Guidance for the Diploma

Engineering: level 3

Curriculum aims

Learning and undertaking activities in the Diploma contribute to achievement of the curriculum aims for young people to become:

- successful learners who enjoy learning, make progress and achieve
- confident individuals who are able to live safe, healthy and fulfilling lives
- responsible citizens who make a positive contribution to society.

The importance of the Diploma

The Diploma is a unique qualification for young people of all abilities who have an interest in sector-related learning. The Diploma qualification and each of its Lines of Learning are employer-verified qualifications. They have been designed in partnership with employers and in response to their views. Diplomas will:

- offer high-quality, credible, industry-related learning
- provide real opportunities for learners to practise the skills they will need when they enter employment and higher education

Learning

To enable learners to see their Diploma experience as a coherent whole, there should be the following:

- constant and explicit reference to learning processes
- learners should understand the various types of learning they are experiencing and the relationships between them.

- promote diversity, opportunity and inclusion for all learners.

The Diplomas have:

- a consistent and explicit focus on learning, encouraging young people to take increasing responsibility for their own learning
- coherent and engaging learning activities based on the experiential learning cycle.

They recognise the value of young people's own experience, within and beyond their work for the qualification.

Diploma programmes include:

- general learning
- applied learning
- theoretical and practical learning
- sector-related skills
- generic skills.

The Diplomas are intended to provide the essential knowledge and skills for young people to operate confidently, effectively and independently in life and work.

Learners will have the opportunity to demonstrate the quality of their learning and skills in a project they will choose for themselves.

The Diploma prepares young people for a range of progression routes. These can be within the sector they have studied, within another sector or in general education. By following the curriculum programme for a Diploma, learners can develop the knowledge, skills and attributes expected by both employers and higher education.

Experiential learning cycle

Learners must understand and be fully engaged in the processes within the experiential learning cycle. This is based on the educational theory that there are four stages that follow from each other and lead to effective learning from personal experience. These are:

1. *experience*
2. *reflection* on the experience
3. *generalisation* from the individual experience or the application to it of theories or principles already known by the learner
4. *application of learning* to new experiences, situations and activities.

Learners following the Diploma programmes should use this cycle in:

1. planning their work
2. reflecting on their experience or prior learning
3. drawing out and articulating the lessons learnt, applying them to new situations or activities.

Applied learning

This can be defined as the practical application of theory. In Diploma terms, it underlines the importance of learning through experience related to the world of work.

Tasks, projects and assignments should be set in sector contexts that have many of the characteristics of real work, or within the workplace itself. The purpose of each task should be relevant to work within the sector. Some will introduce a practical application or skill, from which a theory or principle can be derived, while others will start with theory and move to practice. Learners need to understand this, to appreciate the value of their own experience and be able to apply it. In this way, applied learning clearly has strong links with the experiential learning cycle.

Generic skills

These include functional skills and personal, learning and thinking skills. They support progression within education or to employment with training, within the sector studied or elsewhere.

Attributes

These include: adaptability, perseverance, flexibility, creativity, confidence and self-confidence, independence, initiative, autonomy, and customer service orientation.

The structure of the Diploma

The purpose of this curriculum guidance is to support curriculum planners and teachers in their decisions about introducing the Diploma, choosing qualifications and devising schemes of work.

The Diploma offers significant opportunities to develop new ways of organising teaching and learning because it:

- will be delivered within a partnership
- requires extended periods of learning time, particularly in delivering applied learning
- includes work experience and could include part-time paid employment for older learners
- ensures generic learning is an important aspect throughout
- includes a skills-based project at all levels.

The structure of each Diploma includes the three components of principal learning, generic learning and additional and specialist learning. Functional skills and personal, learning and thinking skills are included within generic learning.

Curriculum managers, practitioners and others will be able to look across a learner's entire programme and ensure the curriculum meets each learner's needs. Since this curriculum guidance is organised in the same way as the statutory programmes of study for key stage 4 (and key stage 3), it will

Teachers

In this guidance, 'teacher' refers to all practitioners involved in delivering the Diploma, whether in schools, colleges or work-based providers.

The structure of each Diploma

The way the Diploma is structured encourages learners to develop:

- broad understanding and knowledge about a sector or sectors
- additional knowledge and skills to complement and broaden sector-relevant learning
- specialist knowledge and skills to deepen or extend sector-relevant learning
- generic learning skills.

Principal learning

This is mandatory learning within each Diploma. It is sector-related, applied in nature and includes opportunities to develop and apply generic skills. At least 50 per cent of the learning within the principal learning component should be applied. It is made up of units of 30 or 60 guided learning hours or GLH.

Opportunities for applied learning:

School-based

- workshops

also facilitate whole-curriculum planning.

Each statutory programme of study begins with a statement of curriculum aims from which an importance statement is drawn. In the same way, the Diploma guidance begins with the statement of aims and an importance statement for the qualification itself as well as one for each Line of Learning. The Line of Learning importance statement describes what is distinctive about that Line of Learning and what it offers to the development of the learner.

Key themes and key processes for the Line of Learning follow from the importance statement. These are central to the area of study and need to be developed and taught through the contexts outlined in the 'Range and content' and 'Curriculum opportunities' sections. These sections provide the criteria for designing individual learning programmes. Curriculum planners can use these to integrate and/or complement learning from a range of curriculum areas. The section 'Unique Diploma features' provides additional guidance on this. It includes additional and specialist learning, the project and work experience.

- The content of each of these sections is based on the work of the Diploma development partnership for the sector(s) involved. Using the outcomes of that work, specifications for units and qualifications developed by awarding bodies will organise the content in different ways, based on units with different titles and of different lengths.

- activities led by employers or employees
- simulated work environments
- use of case studies, simulations, role play and drama
- use of a virtual learning environment (VLE)

Work-based

- part-time jobs
- enterprise activities
- work-based projects.

Generic learning

This component of the Diploma comprises:

- functional skills in English, mathematics and ICT
- personal, learning and thinking skills
- a minimum period of 10 days' work experience
- the project or extended project
- experiential learning/planning and reviewing.

Functional skills

These are the core elements of English, mathematics and ICT that provide the essential knowledge and skills to operate confidently, effectively and independently in life and work. They are an integral part of each Diploma, and learners need to succeed at the specified level to be awarded a Diploma.

They may be taught within Diploma learning and within other qualifications such as GCSE. They will be developed and practised within Diploma units. Learners should be encouraged to develop these skills to as high a level as they can.

Personal, learning and thinking skills

These are the skills that will equip young people for successful employment and lifelong learning. Development and practice of these skills should be built into the teaching and learning processes for all components of the Diploma, so that learners can become:

- independent enquirers

- creative thinkers
- reflective learners
- team workers
- self-managers
- effective participators.

Assessment of these skills will be within the Diploma principal learning. Where partnerships wish to assess them separately, qualifications such as the wider key skills, preparation for employment and certificates in personal effectiveness can be used.

The importance of engineering

In an advanced global economy, everyday human activity and economic growth are dependent upon developments in engineering. Engineering impacts upon everybody's life and creates the infrastructure in which we live, work and spend leisure time. Through this Diploma, learners have an opportunity to develop real enthusiasm and interest in engineering.

Through the engineering Diploma, learners have the opportunity to develop an understanding of the importance of engineering in our rapidly evolving world and the benefits of engineering to humanity and the global economy.

Learners will be able to experience all facets of engineering and gain an understanding of the diverse sectors of engineering such as mechanical, electrical/electronics, telecommunication, biomedical, aerospace, transport, design, environmental, oil, gas, chemical and nuclear energy and utilities, engineering manufacture and building services.

Working through the world of engineering, learners will develop essential employability skills of independent enquiry, problem

The **Diploma in engineering** has been designed in response to and in conjunction with employers from across the sector. The importance statement reflects the attributes expected by both employers and higher education, but also recognises the transferability of these skills into any future career path.

Learning for the Diploma in engineering should be set within the context of the world of work in engineering, and learners need to develop an understanding of how engineering affects the world in which we live. The Diploma in engineering will assist in preparing learners for transition into work and/or into further training.

The engineering Diploma is built around three integrated themes:

- the engineered world
- discovering engineering technology
- engineering the future.

These themes provide, through a blend of general education and applied learning, a programme of study that allows learners the opportunity to fulfil their potential and develop a range of specific and transferable skills.

The Diploma will support personal development, enabling young people to understand the qualities and skills needed for working life and allowing them to make creative and realistic plans for their transition into, through and beyond the 14–19 phase of learning.

solving, creative thinking, self-management and team work.

The principal and additional learning within the engineering Diploma provides learners with a clear understanding of the progression possibilities and career pathways within the various sectors. This will allow learners to make informed decisions about their future as well as providing them with a wealth of general employability skills. The study of mathematics and science is integral to the engineering Diploma and is developed through a range of engineering concepts.

The Diploma can be linked with prior learning in citizenship, which is a subject in the national curriculum at key stage 4. For example, the Diploma engages learners in exploring the role of engineering in shaping society and the potential of 'clean' energy and renewable technologies. This links with the investigation of the policies and practices of sustainability in citizenship, and the actions that citizens can take to protect the environment for future generations.

Key themes

The key themes are central to the study of the engineering Diploma. Understanding them enables learners to deepen and broaden their knowledge, skills and understanding. The key themes give the whole course its coherence and underpin effective teaching and learning.

The key themes listed below are interdependent and should not be delivered in isolation. A holistic approach to teaching and learning, which is contextualised within the 'real world of engineering', is required.

The engineered world

- Understanding how engineering businesses operate, including the process of project management.
- Understanding the importance of working as a competent and responsible employee.
- Understanding the career pathways within the various engineering sectors.
- Understanding the need for legislation and regulation within engineering industries.

Engineering and the environment

- Recognising the requirement for the engineering industry to

Importance of engineering

The underpinning concept of the Diploma in engineering is that learners develop an understanding of the basic questions: what is man's contribution to the world we live in? How has engineering shaped the world in which we live?

The engineering business

This key theme provides learners with the opportunity to understand how engineering businesses operate, their processes and the internal and external factors that affect the business, including the concept of corporate social responsibility.

Engineering and the environment

At this level learners should have a clear understanding of the role of the engineer in the context of everyday living, including the positive and negative impact of engineering on society and the environment. Learners need to appreciate the sustainability of businesses and resources in the 21st century. The significance of the moral and ethical judgements and beliefs of engineers should be apparent to learners as they discuss the environmental concerns and solutions that engineering provides. Current concerns about operating to

operate in a sustainable and accountable way to minimise environmental impact.

- Applying mathematical methods to analyse engineering processes and environmental data.

Discovering engineering technology

- Understanding and applying knowledge to ensure safe working practices are followed in all engineering activities and in the use of all engineering technologies.
- Developing and applying the use of computer-aided design (CAD) in a range of engineering contexts.
- Understanding the impact of material properties with regard to design, cost and availability.
- Recognising the principal components in instrumentation, measurement and control engineering.
- Understanding the importance of planned maintenance in terms of efficiency, cost, environmental impact and loss of production.
- Understanding manufacturing and production systems.

Engineering the future

- Exploring the relationship between innovative engineering design and business success.
- An appreciation and understanding of the importance of new technologies.
- Recognising the importance of entrepreneurship and innovation for all engineering businesses, from small or medium firms to large multinational companies.

Analytical methods in engineering

- Understanding and applying mathematical and scientific principles in engineering analysis, design and problem solving.

minimise carbon footprints should form part of the understanding and knowledge in this area.

The BP website has more information on carbon footprints: www.bp.com/bpes.

Engineering technology

This key concept provides learners with the opportunity to gain an understanding of the importance and breadth of the technologies used in engineering. Learners can extend their practical skills in the use of a range of engineering technologies and equipment, including the use of computers and software packages, construction and testing of control systems, and carrying out maintenance activities.

Engineering the future

Real-life case studies, particularly where new technologies relate to young people, would be appropriate to consider within this key concept. New technologies that make use of new composite material would be worth highlighting.

The Department of Trade and Industry (DTI) defines innovation as: 'The successful exploitation of new ideas' – this is a useful definition for learners to use in developing their knowledge of this key concept.

Analytical methods in engineering

Learning in this key concept is that of mathematics and science in the context of engineering problems and theories. Learners will explore engineering through the application of mathematical and scientific analysis and design.

Key processes

The key processes of critical thinking and enquiry and of taking informed and responsible action (an essential part of citizenship) are at the heart of the Diploma, and are developed through the applied and the experiential learning. As they acquire them, learners will be able to make progress within the engineering Diploma, and beyond it.

Learners should be able to:

- appreciate the applied nature of the learning they are undertaking and relate their learning to the world of work in the engineering sector
- understand and evaluate how engineering businesses operate and the need for this to be in a sustainable and accountable way
- evaluate the different engineering sectors and the range of jobs and career pathways available
- follow given instructions in order to complete engineering tasks, taking into account time and project management considerations
- plan and organise complex activities in order to carry them out in a safe and efficient way, understanding the importance of and the need for risk assessment
- work independently to carry out a range of complex engineering activities
- work in a team situation, taking responsibility for decisions that affect others to solve engineering problems and complete practical investigations
- carry out primary research through activities such as sample collection and subsequent analysis
- carry out secondary research through the use of data, information in research reports, newspapers, magazine and journals

Applied learning

Wherever possible, tasks and assignments should be set within an engineering context, including as many of the characteristics of the real workplace as possible.

Sustainable and accountable way

This would include aspects of the need for 'clean' energy, and that the growth of renewable energy technology will continue. These new technologies require creative engineering and the exploration of alternative design and manufacturing techniques.

Career pathways

Learners need to consider their own career and professional development in engineering, exploring different progression opportunities through the placement they will undertake as part of the Diploma. This area of learning could also form part of the project that learners undertake as part of the Diploma. All learners, irrespective of gender, should be encouraged to research a diverse range of career pathways.

Risk assessment

Learners should be able to conduct risk assessments, applying statutory, organisational and personal health and safety regulations.

Importance of planned maintenance

Delivery in the workshop of this process should be supported by real-life case studies and projects in collaboration with local employers. Projects could be developed to solve real work issues and problems. Examples of good practice should be used from a range of engineering operations.

- select and use appropriate electronic components
- develop understanding of the importance of planned maintenance
- develop understanding of critical failure analysis in the maintenance process
- apply knowledge and understanding to plan a maintenance regime and carry out required maintenance activities
- develop knowledge of different manufacturing processes, assembly systems and techniques
- use a range of equipment and new technologies in different manufacturing processes
- apply knowledge to develop production plans
- apply knowledge and understanding to ensure the correct selection of materials for different engineering applications
- interpret, use and produce engineering drawings and specifications to meet required standards
- use appropriate software packages in designing, modelling, testing and production of drawings
- use appropriate methods, including ICT, to communicate engineering concepts, and contribute to presentations and discussions on a range of engineering issues
- develop knowledge and understanding of engineering design and enterprise, identifying opportunities for technological or commercial advantage
- use mathematical modelling and mathematical techniques to solve engineering problems
- conduct scientific experiments in order to investigate engineering principles and solve engineering problems.

Materials

In order to develop skills in the selection of correct materials, learners should be provided with as much access to as wide a range of materials as possible. This should include both traditional and new materials.

Range and content

When planning and delivering the engineering Diploma, teachers and others should draw on the range and content to develop the key themes and processes. Other sources will include awarding body specifications and statements of content from Diploma development partnerships.

Engineering businesses and career pathways

The study of businesses should cover:

- the organisation of engineering businesses and the influence of internal and external factors
- the career pathways in engineering
- the need for regulation
- the role of project management and contractual arrangements
- legislation in engineering business
- the importance and function of risk assessment
- the importance and function of quality assurance.

Engineering and the environment

This should look at:

- the problem of resource depletion
- pollution control, preventing both air and water contamination
- management to reduce environmental effects of solid and hazardous waste
- waste water and changes in the environment
- managing changes in the environment
- water supply and land management methods
- solutions, such as maximising the use of renewable

Career pathways

Learners need to consider their own career and professional development in engineering, exploring different progression opportunities through the placement they will undertake as part of the Diploma. All learners, irrespective of gender, should be encouraged to research a diverse range of career pathways.

Project management

Learners will need to be able to describe the role of project planning and management and how such processes ensure businesses are effective and comply with legislation and contractual arrangements. Understanding should cover aspects such as: Gantt charts, critical path, milestones, risk assessments, budget control, invoicing and quality assurance.

Engineering and the environment

The sources of environmental engineering pollution and solutions to control them are an important consideration. It is important to look at the cost of manufacturing in terms of minimising waste and re-work and the sustainability of resources and processes. Nitrous oxides are a particular area of concern in certain engineering sectors. See the National Society for Clean Air and Environmental Protection website for more information about pollution, www.nsca.org.uk. Marpol 73/78 is the international convention for the prevention of pollution from ships. The integration of mathematical and scientific methods into this area of study will be crucial.

Drawing to industrial standards

This considers a range of engineering drawings and commands recognised to industrial standards (BS8888:2006):

- orthographic, isometric, components and assemblies, system diagrams, pneumatic, hydraulic, circuit diagrams and electronic

resources, minimising waste and clean manufacturing
- design and development of environmentally friendly products.

Applications of computer-aided designing

This looks at:

- the use of 2D and 3D software
- drawing to industrial standards
- designing for manufacture
- computer systems and data storage
- the integration of CAD into combined design/manufacturing systems
- the use of concurrent engineering systems.

Selection and application of engineering materials

This considers:

- atomic structures, amount of bonding, periodicity and classification of engineering materials
- mechanical and thermal properties and durability of materials
- destructive and non-destructive testing methods
- effects of processing on structure and behaviour of materials
- factors of safety and modes of failure of engineering materials
- the standard forms in which materials are supplied
- using information sources to select materials for engineering applications
- key features of new and smart materials, and their potential applications.

- electric commands such as co-ordinate entry, absolute, relative, polar including line, circle, text, hatching, dimensioning
- viewing, including zoom in, out, previous window and pan
- copy, move, rotate, erase, scale, chamfer and fillet changes-layers, colour, linetypes
- secure storage and retrieval of data.

Engineering materials

This should include metals, polymers, ceramics, non-metal composites, and textiles. The application of nanotechnology could also be considered under this topic: see the Institute of Nanotechnology, www.nano.org.uk/whatis.htm or Defra's website, www.defra.gov.uk/environment/nanotech.

Mechanical and thermal properties and durability of materials

This looks at the following:

- mechanical properties: density, tensile strength, shear and compressive strength, hardness, toughness, ductility, malleability, elasticity, brittleness effects of forming process and heat treatment
- thermal properties: expansivity, thermal conductivity
- durability: corrosion resistance, solvent resistance, protection processes.

Consequences of plant and equipment failure

These include: production stoppages, cost penalties, corporate image, customer expectation, contractual breech, health and safety, regulatory breech, environmental effects, quality and equipment life.

CAE, CAM and CNC

Learners should have the opportunity to study CAE through hands-on experience with parametric solid modelling, FEA and CAM software. Solid models could include an engineered component for machinery, machine parts or concept models for vehicles or buildings. This should also include virtual testing.

Instrumentation and control engineering

This looks at:

- signals and wave guides
- open loop, closed loop, feed-forward and feedback control theory
- data communications and multiplexers
- sensors and transducers
- AD/DA converters, operational amplifiers, PID controllers and PLCs
- actuators and instrumentation displays
- industrial and domestic applications of control engineering.

Maintaining engineering systems and products

This looks at:

- the consequences of plant and equipment failure
- cost analysis of poor maintenance
- effective maintenance strategies
- planning a maintenance activity
- closed loop engineering systems
- risk assessment
- probability
- application of statistics
- work and energy.

Wide-ranging manufacturing/production systems

Look, for example, at mass production, lean manufacturing, flexible manufacturing and just-in-time systems.

Innovative engineering designs

Engineering is an innovative and enterprising business. Learners should appreciate the significance of innovators and inventors. These creative thinkers have led the way in terms of new developments, and many have profited from their ideas. The DTI defines innovation as: 'The successful exploitation of new ideas' – this is a useful definition for learners to use in developing their knowledge of this key concept.

Mathematical techniques

Learners need to develop a range of analytical mathematical skills within an engineering context. They also need to develop logical thinking skills, problem-solving skills using mathematical techniques, and develop critical thinking and reasoning techniques to analyse mathematical data.

Production and manufacturing

This considers:

- different types of manufacturing processes
- computer-aided engineering (CAE), CAM and CNC
- assembly systems and techniques
- the wide-ranging manufacturing/production systems used within engineering industries
- production planning considerations
- quality control and quality assurance requirements in manufacturing
- production, including statistical process control.

Innovative design and enterprise

This looks at:

- innovative engineering designs and new technologies
- the commercial issues of developing, marketing and selling a new product or idea
- successful engineering entrepreneurs
- the environmental and social impact of engineering and sustainability of resources
- designing for the environment.

Mathematical techniques and applications for engineers

This includes:

- trigonometric identities and equations for statics and dynamics, electrical laws, power factor correction, signals, phasors

- geometry, coordinate systems, vectors
- algebra, quadratic equations, indices, binomial expansion, partial fractions
- calculus, differentiation, integration, maxima and minima, rates of change, exponential decay, applications in mechanics
- mathematical modelling, moments and centres of mass, kinematics, Newton's laws of motion
- statistics, data analysis
- work, energy, friction and machines.

Scientific principles and applications for engineers

Subjects covered include:

- electrical properties of solids, resistance and resistivity, dielectric constants and capacitance, basic device characteristics, electric fields, electromagnetic induction, Ohm's law, Kirchhoff's laws, Lenz's law, Lorentz force, semiconductors
- mechanics, statics and structures, kinematics, laws of motion
- thermodynamics, expansion and compression of gases, heat of combustion and changes in state
- inorganic chemical reactions, oxidation and reduction, pH, exothermic and endothermic reactions, and metallurgical principles
- organic chemistry, Friedel–Crafts reaction, alkylation of benzene
- hydrostatic systems, fluids in motion, aerodynamics
- radiation, particles, sound, light and waves.

Curriculum opportunities

The aims, structure, nature and scope of the engineering Diploma provide a range of curriculum opportunities. They should be offered to learners as an integral part of their learning, to enhance their engagement with the themes, processes and content of the Line of Learning.

A minimum of 50 per cent of the learning must be applied learning.

The curriculum should provide opportunities for learners to:

- further develop and achieve functional skills in English, mathematics and ICT
- use real-life examples that contextualise engineering principles
- experience engineering outside the school/college environment including in the workplace
- study engineering in local, national and global contexts to appreciate the importance of the engineering sector and its contribution to society and the economy
- experience local contextualisation in terms of engineering companies and businesses
- become aware of the range of activities undertaken by the different engineering sectors
- study innovative engineering designs and new technologies
- recognise the importance of health and safety in all engineering activities
- undertake focused engineering tasks and solve engineering problems that develop skills, knowledge and understanding in relation to engineering materials, equipment and technology
- experience the use of computers in a range of engineering applications

Functional skills

These are an integral part of the engineering Diploma and should be integrated into Diploma learning as well as being delivered through other qualifications such as GCSE. Functional skills should be developed and practised within the context of engineering, wherever possible. Learners will need to succeed at the specified level of each of the functional skills to be awarded a Diploma. They should be encouraged to develop these skills to as high a level as they can.

To be awarded a level 3 Diploma, learners must achieve the functional skills in English, mathematics and ICT at level 2. Those who have not achieved these before starting their level 3 work will need support, practice and assessment opportunities to ensure they succeed during the course. Those who have achieved level 2 will need opportunities to practise and build upon their functional skills experience within a level 3 context.

Real-life examples and outside the school/college environment

The work placement element should support delivery of all key themes in the Diploma. Also, visits to companies, including the voluntary and community sector, and lessons with visiting speakers and demonstrators with expert knowledge would be an important aspect to include.

While on work placement, learners could make use of a standard template to collect information about the people employed within the company. This will result in a more in-depth understanding of the progression routes within the industry.

Local, national and global contexts

Opportunities should be provided for learners to investigate different engineering businesses and industries that operate locally, within the UK and internationally. This should include companies' policies and practice in relation

- recognise the importance of sustainability in engineering developments
- work individually and in teams, taking on different roles and responsibilities
- use mathematical modelling and mathematical techniques to solve engineering problems
- conduct scientific experiments in order to investigate engineering principles and solve engineering problems.

to corporate social responsibility. Real-life examples, such as local case studies, should be provided and examples of community projects in other countries using engineering expertise. Work experience placements and visits to local firms enable learners to gain a detailed insight into how engineering businesses operate.

Innovative engineering designs and new technologies

This is an underpinning theme and should be embedded throughout the delivery of the Diploma. The DTI's useful definition and model of innovation can be used to support learners' learning. Also, see its website, www.dti.gov.uk/innovation. Real-life case studies that show examples of how new technology relates to the world of young people would be extremely useful.

Importance of health and safety

As well as the obvious delivery of this underpinning aspect in practical activities, teachers could also make use of local case studies to help learners understand employer practice and compliance with legislation.

Engineering tasks and engineering problems

Tasks and problems can form the basis of assignment work that requires skills from a range of 'topics', such as properties of materials and production engineering. This integrated approach to the delivery of the content is suggested as appropriate delivery strategy.

Teams

At this level learners should understand what type of team player they are and what types of behaviour form the basis of great teams.

Unique Diploma features

This section includes some of the major features that make the Diploma a unique qualification – work experience, the extended project and additional and specialist learning.

Progression qualification

At level 3, the progression qualification is available and comprises the principal learning and generic learning from the full Diploma. Within those components, students should have the same opportunities as those taking a full Diploma.

Additional and specialist learning

Learners will be able to tailor their personal programme to their own interests and aspirations through their choice of additional and specialist learning (ASL). Qualifications can be chosen from the wide range available in the relevant catalogue of opportunities. This lists the qualifications that have been proposed by an awarding body and accepted by QCA as contributing to a coherent learning package.

Additional learning is complementary or broadening in character. It can include:

- qualifications that enable learners to explore a related sector
- national curriculum entitlement areas
- learning options such as languages, music or science that relate to individual needs, interests and aspirations
- AS/A levels and other qualifications.

It should not duplicate the learning undertaken as part of the principal learning or generic learning.

Additional and specialist learning

This will often be chosen from the general options available to all learners within the school or college. Provision may include:

- a GCE
- another qualification (section 96 compliant)
- a range of smaller qualifications (section 96 compliant).

In deciding on the range of provision for ASL, or in advising students on their choice of ASL, the following points should be considered:

- evidence of student aptitude and interest
- principal learning available/chosen
- whether ASL beyond the minimum GLH requirement will be achievable
- availability of appropriate AS/A2 level qualifications
- availability of specialist qualifications
- breadth and depth of planned programme
- progression route(s) appropriate to the student(s)
- local employer skills needs.

For the engineering Diploma other qualifications could be in topic areas such as: customer services, health and safety, rights and responsibilities and preparation for employment such as CV and interview skills, and citizenship.

GCEs in art and design, design and technology, humanities, citizenship studies and additional science could also form part of the additional learning for the engineering Diploma.

Languages

Engineers function in a global market. Learners with language skills and

Specialist learning gives the learner the opportunity for further learning within their chosen sector. It can include:

- existing qualifications designed to support progression within a chosen sector
- AS/A levels and other qualifications
- some specialist qualifications designed specifically for the Line of Learning that may enable learners to select an identified pathway or progression route.

ASL can include qualifications at a higher level than the principal learning.

Work experience

The Diploma at each level requires a minimum of 10 days' work experience.

Where possible, this should be linked to one or more of the following:

- the Line of Learning
- the project topic chosen by the learner
- the desired progression route.

Work experience will:

- support the development and recognition of work-related learning
- develop sector-related skills when undertaken in a relevant setting
- develop general employability skills.

cultural awareness will be able to excel in the worldwide marketplace.

Pathway

The level 3 Diploma requires 1,080 GLH of which 540 is for the principal learning. The remainder will be drawn from one or more of the following pathways: energy and utilities, science engineering and manufacturing technologies, passenger transport, automotive skills and building services.

Higher education units

These can be units from foundation or other degree courses. They may be existing units, for example from the Open University (OU), or be specifically developed for Diplomas in individual lines of learning.

For further guidance, see the QCA website www.qca.org.uk/14-19/higher-education. For information on OU units see www.open.ac.uk/yass.

Work experience

A great deal of guidance is available on the QCA (www.qca.org.uk) and DCSF (www.dfes.gov.uk) websites. Please visit these sites for the most up-to-date guidance.

Part-time employment

Learners who are in paid employment or do voluntary community work should be encouraged to see this as relevant to the development of their employability skills. Where the employment has links with the Line of Learning, they could use the company or organisation to contribute to activities within other aspects of their Diploma learning.

The extended project

Learners are required to choose an appropriate topic for their project through negotiation with their teacher, mentor or tutor (and if appropriate an employer). The project need not be within an engineering context but should be relevant to the principal learning in either or both of the following ways:

- it complements and develops the themes and topics of the learners' principal learning
- it supports learner progression.

It may also:

- provide evidence of attainment, where appropriate
- provide a stimulus or context for a project.

Part-time employment can also be used to contribute to Diploma learning.

The extended project

The extended project is a stand-alone, single-unit qualification that forms part of the generic learning component of the Diploma and can also be taken as part of an A level programme of study.

The extended project will provide an opportunity for learners at each level to draw on and integrate learning from each component of their Diploma and to demonstrate independent learning skills. Learners should be encouraged to use and apply appropriate technologies in carrying out their project.

Topics should be chosen by the learner, with guidance appropriate to each level. Guidance may come from any of the adults professionally involved with the learner. Topics should complement and develop principal learning and/or support individual progression.

At level 3, the extended project will provide opportunities for:

- the development of enquiring and independent learners
- exploration of new areas or methods of study
- demonstration and further development of learning skills
- working individually or as part of a group
- application of the experiential learning cycle
- development and application of specialist technical skills
- presentation of the outcome.

For example:

- if a learner is studying an engineering Diploma but intends to go on to a business course, then a project in a business-related area would clearly support his or her progression aspirations
- if a learner is studying an engineering Diploma and wants to progress in engineering it would be advisable that the project is relevant to engineering.

Learners may choose one of many different types of project, but the topic selected must have the potential to provide the learner with opportunities to meet all the assessment objectives for the extended project.

The extended project should reflect current engineering employer practices. It could also involve active citizenship, developing skills of an active participator.

The extended project at level 3 should align with the project requirements in GCE A levels; this means learners will be expected to:

- have a significant input to the choice and design of an extended project and take responsibility either for an individual task or for a defined task within a group project
- develop and improve their own learning and performance in research, critical thinking, analysis, synthesis, evaluation and presentation skills
- develop and apply decision-making and, where appropriate, problem-solving skills and skills of an effective participator
- demonstrate reflective and independent learning that develops and applies skills creatively, demonstrating initiative and enterprise
- select a project topic that allows the opportunity to engage in a business, social community venture/enterprise and/or on a local, regional or international team project.

The types of final outcomes and products are demanding and wide ranging:

- a design
- findings of an investigation or study
- a dissertation presenting an argument
- an artefact.

In addition to achieving an appropriate level in the above, students will be expected to develop higher level skills and cognitive abilities.

At level 3, there is a common structure and common standards. These include criteria for learners who take the project, whether as the free-standing extended project qualification or as part of the generic learning of a Diploma.

Progression

The Diploma is designed to facilitate progression:

- within the Line of Learning studied, **or**
- to another sector, **or**
- to general education at any level.

The focus on generic skills makes Diploma learning applicable to both general education and employment with training (including the apprenticeship).

Achievement of a Diploma at any level provides the foundation for progression to the next. Qualifications within ASL generic learning can be taken above the level of the Diploma being studied. Principal learning and the project must be taken at the level of the Diploma award.

Learners can embark on a Diploma at levels 2 or 3 without necessarily having taken a Diploma at a lower level, but in these cases teachers should check their learners have all the knowledge, skills and understanding they will need.

Any of the above can include an active citizenship outcome.

Evidence should provide the following:

- planning and of the progress of the project, such as a validated log documenting the progress of the project and the decision-making process – this could be via a diary, IT logging system, staged reviews/interviews
- sources of and range of information accessed
- evidence of the range of skills used including, where appropriate, new technologies and/or access to e-learning materials
- details of the design, knowledge, understanding and skills used to complete the tasks/activities of the project, such as an experiment, a construction, a performance or research interviews
- a project conclusion to include: an evaluation of the outcomes of the project, an evaluation of own performance of learning and decision making, and a presentation for a non-specialist audience, using media appropriate to the type of project
- evidence individual to the candidate – while larger group activities, such as an expedition or a performance, may be a vehicle for evidence, that evidence must demonstrate how the individual has met the assessment objectives and performance criteria.

The extended project can be offered in a variety of ways including an e-project. The e-project would see learners working as a virtual team within a virtual scenario developing real-life engineering solutions. It should include consideration of social, moral, ethical, economic and environmental issues.

Examples of projects could include:

- improving an everyday gadget – make it work better, expand its function
- how can an understanding of engineering help reduce energy bills?
- does the viscosity of motor oil change with time?
- what are the best materials for blocking out unwanted noise?
- how can engineering technology be used to protect the environment?
- design and build a device that could be used to help patients with mobility problems
- an in-depth study of the properties and characteristics of engineering materials

- designing, building and testing a hovercraft
- designing and building a product using two different materials – compare and contrast the outcomes
- how do developments in the motor sport industry influence the design of family cars?
- investigate the technology involved in the development of hybrid vehicles
- investigate the technology used in the modern family car
- a historical study into an important engineering innovation
- an investigation into a renewable energy technology
- an evaluation of the recycling and safe disposal sites available for engineering companies to use in your local area.

Additional information

The Small Peice Trust is an independent charity providing programmes to promote engineering careers to young people. The trust runs a range of projects through residential courses suitable for year 9, 10, 11 and 12 learners, and these projects could form the basis of the extended project. See www.smallpeicetrust.org for further details

The use of suitable engineering competitions or challenges that will offer an assessment of the level 2 knowledge is suggested, such as F1 in schools, CREST awards and other STEM activities.

Download the Royal Academy of Engineering *Shape the future* booklet from www.shapethefuture.org.uk. It is a useful resource.