Guidance for the Diploma

Engineering: level 2

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

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.

education

- 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 also facilitate whole-curriculum planning.

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
- activities led by employers or employees

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.

- 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 – attainment can be above the level of the principal learning.

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 allow them to make creative and realistic plans for their transition into, through and beyond

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.

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 the importance of engineering to social and economic development.
- Investigating the different engineering sectors.
- Understanding the types of jobs and career pathways available within the engineering industry.
- Recognising the requirement for the engineering industry to operate in a sustainable and accountable way.

Discovering engineering technology

- Understanding the importance of safe working in an

the 14–19 phase of learning.

The Diploma can be linked with 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.

Importance of engineering

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

Society

The engineering industry as a whole employs over 3 million people. During recent years the engineering sector in the UK has been experiencing a number of dramatic changes, including aspects of the need for 'clean' energy and the continuing growth of renewable energy technology. These new technologies require creative engineering and the exploration of alternative design and manufacturing techniques.

Learners should understand how the industry is shaped by political, social, legal, economic and cultural factors, and the ways in which identities are affected by change. Learning can be linked with work in citizenship that develops an understanding of the key concepts of rights and responsibilities, and democracy and justice, and how a balance between competing and

engineering environment.

- Understanding the safe use of simple hand tools and basic manufacturing equipment.
- Understanding the importance of scheduled maintenance procedures.
- Producing engineered products using cutting, forming and joining processes.
- Understanding the techniques required to work effectively in the assembly and disassembly of basic products.
- Producing simple engineering drawings and diagrams to communicate technical information.
- Understanding how computer software packages and systems are used in designing and manufacturing engineering components.

Engineering the future

- Recognising the importance of innovation and creativity in engineering design and development of new products and services.
- Understanding how developments in engineering technology have had a significant impact on quality of life (in the home, businesses, the economy and society).
- Recognising the impact of recycling and safe disposal of engineered products.

conflicting demands can be achieved.

Different engineering sectors

Engineering employers can be found working in a wide variety of sectors, from automotive to the chemical and nuclear industries. There are numerous websites which explain the roles within each engineering sector, such as:

Connexions career database, www.connexions-direct.com/jobs4u

Enginuity site, www.enginuity.org.uk

Learning Skills Council's apprenticeships website, www.apprenticeships.org.uk

UK Resource Centre for Women, www.setwomenresource.org.uk

Learn Direct job profiles website,

www.learndirect-advice.co.uk/helpwithyourcareer/jobprofiles.

Types of jobs and career pathways

Employees within the engineering industry undertake a range of occupations, from managers to diagnostic technicians to operators and assemblers. Currently engineering in the UK is suffering from a skills shortage and so there is a continual need to recruit a diverse range of individuals with high-level skills and up-to-date knowledge. Engineers of the future will need to be enterprising individuals who are able to create and implement new ideas and procedures.

Training opportunities

Apprenticeships and advanced apprenticeships are available across the range of engineering sectors. The duration of training is between 18 months and 42 months, depending on the type of apprenticeship.

Safe working

As with many working environments, engineering is a potentially high-risk area and safety is of paramount importance. Learners should be made aware of all aspects of health and safety including: PPE (personal protective equipment), hazards and hazard warning signs, fire procedures and the relevant legislation. Clearly this links with the Every Child Matters agenda and the personal development curriculum, ensuring that learners know how to stay safe and to manage risk. The Health and Safety Executive provides a range of useful information at its website www.hse.gov.uk/engineering.

Rights and responsibilities

This should include information on employment law, equal opportunities, disability discrimination and health and safety, as well as copyright and patent legislation and consumer protection. It could also include consideration of corporate social responsibility in relation to the industry's relationship with local and wider communities.

Range of engineering applications

There is a wide range of computer use in engineering, such as:

- in design, such as CAD,CAM and computer numeric control (CNC)
- in process control and manufacture
- in fault diagnosis
- microprocessors in products such as toasters, burglar alarms and toys.

Quality checks

Learners need to understand that work must conform to the specification and therefore inspection and testing through measurement is required. Quality checking should include dimensions, tolerances, fit, finish and performance.

Applied mathematical skills

- Learners need to understanding that mathematical knowledge underpins design principles. Mathematics is used extensively to perform required calculations in electronics and electrical systems. In production statistical methods are used in testing and also in maintenance for analysing failure trends.

Innovation and creativity

Learners should appreciate the significance of innovators and inventors in the world of engineering. These creative thinkers have led the way in terms of new developments, many have profited from their ideas.

Impact on quality of life / impact of recycling and safe disposal

Learners should understand the impact of the engineering industry on developing communities and shaping identities. This includes seeing how engineering solutions are all around us: portable devices, clean water and

healthcare products that enable us to live longer and arguably better lives.

Learners need to look at recycling of metals, plastics and packaging, and safe disposal of materials such as batteries, electronic equipment, PCBs and CFCs. For more information, see:

- the Royal Society of Arts WEEE Man website, www.weeeman.org
- the Recycling Guide website, www.recycling-guide.org.uk
- the Recycling Marketplace website, www.recycle.co.uk.

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
- appreciate the importance of engineering in local, regional, national and global contexts and the need to operate in a sustainable and accountable way
- identify the different engineering sectors and the range of jobs and career paths available
- follow given instructions in order to complete engineering tasks
- develop self-management skills#14 to plan and organise practical activities and to carry them out in a safe and efficient way
- work independently and with others to carry out a range of practical investigative activities

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, such as risk assessments and job cards.

Follow given instructions

Learners need to develop and use task operation sheets to ensure correct procedures are adopted when manufacturing components.

Self-management skills

These include a whole array of skills and techniques that learners can develop to increase their chances of employment. Simple skills such as time management, organising files and planning practical activities can all be incorporated into this key process.

Safe and efficient way

This is an underpinning theme that runs through all topic areas within the Diploma. Learners must be able to identify health and safety issues relating to themselves and colleagues and apply appropriate health and safety precautions. This is linked with the task operation sheets noted above and the

- select and use, with increasing efficiency, the appropriate tools and equipment for a given task
- apply knowledge and understanding to analyse and solve engineering problems
- interpret and use engineering drawings and specifications
- dismantle engineering products
- perform quality checks and apply statistical methods for testing
- use appropriate methods including ICT to communicate engineering concepts and evaluate engineering data
- contribute to presentations and discussions on engineering issues
- use appropriate software packages to design and manufacture products
- use appropriate computer systems in process control and manufacture
- produce a product design specification and present a design solution from this.

assessment of risk in undertaking any engineering activity. Clearly this links with the Every Child Matters agenda and the personal development curriculum, ensuring that learners know how to stay safe and to manage risk.

A useful document *Work-related learning and the law* is available from DCSF publications http://publications.teachernet.gov.uk.

Solve engineering problems

The activities undertaken here could be in the context of production, maintenance, installation or commissioning. This will ensure the applied nature of the Diploma, with problems set in a engineering context.

Statistical methods

This should include normal distribution curves, standard deviation and histograms.

Software packages and computer systems

Learners need to use a CAD system to produce drawings and circuit diagrams. They also need to understand the relationship between a drawing package (CAD) and the conversion to a programme to operate a machine tool to manufacture a product (CAM and CNC).

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.

Importance and impact of engineering

The study of importance and impact of engineering should include:

- the sectors of engineering and their products and services

Importance and impact of engineering

The intention with this area of study is that learners are able to develop an understanding of the way the world is as a result of engineering. So questions to introduce this area of study could include:

- how would you live without electricity, clean water, sewers or waste management?

- job roles and career opportunities in engineering
- engineering achievements in the 19th, 20th and 21st centuries
- rights and responsibilities of employers and employees.

Marking out and measuring

The study of marking out and measuring should include:

- types of measuring equipment
- correct selection and use of measuring equipment
- using correct units of measurement
- marking out equipment and products
- accurate measurement and making out from datums
- the importance of dimensional tolerances and their industrial application.

Working in engineering

The study of working in engineering should include:

- the importance of safe working practices and adhering to safe working practices at all times
- selecting and using tools safely and effectively
- cutting, forming and joining processes
- assembling and disassembling engineered products
- producing and interpreting drawings.

Properties of materials

The study of properties of materials should include:

- selecting and using the correct type of material to enable a product to be manufactured
- how would the world work without transportation?

Jobs roles and career opportunities

Employees within the engineering industry undertake a range of occupations, from managers to diagnostic technicians to operators and assemblers. Currently engineering in the UK is suffering from a skills shortage so there is a continual need to develop individuals with high-level skills and up-to-date knowledge. Engineers of the future will need to be enterprising individuals who will be able to create and implement new ideas and procedures.

Measuring equipment

Measuring equipment would include vernier gauges, external micrometers, comparators, gauges, height gauges and callipers.

Correct units

Both imperial and metric should be included.

Datums

Datums are the horizontal or base lines from which all points must be measured during component manufacture.

Dimensional tolerances

Learners need to understand about working within given tolerances, including bilateral tolerance, namely, the variation in both directions from a specified dimension.

Safe working practices

This is an underpinning theme that runs through all topic areas within the Diploma. Learners must be able to identify health and safety issues relating to themselves and colleagues and apply appropriate health and safety precautions. Learners must be able to undertake an assessment of risk before starting any engineering activity. Clearly this links with the Every Child Matters agenda and the personal development curriculum, ensuring that learners know how to stay safe and to manage risk.

Forming and joining

Range of processes to include:

- types of materials that engineers use and the basic properties of materials
- forming processes applicable to particular materials
- testing materials to investigate basic properties.

Engineering design

The study of engineering design should include:

- the importance of performance/functions of an engineered product
- key requirements and key factors influencing design briefs and product specifications
- how standards and legislation effect design
- techniques for producing and presenting design solutions
- the importance of mathematical and materials knowledge in producing design solutions.

Engineering applications of computers

The study of applications of computers should include:

- use of computers in process control and manufacturing
- use of microprocessor controllers in domestic products
- use of computers in maintenance operations.

Construct electronic and electrical systems

The study of electronic and electrical systems should include:

- basic principles and techniques used in the construction of electronic and electrical systems
- testing electronic circuits using a range of test equipment
- assembling circuits using correct tools and test equipment
- brazing, manual metal arc (weld), oxyacetylene (gas weld), injection moulding and vacuum forming
- soft soldering as well as a range of fastening devices, bolts, screws, set pins, studs and nuts
- adhesive joining such as epoxy resins, superglue and PVA.

Types of materials

Types of materials studied should include: ferrous and non-ferrous metals, such as mild, carbon and stainless steel, brass, aluminium and copper, thermoplastic and thermosetting plastics, rubber, elastomers, ceramics, composites, fabrics, industrial gases, lubricants and chemical treatments.

Basic properties of materials

In the making of any engineered product, learners need to develop an understanding of the reasons for selecting particular materials. These decisions are based on a thorough understanding of the properties of materials.

Performance/functions

Learners need to appreciate that in producing design solutions, aspects such as function and shape, shape and aesthetics, safety, reliability and economy must all be considered alongside performance.

Standards and legislation

Learners need to appreciate both British and European requirements relating to quality, safety, operation and the environment.

Application of computers

This could include the use of computers in process control, such as chemical industry, control PF flow and temperature. Products making use of microprocessor controllers could include washing machines, microwaves, toasters and burglar alarms.

Applied mathematical skills

Engineers solve problems, many of which require the use of mathematical formulae and equations. Learners need to be able to solve practical

- how applied mathematical skills are required to perform calculations.

Production engineering

The study of production engineering should include:

- basic principles and techniques of multiple production processes
- importance of planning for multiple production
- importance of and how to undertake quality checks
- how to programme and set up machines for multiple production.

Maintenance procedures

The study of maintenance procedures should include:

- the basic principles and techniques of engineering maintenance
- how to interpret manufacturers' information and use statistical methods in fault finding
- the implications of poor maintenance and the importance of a range of preventative maintenance techniques.

Engineering in the future

This should look at:

- the importance of innovation and creativity in engineering design and development of new products and services
- the role of research and development when designing and developing products
- environmental and social impact of engineering and sustainability of resources.

engineering problems using mathematical techniques.

Multiple production processes

This is a process by which learners are able to replicate the methods used to produce a component or system on a quantity production basis.

Statistical methods

This should include normal distribution curves, standard deviation and histograms.

Innovation and creativity

Creativity is an important aspect in any engineering solution – without creativity new ideas could not be considered, including those that lead to the design and development of innovative technologies.

Research and development

The research and development stage of design and development includes market research, as well as research into: product function and purpose, visual appearance, materials and technology, costs, scale of production and timescales. In developing the product design specification, it is important to carry out an analysis of customer requirements in terms of performance specifications, size, mass, compliance to standards, product life, reliability and service requirements.

Learners should be encouraged to evaluate their product, reflect on the production processes and make suggestions for future improvements.

Sustainability of resources

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.

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:

- 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
- explore contemporary and historical engineering developments and how they have contributed to social and economic development
- specialise in a range of engineering disciplines, perhaps with a regional context
- recognise the importance of health and safety in all engineering activities
- undertake focused engineering tasks that develop skills, knowledge and understanding in relation to engineering materials, tools and equipment
- discuss and subsequently produce a design specification and design solution against a given design brief
- 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 – attainment can be above the level of the Diploma.

Real-life examples

The work placement element should support delivery of this aspect of the curriculum. 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, meeting ethical codes of practice. This will result in a more in-depth understanding of the progression routes within the industry.

Importance of the engineering sector and its contribution to society and the economy

Learners should have the opportunity to learn about engineering today and the way it impacts on and improves our lives. Where possible, learning opportunities should include visits to engineering and manufacturing companies, science, engineering and transport museums and involve activities and lessons with visiting speakers and demonstrators with expert knowledge. Learning activities should emphasise the importance of engineering's contribution to the world that we live in.

- use creativity and innovation in producing engineering solutions
- recognise the importance of sustainability in engineering developments
- work individually and in teams taking on different roles and responsibilities.

Contemporary and historical engineering developments

This should include an appreciation of national and global developments such as automobiles, trains and other transport innovations, and electrification, water treatment, chemical engineering, space technologies and telecommunications. Engineering achievements of men and women from all cultures should be considered.

Applications

These should include problem solving, diagnostics, process control and manufacturing. Centres may wish to link this activity to the enterprise agenda through the development of a prototype product and to include the associated business planning.

Creativity and innovation

Creativity is an important aspect in any engineering solution, as without creativity new ideas could not be considered, including those that lead to the design and development of innovative technologies.

Engineering solutions

The activities undertaken here could be in the context of production, maintenance, installation or commissioning.

Work individually and in teams

Much individual practical work goes on in engineering. Learners should be encouraged to take on different roles and responsibilities, participate in decision making and in taking informed actions to bring benefits to others as well as themselves. Team working should be encouraged, with appropriate challenges and tasks being set. For example, at the start of their studies, learners could be introduced to the workshop environment, with teams carrying out risk assessments on individual pieces of equipment. To study new technologies, learners could work in teams to investigate a particular material or component, such as a solar cell, and then develop a product incorporating the new technology.

Unique Diploma features

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

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
- GCSEs and other qualifications.

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

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

Additional and specialist learning

At key stage 4, this will often be chosen from the general options available to all learners within the school or college. Provision may include:

- a GCSE
- 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 GCSE qualifications
- availability of specialist qualifications
- breadth and depth of planned programme
- progression route(s) appropriate to the student(s)
- local employers 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.

GCSEs 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.

- GCSEs and other qualifications

- 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.

It may also:

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

Languages

Engineers function in a global market. Learners with language skills and cultural awareness will be able to excel in the worldwide marketplace.

Pathway

For specialist learning, learners could undertake one or more of the following pathways: energy and utilities, science engineering and manufacturing technologies, passenger transport, automotive skills and building services.

Work experience

A great deal of guidance is available on the QCA (www.qca.org.uk) and DCSF (www.dcsf.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 or 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 Diploma 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 learner's principal learning
- it supports learner progression.

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

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

The Diploma project

The project is a stand-alone, single-unit qualification that forms part of the generic learning component of the Diploma.

The Diploma project will provide an opportunity for learners to:

- draw on and integrate learning from each component of their Diploma
- demonstrate independent learning skills.

Learners should be encouraged to use and apply appropriate technologies in carrying out their project.

Project topics should:

- be chosen by the learner (with guidance appropriate to each level, given by any of the adults professionally involved with the learner)
- complement and develop principal learning and/or support individual progression.

At level 2, the Diploma 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.

engineering it would be advisable that his or her 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 project.

The project may develop a specialism or area of interest from within the principal learning or ASL and allow for deepening of understanding and/or skill level. It may also provide an opportunity for connectivity between disciplines as advocated by the principal learning criteria. The project also provides an opportunity for learners to participate in active citizenship.

The Diploma project should reflect current engineering employer practices. The use of suitable engineering competitions or challenges that will offer a synoptic assessment of the level 1 knowledge is suggested, e.g. F1 in schools, CREST awards and other STEM activities. Download the Royal Academy of Engineering *Shape the future* booklet from www.shapethefuture.org.uk.

Examples of projects could include:

- improving an everyday gadget – make it work better, expand its function
- a study of the history of electricity – which materials make the best conductors and why
- how can an understanding of engineering help reduce energy bills?
- an investigation of an engineering project that resulted in a public safety inquiry such as the Potters Bar train crash or the Millennium Bridge in London
- how can laminates be made stronger?
- which metal is the most resistant to corrosion – conduct scientific experiments to provide the answer
- which is the best insulation material and why?
- 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?
- a study of the properties and characteristics of engineering materials
- a historical study into an important engineering innovation

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.

- an investigation into a renewable energy technology
- evaluation of the recycling and safe disposal sites available for engineering companies to use in your local area
- an investigation into the properties of minerals and what happens when they run out
- it could also involve citizenship, developing skills as an effective participator.

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. These projects could form the basis of the Diploma project. For more details, go to www.smallpeicetrust.org.