databases

Use of information: eg for the solution of engineering problems, for product/service/topic research, gathering data or material to support own work, checking validity of own work/findings

4 Be able to use information and communication technology (ICT) to present information in engineering settings

Software packages: word processing; drawing eg 2D CAD, graphics package; data handling and processing eg database, spreadsheet, presentation package, simulation package such as electrical/electronic circuits, plant/process systems; communication eg email, fax, inter/intranet, video conferencing, optical and speech recognition system

Hardware devices: computer system eg personal computer, network, plant/process control system; input/output devices eg keyboard, scanner, optical/speech recognition device, printer, plotter

Present information: report that includes written and technical data eg letters, memos, technical product/service specification, fax/email, tabulated test data, graphical data; visual presentation eg overhead transparencies, charts, computer-based presentations (PowerPoint)

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.

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 an engineering drawing/circuit/network diagram	**M1** evaluate a written communication method and identify ways in which it could be improved	**D1** justify their choice of a specific communication method and the reasons for not using a possible alternative
P2 produce an engineering sketch/circuit/network diagram [CT1]	**M2** review the information sources obtained to solve an engineering task and explain why some sources have been used but others rejected	**D2** evaluate the use of an ICT presentation method and identify an alternative approach.
P3 use appropriate standards, symbols and conventions in an engineering sketch/circuit/ network diagram	**M3** evaluate the effectiveness of an ICT software package and its tools for the preparation and presentation of information.	
P4 communicate information effectively in written work		
P5 communicate information effectively using verbal methods		
P6 use appropriate information sources to solve an engineering task [IE4]		
P7 use appropriate ICT software packages and hardware devices to present information.		

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

Delivering this unit at an early stage of the learning programme would help learners communicate effectively in the other units of the programme. The unit assumes that the underpinning skills (for example ability to produce sketches/circuit/network diagram, ability to use ICT) are in place and focuses on developing these skills to communicate information.

Learners should be given opportunities to develop their communication skills and enable them to add to the breadth and depth of the their experience. In particular, emphasis should be placed on the development of 'hands-on' skills. Formative learning activities (either stand alone or, ideally, activities integrated with other units in the programme) could be constructed around the following typical engineering tasks:

- reading and using an engineering sketches/circuit/network diagrams to obtain information/understand a task
- producing freehand sketches (2D and 3D) of engineering arrangements, for example a component, circuit, layout arrangement
- preparing a circuit/network diagram template (to include standard drawing/circuit/network information)
- using a 2D ICT-based software package to produce a detailed engineering component drawing or circuit/layout/network diagram (using the template produced previously)
- delivering a brief presentation (of eight minutes or more) using appropriate visual aids and responding appropriately to questions
- conducting a brief interview (lasting no longer than 15 minutes) with another learner and taking notes to summarise the outcome
- taking part in a group discussion to identify or share technical information within a set task
- preparing a letter to an engineering supplier requesting modifications to an engineered component
- preparing a brief technical report concerning a design modification
- producing a data sheet for a simple engineered product or service
- using information sources (literature, CD ROM and websites) to obtain data relating to an engineered product and summarise this in the form of a brief technical report
- sending and receiving email correspondence to convey engineering ideas and technical data.

The teaching and learning strategies used to deliver the unit must be set within an engineering context. There is a strong case for the delivery of this unit to be integrated, as far as possible, with other units in the programme rather than being taught as a stand-alone unit. This would ensure that the skills required (producing drawings and documents, finding, using and presenting information, using ICT) are developed as they are needed. By not adopting an integrated approach there is a risk that it could lead to a loss of relevance and the need for learners to undertake unnecessary learning development and assessment activities.

Note that the use of 'eg' in the content is to give an indication and illustration of the breadth and depth of the area or topic. As such, not all content that follows an 'eg' needs to be taught or assessed.

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 demonstrates one way in planning the delivery and assessment of this unit.

Topic and suggested assignments/activities and/assessment
Whole-class teaching: • introduction to unit, scheme of work and methods of assessment • introduction to engineering sketches/circuit diagrams/network diagrams. *Group activities*: • work with engineering components to gather information and describe features.
Individual learner activity: • preparation of engineering sketches/circuit/network diagrams using common conventions and standards • explore manufacturing/assembly/process instructions including graphical information.
Preparation for and carry out **Assignment 1: Communicating Technical Information** (P1, P2 and P3).
Whole-class teaching: • introduction to verbal and written communication skills • activities to explore note taking, writing styles and methods. *Group activities*: • explore mind mapping and the use of flow diagrams to model engineering systems and for data collection.
Whole-class teaching: • explain and demonstrate use of graphs, charts diagrams (link to LO4 – use of ICT). *Group activities*: • case study work to investigate the use of graphical presentation techniques in engineering settings • preparation of graphs, charts and diagrams based on engineering data.
Whole-class teaching: • introduction to planning and prioritising work schedules. *Individual learner activities*: • activities to maintain diary/log of events.
Whole-class teaching: • explain importance of quality and accuracy of written work – proofreading and amending text. *Group activities*: • practise proofreading and amending documents.

Topic and suggested assignments/activities and/assessment
Whole-class teaching: • introduction to verbal communication methods • whole-class teaching on the critical aspects of speaking, listening and impact of body language. *Group activities*: • explore use of language, listening skills and body language.
Preparation for and carry out **Assignment 2: Writing, Talking and Listening** (P4 and P5).
Whole-class teaching: • introduction to non-computer-based and computer-based engineering information and sources. *Group activities*: • case study work to research relevant engineering information using both non-computer-based and computer-based engineering information and sources.
Preparation for and carry out **Assignment 3: Finding and Using Information** (P6).
Whole-class teaching: • computer systems in engineering and input/output devices.
Whole-class teaching: • explain and demonstrate word-processing software, drawing packages, data handling and processing software and communications software.
Preparation for and carry out **Assignment 4: The Use of ICT in Engineering** (P7).
Feedback, unit evaluation and close.

Assessment

Unit 3: Engineering Project could provide an excellent vehicle for an integrated approach to the assessment of this unit. The project work undertaken will require learners to use communication skills to interpret information, prepare sketches and drawings, give presentations, develop and use data sheets, produce technical reports and letters etc. Other units within the programme could also be used to provide effective and relevant learning and formative or even summative assessment opportunities. However, using *Unit 3: Engineering Project* for assessment has the advantage of providing a structured focus for the work and a coherent source of relevant evidence.

To achieve a pass, learners should be able to interpret (P1) and produce (P2) engineering sketches (2D and 3D)/circuit/network diagrams and sketches. This will need to be at a level sufficient for them to understand and communicate technical information. This must include identification and use of appropriate standards, symbols and conventions (P3). The use of 'sketches/circuit/network diagrams' in the criteria P1 and P2 is intended to indicate a choice that will depend on the focus of the learning programme in which this unit is being delivered. For example, a learner on a mechanical programme is likely to choose to interpret and produce sketches of components, whilst a learner studying electrical/electronics is more likely to interpret and produce circuit diagrams.

A single assessment activity could be used to link and capture evidence for the first three pass criteria (P1, P2 and P3). The activity would need to ensure that learners had an opportunity to obtain information, describe features, identify instructions and make use of graphical information (P1). For example, the task could be to work with written operating instructions that include supporting diagrams and sketches (2D and 3D). From the initial investigation, the activity could then require learners to produce their own drawing and sketches (P2). The criterion P3 would need to be applied to both the interpretation (identify) and the production (use) of their working document.

Learners should also be able to use written (P4) and verbal (P5) communication methods. The written work must include evidence of note taking, the ability to use a specific writing style, proofread and amend text, use a diary/logbook and use graphical presentation techniques. It might be that all of these will not necessarily occur in a single task/activity. If not, it would be acceptable for a number of pieces of assessment evidence to be brought together to meet this criterion.

The use of verbal methods (P5) will require learners to demonstrate speaking and listening skills and an understanding of the impact and use of appropriate body language. The evidence for this should come from one task/activity so that all three aspects are being dealt with at the same time. This could be a meeting with either peers and/or a supervisor, or could come from a presentation delivered by the learner to a group. It would be important to ensure that the learner had to take questions from the group to enable the tutor to capture evidence of their ability to listen. The evidence for this criterion is likely to be a tutor observation record or witness statement.

P6 can be assessed using any structured activity that requires learners to identify and use appropriate information sources to solve an engineering task. It is essential that the information comes from both computer-based and non-computer-based sources. The evidence for this criterion could be as simple as suitably referenced work (a bibliography would not be sufficient). However, it would be preferable to have a record of the original source and a hard copy, annotated to show the information identified and used for the task (or at least an example of this process).

The final pass criterion (P7), could also be assessed using any relevant tasks that require learners to select and use appropriate ICT software packages and hardware devices to present information. It is essential that the task or tasks chosen for this criterion provide learners with opportunities to use appropriate software to cover all the ICT applications listed in the content, ie there must be evidence of learners' selection and use of ICT for word processing, drawing, data handling and communication (such as email). The requirement for hardware devices is limited to the choice and use of a computer system and relevant input/output devices that would be needed for the task carried out. It is expected that the range of information presented using ICT will include a technical report and visual presentation material, for example overhead transparencies, chart, computer-based presentation (PowerPoint).

As already suggested, *Unit 3: Engineering Project* could provide an excellent vehicle for assessment of this unit since it could provide a central focus and therefore a source of coherent assessment evidence. Any alternatives should try to establish a similar coherence and avoid fragmentation of the pass criteria wherever possible.

To achieve a merit, learners should be able to evaluate a written communication method and identify ways in which it could be improved (M1). This could be learners' own written work or the written work of someone else. The important aspect of this criterion is the learners' ability to use their skills and understanding of communication methods to appraise the work and identify enhancements.

In addition, learners will need to be able to review the information sources obtained to solve an engineering task and explain why some sources have been used but others rejected (M2). This criterion is about reflection and the need to carefully consider, measure and express the value (or not) of other people's work as a source of information. Learners need to have identified both non-computer-based and computer-based information sources for P6 and it is this material that they should be reviewing for M2. Achievement might well be implicit if the task undertaken for P6 has reached a satisfactory solution. However, the expected evidence for this criterion would be a copy of the source material used, suitably annotated to explain its value or why it has been rejected.

Finally, merit criterion M3 requires learners to evaluate an ICT software package and its tools for the preparation and presentation of information. This criterion requires learners to have taken time to reflect on their work and consider the use of software tools available (for example good/consistent use of font size/colour, alignment of text, positioning on the page, use of automated labels, legends and titles for graphs).

To achieve a distinction, learners should be able to justify their choice of a specific communication method and the reasons for not using a possible alternative (D1). This could be any communication method that the learner has chosen to use (for example drawings, written, verbal). It does require learners to have considered at least one possible alternative during the initial selection of the method used. Learners will therefore need to be briefed to collect evidence of this selection process, which might otherwise be lost or ignored (for example initial outlines/drafts, notes of any consultation with others on method to be employed). The key issue for this criterion is learners' ability to reflect and evaluate. At pass level, learners will have shown their ability to communicate information effectively and, at merit, to be critical of the content of their own or other people's work. At distinction level, they should be critical of the choice of communication method used.

D2 requires learners to evaluate their use of an ICT presentation method and identify an alternative approach. This criterion is about the method of presentation and not the method of communication. It also has a direct link with related pass (P7) and merit (M3) criteria. At pass, learners needed to be able to use ICT to present information and, at merit, to evaluate the effectiveness of the presentation. For D2, learners should consider the overall approach taken. For example, could a word-processed technical report have been presented using a computer-based presentation package, such as PowerPoint, including automated routines and animated graphics or video clips? The evidence for this is likely to be a written evaluation. A rough outline illustrating their identified alternative approach or even a small section of the original reworked using an alternative approach could be used to support the written evaluation.

Programme of suggested assignments

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

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2 and P3	Communicating Technical Information	Explore a product/circuit/ network and interpret and prepare appropriate engineering sketches/circuit/ network diagrams.	A written report providing the learner's interpretation of the information and features found. Engineering sketches/circuit/ network diagram prepared by the learner.
P4 and P5	Writing, Talking and Listening	A series of tasks focused on written work and verbal communication methods.	A portfolio of evidence containing examples of note taking, writing styles, use of diary/logbook and use of graphical presentation techniques. Tutor observation of speaking, listening and use of body language.
P6	Finding and Using Information	Solving an engineering problem through research and use of information.	A written report with suitable reference to the range of sources found and used including non-computer-based and computer-based resources.
P7	The Use of ICT in Engineering	Presenting engineering information using ICT	A written report on the selection and use of computer hardware devices. A portfolio of evidence of the use of word processing, drawing, data handling and communication software packages to present engineering information.

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

This unit forms part of the BTEC Engineering sector suite. This unit has particular links with the following unit titles in the Engineering suite:

Level 1	Level 2	Level 3
	Interpreting and Using Engineering Information	All BTEC Level 3 Engineering units

The unit also covers some of the knowledge and understanding associated with several of the SEMTA Level 3 National Occupational Standards, particularly:

- Level 3 NVQ in Business Improvement Techniques – Unit 2: Contributing to Effective Team Working
- Level 3 NVQ in Mechanical Manufacture – Unit 2: Using and Interpreting Engineering Drawings and Documents
- Level 3 NVQ in Engineering Maintenance – Unit 2: Using Engineering Drawings and Documents in Maintenance Activities.

Essential resources

Access to information and communication technology resources (including the internet) is essential for the delivery of this unit, as is a well-stocked source of reference material.

Learners should be provided with a variety of sample written materials (letters, memos, technical reports, data sheets, catalogues) and sketches. Centres will need to provide access to appropriate presentation and graphics software (for example Microsoft PowerPoint, Visio), spreadsheet/database software (for example Microsoft Excel/Access) and computer hardware (for example scanners, printers, optical character recognition and speech recognition software, barcode readers).

Employer engagement and vocational contexts

Much of the work for this unit can be set in the context of learners' work placements or be based on case studies of local employers. All the learning outcomes rely on the application of communication methods within engineering settings. Engineering companies with research and design facilities will be well suited to show the use of drawings, sketches and information systems. Production and manufacturing facilities would probably be best suited to examples of verbal and written communication methods.

There are a range of organisations that may be able help centres engage and involve local employers in the delivery of this unit, for example:

- Work Experience/Workplace learning frameworks – Centre for Education and Industry (CEI, University of Warwick) – www.warwick.ac.uk/wie/cei
- Learning and Skills Network – www.vocationallearning.org.uk
- Network for Science, Technology, Engineering and Maths Network Ambassadors Scheme – www.stemnet.org.uk
- National Education and Business Partnership Network – www.nebpn.org
- Local, regional Business links – www.businesslink.gov.uk
- Work-based learning guidance – www.aimhighersw.ac.uk/wbl.htm

Indicative reading for learners

Textbooks

Boyce A, Cooke E, Jones R and Weatherill B – *BTEC Level 3 National Engineering Student Book* (Pearson, 2010) ISBN 9781846907241

Boyce A, Cooke E, Jones R and Weatherill B – *BTEC Level 3 National Engineering Teaching Resource Pack* (Pearson, 2010) ISBN 9781846907265

Tooley M and Dingle L – *BTEC National Engineering, First Edition* (Newnes, 2007) ISBN 978075068521 4

Delivery of personal, learning and thinking skills

The table below identifies the opportunities for personal, learning and thinking skills (PLTS) that have been included within the pass assessment criteria of this unit.

Skill	When learners are ...
Independent enquirers	analysing and evaluating information, from both non-computer based sources and computer based sources, to judge its relevance and value when solving an engineering task
Creative thinkers	generating ideas and exploring possibilities when producing engineering drawing/ circuit/network diagram and sketches.

Although PLTS 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 ...
Self-managers	solving an engineering task by organising time, resources and prioritising actions.

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	using non-computer based information sources to solve and engineering task
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	using computer based information sources to solve and engineering task
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	using appropriate ICT software packages and hardware to organise and edit information for engineering reports and visual presentations including written, graphical and technical data
Bring together information to suit content and purpose	use charts, spreadsheets, databases to represent engineering data
Present information in ways that are fit for purpose and audience	check reports and visual presentations for clarity and accuracy
Evaluate the selection and use of ICT tools and facilities used to present information	selecting appropriate ICT software packages and hardware to organise and edit information for engineering reports and visual presentations including written, graphical and technical data
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	speaking with and listening to peers and supervisors in an engineering context to communicate complex engineering concepts
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	selecting, reading and using appropriate information sources to solve an engineering task
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	taking notes and preparing documents to communicate engineering information effectively.