Teacher's guide

Edexcel GCSE in Engineering (Double Award)

First award 2004

October 2002

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Acknowledgements

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Authorised by Peter Goff

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Contents

Introduction

This teacher's guide accompanies the Edexcel GCSE specification for Engineering (Double Award) and has been designed to help teachers prepare their students for assessment in 2004 and beyond.

This guide should be used in conjunction with the specification. It provides sections to help with planning teaching programmes and managing the assessment requirements.

It is planned to issue a separate publication containing assessed items of student work. This will give further guidance on the application of the mark bands in the assessment grids for each of the internally assessed units, and provide a first indication of the levels of response.

Specification summary

GCSEs in vocational subjects

A range of GCSE (Double Award) specifications in vocational subjects has been introduced to replace and extend the range of Part One GNVQ courses at levels 1 and 2 of the National Framework of Qualifications. They can be taken as two-year courses from September 2002 and one-year courses from September 2003 for first awarding in summer 2004.

Edexcel GCSE in Engineering (Double Award)

The Edexcel GCSE in Engineering (Double Award) has been designed to provide a broad educational basis for further training, further education or for moving into employment within the engineering industry.

Specification structure

The specification consists of three compulsory units, which are equally weighted. Two units are internally assessed through the production of portfolios, and one is externally assessed by a written test. The first external assessment opportunity and first moderation of internal assessment will be carried out in May/June 2004.

Unit content	Assessment
Unit 1: Design and graphical communication The design process, client design briefs, design specifications, solutions, scientific principles, using engineering drawings and communication of design solutions.	**Internal assessment** Produce a design specification and design solution for an engineered product.
Unit 2: Engineered products Understand the process of designing a product and producing it by the use of product specifications, engineering drawings, creation and application of a product plan incorporating tools, materials and equipment and quality, health and safety checks.	**Internal assessment** Use a product specification to make an engineered product.

Unit content	Assessment
Unit 3: Application of technology How technology has developed design and manufacturing processes, improved the quality of products and customer service and the implications of modern technology on the work force and wider community.	**External assessment** 1½ hour examination. Choice of **one** from the following **six** sectors: • printing and publishing, paper and board • food and drink, biological and chemical • textiles and clothing • engineering fabrication • electrical and electronics, process control, computers, telecommunications • mechanical, automotive. Pre-release information on sector based product will be available to centres in September for the following June examination.

Planning a teaching programme

The programme has been designed to be delivered as a two-year course. As such, when considered within the normal GCSE framework, it would be suitable for delivery over years ten and eleven. However, it is possible to deliver the qualification as a one-year programme and as a vocational course would be suitable for year twelve students.

When planning a programme of learning and assessment, centres will need to consider the availability of resources. This consideration will focus on the availability and expertise of staff, the availability of external resources such as industrial expertise and vocational placements. The availability of resources will, in many cases, direct the most suitable delivery model.

Unit 3 in the Engineering programme is identical to that of the Manufacturing programme. Other similarities exist with Units 1 and 2. Centres could offer both qualifications and co-teach some aspects of the programme. This would be particularly useful if accommodating a team teaching approach. It must be remembered though, that when choosing their options of study, an individual student cannot study both Engineering and Manufacturing since they form a forbidden combination.

The demands within the programme are such that the vocational aspects should be planned into the delivery of the course at every opportunity. Visits to local or national engineering companies should be considered a priority when planning. The timing of these visits is a crucial aspect of planning. It would be appropriate for the course team to explore the content of each unit in order to clearly identify resource requirements and plan visits that meet any shortfalls. Should suitable visits or work experience opportunities not be available or practical, the course team should organise guest speakers to provide the relevant input into the programme. Most Local Education Authorities will have a person responsible for supporting work-based learning and work-based contact. The Engineering and Manufacturing Training Authority and the Engineering Employers Federation are also helpful in supporting setting the GCSE in a vocational context. Centres are encouraged to draw upon these organisations for support. Links with local colleges may also prove beneficial.

It is important that the course has an induction programme and could include information such as:

- outline of the course
- an overview of each unit
- teaching and learning strategies
- requirements of the students
- assessment procedures
- examples of expected outcomes/exemplar material.

During the planning stage, it is important that the course team considers the assessment requirements of the programme. Unit 3 is subject to an external assessment and students should be taught examination techniques to enable them to achieve maximum success. Centres should prepare candidates by using the exemplar materials and previous examination papers, as they become available.

By studying the content of each unit and identifying the availability of resources, the course team should be able to decide on those strategies best suited to the delivery of the programme. Engineering is a complex area and the units have strong links. Unit 1 carries design skills that can only be fully exploited with an understanding of how products are engineered and made, which is also a requirement of Unit 2. The application of technology spans both these units and is delivered and assessed in Unit 3. Students are encouraged to use manufacturers and sector specific websites during their study and centre need to consider this requirement when planning access to resources.

Centres have the option of delivering the Engineering GCSE through the main study of any one of the following sectors:

- mechanical, automotive – utilises Systems & Control (Mechanical) resources
- engineering fabrication – utilises Resistant Materials resources
- electrical and electronics, process control, computers, telecommunications – utilises Systems & Control (Electronics) resources.

Timetabling needs to ensure that staff can accommodate the requirement to set the programme in a vocational setting. The programme demands blocks of time, particularly when considering the need for industrial visits. Whole morning or afternoon sessions are advisable. This will enable the team to arrange visits, research etc without disrupting the normal timetable. Time is also required for tutorial support including assessment feedback.

If centres are delivering Design and Technology at Key Stage 4, it may be worth considering how aspects of its delivery could support the learning required for GCSE Engineering.

Models of delivery

When planning a programme of learning and assessment, centres may find it useful to consider the effects of differing delivery models. The following tables provide examples of possible delivery models. These are not intended to be exhaustive or prescriptive, but may provide a useful start to programme planning.

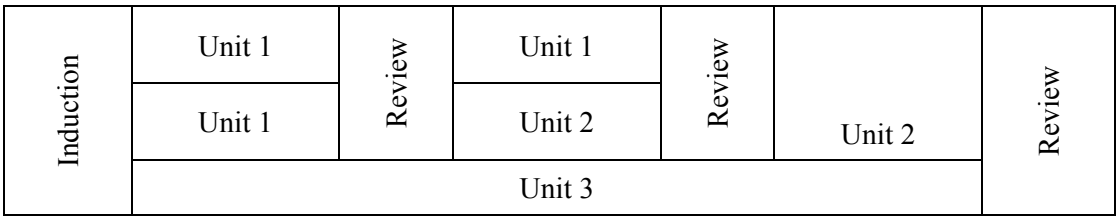
Model 1

<table>
<tr><td rowspan="3">Induction</td><td>Unit 1</td><td rowspan="3">Review</td><td>Unit 1</td><td rowspan="3">Review Assessment</td></tr>
<tr><td>Unit 2</td><td>Unit 2</td></tr>
<tr><td>Unit 3</td><td>Unit 3</td></tr>
</table>

Characteristics:

- the timing can be adjusted to meet one or two year delivery programmes
- it provides opportunities for sequential development of related skills and knowledge across different learning blocks
- it provides the opportunity to link skills development across the units
- it includes review periods to enable action planning and ‘top-up’ workshop activity.

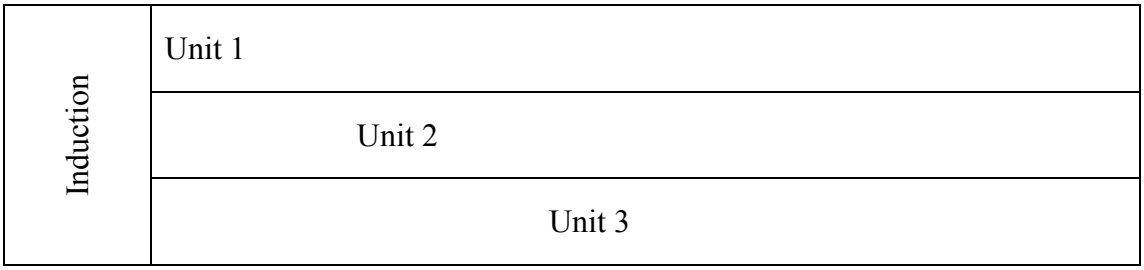
Model 2



Characteristics:

- it enables linear delivery/assessment where skill development is necessary over time
- it includes review periods to provide feedback and aid improvements
- it enables consolidation of the content of several units, when applied to and enhanced by a 'summative' unit (applies in situations when skills, knowledge and understanding from other units can be applied to a further unit to enhance performance, often practical units).

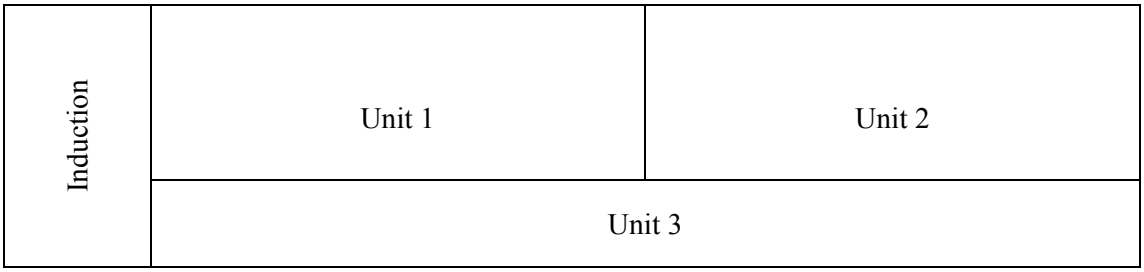
Model 3



Characteristics:

- it provides a linear approach to learning and assessment that may be helpful when continuos skill development is necessary
- it may be better suited to a one-year programme.

Model 4



Characteristics:

- it provides an opportunity to use outcomes from one unit and follow through into a second unit
- it may be better suited to a one-year programme.

When centres are considering programme construction, they need to be mindful of the effects that certain units will have on subsequent units. With this in mind, it may be useful to audit all units to maximise learner achievement.

Centres will also need to give consideration to the positioning of the external assessment instrument for Unit 3.

Developing assignments

When designing assignments, course teams should ensure that all activities proposed generate evidence, which meets the requirements of the assessment grid. The assessment grid is therefore an appropriate document to consider when planning and developing suitable activities and assignments for students. Each mark band will differentiate the levels of performance required to be built into the assignments.

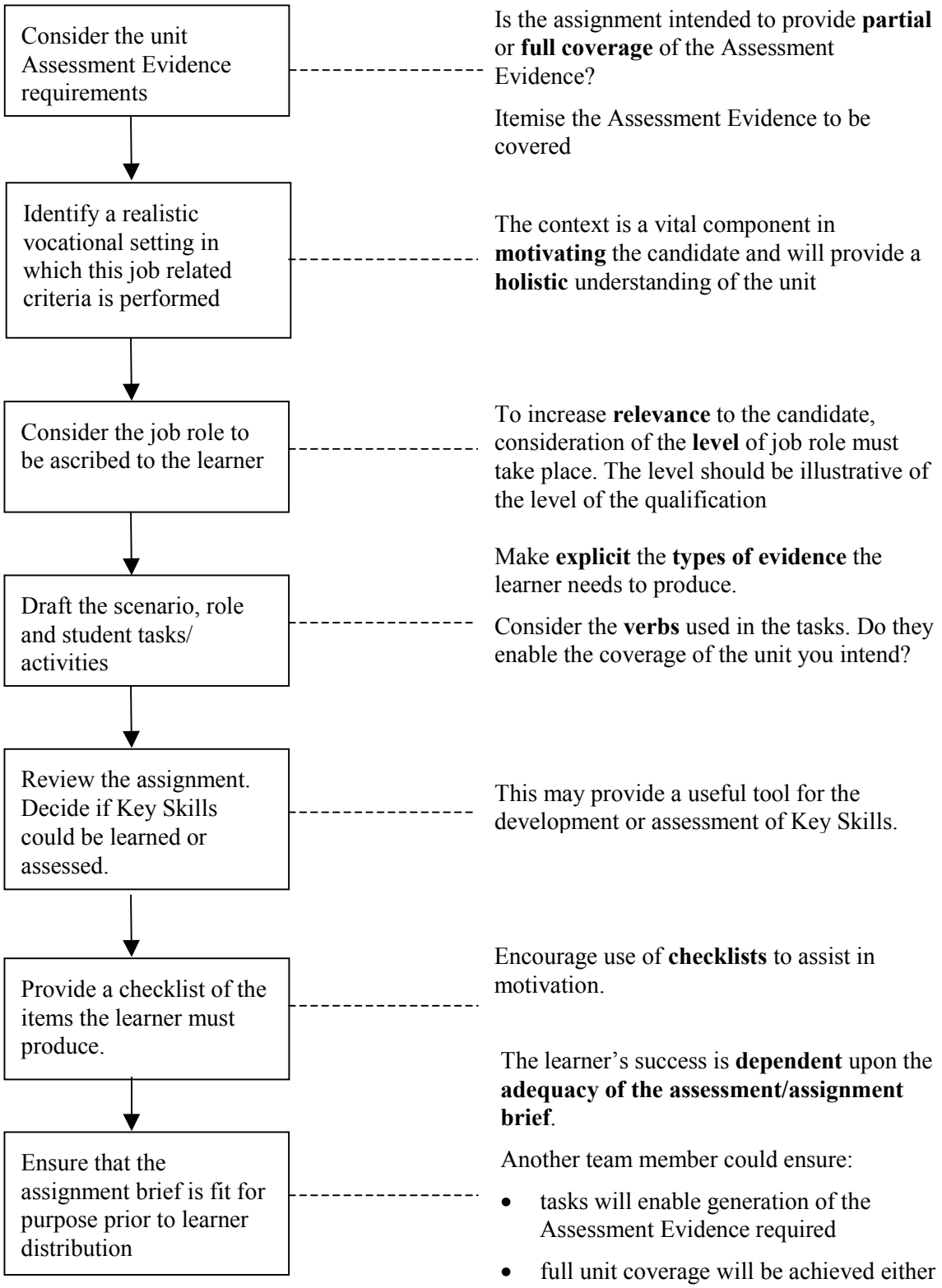
The design of an assignment should allow students to achieve at different levels. Students will require support and guidance in order to make good progress across the grade boundaries and this will be characterised by:

- increasing breadth and depth of understanding
- increasing coherence, evaluation and analysis
- increasing independence and originality.

Whilst an overall assignment brief may exist, it should be broken down into small tasks that require short spans of activity. This approach should allow access to the assignment for those students performing at level 1. Whilst GCSE Engineering lends itself to a design and make project, this approach would not be helpful to those students working at level 1, although motivation may be higher. A design and make type project could be used as the outcomes from Unit 1, a product specification and a set of engineering drawings, could become the input for Unit 2. If this approach is contemplated the centre must make sure, through careful guidance and support at the initial client brief and design stages, that the final design and product is suitable for planning and making in Unit 2.

The assignment brief should also have opportunities for those performing at the higher levels and should allow them to evidence and demonstrate their level of performance, as indicated at mark band 3 of the assessment grid.

The following represents a methodology that could be followed to develop an appropriate assignment and learning activity:


Consider the unit Assessment Evidence requirements
Is the assignment intended to provide **partial** or **full coverage** of the Assessment Evidence?
Itemise the Assessment Evidence to be covered
Identify a realistic vocational setting in which this job related criteria is performed
The context is a vital component in **motivating** the candidate and will provide a **holistic** understanding of the unit
Consider the job role to be ascribed to the learner
To increase **relevance** to the candidate, consideration of the **level** of job role must take place. The level should be illustrative of the level of the qualification
Draft the scenario, role and student tasks/ activities
Make **explicit** the **types of evidence** the learner needs to produce.
Consider the **verbs** used in the tasks. Do they enable the coverage of the unit you intend?
Review the assignment. Decide if Key Skills could be learned or assessed.
This may provide a useful tool for the development or assessment of Key Skills.
Provide a checklist of the items the learner must produce.
Encourage use of **checklists** to assist in motivation.
Ensure that the assignment brief is fit for purpose prior to learner distribution
The learner's success is **dependent** upon the **adequacy of the assessment/assignment brief**.
Another team member could ensure:
• tasks will enable generation of the Assessment Evidence required
• full unit coverage will be achieved either with the assignment brief or across several briefs
• learners will know what they have to produce and why
• language used in the brief is suitable for the level of candidates.

By identifying the centres strengths and weaknesses in terms of utilising the resources required to meet the needs of the programme, the course team should be able to develop assignments based around the support and partnership activities required by the vocational nature of the programme. Some centres may find that exposure to CAM, for example, is better done in partnership with a college or industry. A visit to a company employing CAM could utilise an assignment that covers aspects of Unit 2 and 3.

If teamwork is used in any of the assignments, the course team should ensure the individual roles, responsibilities and achievements of students are identified and recorded.

Assignments should be developed within the sector specific framework to meet the requirements of the centres strengths and resources.

These sectors are:

- mechanical, automotive
- engineering fabrication
- electrical and electronics, process control, computers, telecommunications.

Some assignment ideas for development into one or both of Units 1 and 2 are:

- electronic systems for measurement and control, eg movement (speed and direction), light, temperature, moisture, liquid levels
- clocks
- power supply
- sound producer
- battery charger
- electrical and mechanical toys
- micro-rover
- robots
- hovercraft
- boats – various power sources
- planes – rubber powered and electrically driven
- F1 racing car models
- windmills and other ways of harnessing renewable energy sources
- pumps (peristaltic and piston driven).

Unit 1: Design and graphical communication

Introduction

This unit attempts to simulate the work done when designing and specifying an engineered product. It allows the students to gain an understanding of the design process. Students are encouraged to analyse a customer brief, produce a product design specification, consider production constraints and quality standards, develop a number of design proposals, use a selection of drawing techniques and finally present these proposals to the customer using the most effective techniques.

This unit is about the process of designing. Students will learn about the following aspects of the design process:

- analysing client design briefs
- developing design specifications and solutions
- applying scientific principles
- producing and reading engineering drawings
- selecting appropriate drawing techniques
- communicating a design solution.

Unit overview

Background

The aim of this unit is to give students an understanding of the knowledge, techniques and procedures used by engineers in design work and graphical communications.

Summary of learning outcomes

This unit is assessed through the student's portfolio. The unit grade will be based on the portfolio grade, within the range U, G to A, A*. The higher grades are dependent upon the students achieving the high mark band criteria for the portfolio listed in the Assessment Evidence grid in the unit specification. The higher achievers will show increasing depth and breadth of knowledge, skills and understanding, increasing coherence, evaluation and analysis and increasing independence, innovation and originality.

The students will be required to provide evidence that matches the Assessment Evidence grid for this unit. The unit specification stipulates how the evidence of this practical unit is to be produced. A Design Specification and Design Solution need to be produced. The students will produce work in response to learning actives described in the later schedule, covered in the 'what you need to learn' section of the unit. Much of this work, although marked, could form part of the student portfolio of evidence, if it is needed to provide proof of assessment evidence coverage.

The learning from this unit will given students opportunities to:

- develop a range of ideas and a final design solution by analysing a client brief
- select and use a range of engineering drawing techniques
- show how a solution is fit for purpose against the product criteria.

To achieve a grade F, students will provide evidence to show:

- a basic analysis of the client brief, the development of some basic ideas, outline details of simple design solutions and limited testing of ideas
- use of a limited range of drawing techniques with sector specific standards and conventions
- a limited description of how the design meets the brief and specification.

To achieve a grade C, students will also show:

- a more detailed analysis of the client brief, the development of alternative design ideas and some detailed design solutions and a broader range of testing techniques
- broader use of drawing techniques, communicating in some detail the final solution with sector specific standards and conventions, describing the purpose of the components and features used
- a more detailed description of how the design meets the brief and specification.

To achieve a grade A, students will also show:

- an analysis of the client brief that details the justification for alternative and imaginative design ideas, detailed design solutions and use of objective testing to justify the final design solution
- use of an effective range of drawing techniques, communicating in detail the final solution with sector specific standards and conventions and explaining the purpose of the components and features used
- a detailed explanation of how the design meets the brief and specification explaining any relevant modifications.

Links to other units

There are links with *Unit 2: Engineered Products*, where the product identified and designed may well become the product chosen for manufacture. However, the teacher should consider that linking these two units would produce a long ‘design and make’ task that may well prove be too long for some students, but may improve the motivation of others. This unit builds on the experiences and prior learning from design and technology work. It also provides knowledge, skills and understanding for several National Vocational Qualification units, in Performing Engineering Operations (PEO) NVQ at level 2.

The wider curriculum

Delivery of this unit can also contribute to the students' understanding of moral, ethical, social and cultural issues, health and safety considerations and European initiatives, consistent with relevant international agreements, in the following manner:

- Social: when considering client's requirements for intended markets/customer base and representing varying sectors of society and preferences for styling aesthetics.
- Health and safety: when considering design in relation to the choice and use of suitable materials, components and particularly processes.
- European initiatives: when considering the application of production methods and materials in design, standards and conventions.

Overview of learning and assessment strategies

Teaching and learning strategies

Centres should use a wide range of learning methods in order to achieve the learning outcomes of this unit. These could include:

- question and answer sessions
- practical demonstrations
- manual drawing practice
- discussions
- practical use of workshop equipment
- practical activities and use of CAD
- research activities
- use of mathematical and scientific techniques and principles
- use of case study material and videos
- visits.

The teaching and learning activities should draw on material based in industry, wherever possible. This will help students develop vocationally focused, transferable skills.

Although this unit does not contain a mandatory requirement for the assessment of mathematical and scientific techniques and skills, these need to be applied in a variety of ways and will need to be embedded into the delivery and learning of the whole programme. Engineers need to be able to use mathematical techniques and skills and scientific principles.

Students should be actively involved in their learning. They should be encouraged to identify case studies, and apply the sector standard designing methods to their own design briefs. Group work is encouraged. However, the work presented for evidence in portfolios must be the student's own work. Discussion and analysis is standard industrial practice and should be encouraged.

The centre should, if possible, develop a range of different client briefs involving a simple product for the students to use. Alternatively, the brief could be more demanding, with a number of students working together with a view to designing separate parts for a complex product. If this approach is taken, it is important to ensure that roles and responsibilities are clearly identified.

Students will need to be provided with the opportunity to explore and analyse different presentation techniques in order to identify strengths and weaknesses. They will also need to practice these skills and techniques before assessment.

The centre will need to provide opportunities for students to present their final design solutions to a client. This client may be an industrial representative or some other person taking on a role-play part. This client should be capable of providing constructive and industrially relevant comment about the suitability of the design solution, in order to provide the student with the opportunity to comment on any appropriate modifications to the design solution.

Students wishing to attain grades around the grade C boundary, will need to show a variety of approaches, with few significant omissions in their design solution. The student is able to understand and use more information to make appropriate design choices with little or no help. There is a much clearer awareness of what the client wants which leads to a more realistic design specification and design solution. Any evaluation such as that of the strengths and weaknesses of different design solutions is appropriate, leading from a logical and well structured analysis of the clients' brief and an effective identification of key features. The method of presenting the final design solution is independently chosen, accurate and is sufficient to mainly meet the clients' requirements. There is relevant recognition of a range of symbols to support the engineering drawings.

There will be a range of engineering drawings, both manually and computer generated which have been produced in a confident way and which reflect the accurate use of appropriate information.

The development of design ideas will come from the use of a range of techniques. It is expected that no help will need to be given in the research and analysis of information and data.

Students wishing to attain grades around the grade A boundary will need to show approaches that are well considered, complete and detailed. The student is able to evaluate information and make logical design choices. There is a clear understanding of what the client wants, which leads to a design specification and design solution that is justified and accurate. Any evaluation such as that of the strengths and weaknesses of different design solutions is carried out in a confident way and leads from a balanced analysis of the client brief and an effective identification of key features. The method of presenting the final design solution is effectively chosen, accurate and is sufficient to meet the clients' requirements. It is explained in a confident manner. There is detailed recognition of a range of symbols to support the engineering drawings.

There will be a range of engineering drawings, both manually and computer generated, which have been produced in a more confident way demonstrated by a high level of skill and vocational competencies and which reflect comprehensive information that can be used effectively.

The development of design ideas will come from the use of a range of techniques and there is intelligent use of research and analysis of information and data.

Assessment strategies

Learning should be supported by an assessment programme. Opportunities should be available for peer and self-assessment in order to develop students' skills in being responsible for their own learning and development. Although this is not a mandatory requirement within the programme or unit, it is good practice to develop candidates' skills in these areas.

Assessment can consist of a combination of formative and summative assessments, depending on the method of delivery.

The assessment grid for this unit indicates the different levels of performances (1 to 3) expected from students. Each level shows descriptors that are attached or linked to the Assessment Objectives (AO) in the specification for the award.

These objectives cover:

- recalling and applying knowledge, skills and understanding
- planning and carrying out investigations and tasks in which they analyse vocational issues and problems
- gathering, recording and analysing relevant information, data and other forms of evidence evaluating evidence, making reasoned judgements and presenting conclusions.

In awarding the higher grades, the teacher should ensure that students have taken opportunities to work in an independent way, producing comprehensive work in a confident manner.

The formative assessment in the suggested teaching schedule would occur while the students are working through the initial stages covering the 'what you need to learn' section of the specification. It may also occur during the making of the product, with the teacher monitoring the students log. The summative assessment will match the Assessment Evidence grid to the students log.

As this unit is internally assessed, the assessment for this unit, although treated holistically, is in three parts:

- the development of a design specification
- the development of design ideas
- the final design solution.

Suggested delivery/activity schedule

The suggested delivery/activity schedule indicates to the deliverer the order in which to teach the topics, the learning activities and the resources associated with Unit 1. The teacher may wish to use or adapt this schedule for use with this unit. The following schedule is for centres wishing to deliver this as a stand-alone unit.

Activity number	Title	Learning/assessment activity	Resources
1	What are the client needs?	Tutor input – description and examples Student activity	Specifications Textbooks Examples of design briefs Incomplete description statements
2	Analysis of design briefs.	Tutor outlines examples Student group activity	Examples of design briefs
3	Choosing a design brief	Tutor input on design briefs Students make choice	Design briefs
4	The design specification	Tutor input Student activity Group discussion Students develop their own specification	Examples of briefs and design specifications
5	Identify client needs	Student activity Group discussion	Specifications
6	Research client needs	Tutor describes 'How to' Student activity – research	Textbooks Technical information Specifications
7	Production constraints	Tutor activity Student activity – research Students produce conclusions Reference to Unit 2 Setting the scene	Textbooks Examples of production constraints Specifications Workshop scenario
8	Initial designs	Tutor activity Student response	Textbooks Tutor support Drawing equipment
9	Standard Symbols	Group activity – matching symbols to names	Pre prepared exercise British Standards

Activity number	Title	Learning/assessment activity	Resources
10	Engineering Drawing	Tutor input – drawing techniques Student activity	Drawing equipment Drawing exercises British Standards
11	Choosing the design Evaluating strengths and weaknesses	Tutor description Student activity	Tutor support. Textbooks.
12	Use of CAD	Tutor led practical activity	CAD Practical activities
13	Presentation techniques	Tutor input – presentation techniques Students plan presentations	Textbooks Presentation resources OHPs etc

Suggested learning activities

These provide examples of activities that may be used by the tutor to cover the 'What you need to learn' part of the unit. They are designed to give the student the opportunity to practice specific areas of knowledge, understanding and practical skills.

There should be opportunities for students to practice and demonstrate the skills and knowledge required for achieving higher grades.

Activity 1

Identifying the clients needs

The tutor outlines the clients needs ie

Function – where and what the product will be used for?

Quality standards – sector and/or client quality standards

Styling aesthetics – the appearance and appeal of the product

Performance – how well the product has to perform?

Intended markets – who might use the product, competition with other similar products, client's own customer base

Size – the approximate size in three dimensions

Maintenance – planning for this during the design and manufacturing stage and for when the product is in use

Production methods and materials

Cost – including design, production and material costs

Regulations – including health and safety

Scale of production – quantity required, use of mass or batch production

A suitable student response would involve students completing sentences/missing words etc.

Activity 2

Analysis of the design brief

The tutor discusses examples of design briefs. Working in small groups/pairs, the students choose a favourite product and write a design brief for that product, perhaps using the 'key features' headings from the unit specification.

Activity 3

Selecting a design brief

The tutor discusses the design briefs, helping the students choose the most suitable one. It is best if the brief is based on a topic that the student has shown an interest in. However, it is appropriate that the brief chosen allows the student to produce a design solution that is appropriate for this level.

Activity 4

Developing a design specification

Following a general discussion regarding the design brief and how it develops into a design specification, the students discuss and discover the relationship between the brief and the specification. Examples are required for this. Focussing back on the example material, students develop their own design specification.

Activity 5

Identifying the clients needs

Following a general discussion regarding the client needs for the chosen design brief the students' list the client needs under the headings previously used in activity 1.

Activity 6

Developing researching techniques

The tutor discusses research techniques and the students research the areas they have identified.

Activity 7

Production constraints

The tutor describes and gives examples of production constraints eg labour, relevant quality standards, and then 'setting the scene', provides the students with information about workshops etc. Discussion could include what the students are doing in Unit 2.

The students then need to add this information to their design specification.

Activity 8

Developing initial design proposals

Tutor input regarding initial design proposal techniques:

Research and analysis of information and data

Consideration of scientific principles, for example recognition and use of structures and how to support and reinforce them

Generation of ideas and solutions

Evaluation of ideas, solutions, testing and subsequent modifications

2D and 3D drawing and sketching techniques

Modelling techniques.

Students need to develop some initial ideas through to at least two design proposals, including all relevant information (production, materials, cost, market and quality standards). Practice freehand sketching and perspective drawing. Simple block, flow, schematic and circuit diagrams.

Activity 9

Standard symbols

A group activity where students match a symbol to an electrical component or mechanical/pneumatic/hydraulic feature. Set this as a timed/competitive activity, ie which group can produce the most correct matches?

Activity 10

Engineering drawing techniques

Following tutor input, students practice drawing techniques. Generation of first and third angle projection drawings. Generation of assembly and exploded diagrams. Use of isometric and oblique projection. A suitable range of skills is required to enable the final design solution to be drawn. Appropriate standards to be used.

Activity 11

Selecting a design proposal

The tutor describes methods of applying product evaluation criteria to the students' design proposals. One method may be the use of a score chart where students award points depending on how well each proposal meets the design specification. The students can then choose one proposal to become the design solution.

Activity 12

Application of CAD/ICT

A teacher led activity to allow students to gain sufficient skills to produce part of their design solution using this technology. It is appropriate to include this learning opportunity at this stage of the course, as students will be motivated to do preceding work if they know that they will be allowed access to CAD upon completion of their work and activities. Where possible, designs should be linked to computer aided manufacture (CAM). There may be restrictions within the centre due to lack of some workshop resources. Links with local further education engineering departments may prove useful for training and practical work. This may be a particularly helpful way of introducing the link between computer-aided design (CAD) and computer aided manufacture (CAM).

Activity 13

Developing presentation techniques

The tutor outlines various examples of presentation techniques, highlighting the need to understand audience requirements in terms of understanding and interest.

Students need to produce a plan for the presentation of their design solution using their preferred technique, addressing the key features of the solution, including information on production constraints, and how their solution meets the clients' design brief.

Additional resources

For textbooks and websites see *Appendix A*.

For links to employers and work placement information see *Appendices B*, *C* and *D*.

Some useful publications of National Standards for drawing include:

- BS 1553 General Engineering
- BS 2917 Fluid Power Systems
- BS 308 Engineering Drawing Practice
- BS 3939 Electrical/Electronic Drawing Practice
- BS 4500 ISO System of Limits and Fits
- Manual of British Standards in Engineering Drawing and Design published by British Standards Institution in Association with Stanley Thornes (Publishers Ltd).

CAD

The CAD requirements of this unit are at an introductory level. It is not necessary for students to use very complex computer-aided design (CAD) packages at this level. Some of the smaller, inexpensive packages available such as Autosketch and Turbo CAD would be more than adequate.

Unit 2: Engineered products

Introduction

This unit attempts to simulate the work done when making an engineered product. The product produced should use a limited number of production processes, however it must have a minimum requirement of one process from a range of categories. It must have sufficient detail and complexity to capture the requirements of mechanical and electrical aspects in order to produce an electro-mechanical product. Using a product specification and being able to read and interpret engineering drawings and diagrams, are important aspects that link to the design unit of this qualification. The applications of health and safety and quality checks need consideration when creating and following a production plan.

This is a practical unit in which the student will develop a production plan and make an engineered product. The unit will develop an understanding of production planning and product engineering and help students to:

- use product specifications
- identify and use materials and components
- develop and follow a production plan
- use the processes, tools and equipment required to manufacture an engineered product
- check the quality of their work
- work to health and safety procedures.

Unit overview

Background

The aim of the unit is to give students an understanding of the knowledge, techniques and procedures used by engineers when planning and manufacturing products.

Summary of learning outcomes

This unit is assessed through the students' portfolio. The unit grade will be based on the portfolio grade within the range U, G to A, A*. The higher grades are dependent upon the students achieving the high mark band criteria for the portfolio, listed in the Assessment Evidence grid in the unit specification. The higher achievers will show increasing depth and breadth of knowledge, skills and understanding, increasing coherence, evaluation and analysis and increasing independence, innovation and originality.

The students will be required to provide evidence that matches the Assessment Evidence grid for this unit. The unit specification does not stipulate how the evidence of this practical unit is to be produced. However, the most suitable method could be a student log/diary of their activities during the preparation and making of their product. Students should be encouraged to record their performance with the aid of annotated photographs and also witness statements. Students will produce work in response to the learning activities described in the later schedule, which are covered in the 'what you need to learn' section of the unit. Much of this work, although marked, could form part of the student portfolio of evidence, if it is needed to provide proof of assessment evidence coverage.

The student log needs to allow students the opportunity to register all the work that they were personally involved with. This need not be completed at the end of each lesson. A more useful time for recording coverage could be at the end of each stage.

The learning from this unit will provide students with opportunities to:

Develop a production plan from a given product specification

Manufacture a product using a range of processes

Select and investigate the use and limitations of materials, tools and equipment

To achieve a grade F, students will provide evidence to show:

The development of a production plan, which required some help so as to ensure that key aspects of the given product specification were met. The actual plan will not be commercially accurate or acceptable in an industrial situation.

A completed engineered product that has been produced with limited competencies, reflecting a low level of skill.

During the selection and investigation into the use of materials, components, tools and equipment, the student required guidance.

To achieve a grade C, students will also show:

No help was required to create the production plan, which will be accurate with key aspects of the given product specification being met. It will be acceptable for limited industrial application.

Relevant competencies were used, reflecting a high level of skill, when making the engineered product.

During the selection and investigation into the use of materials, components, tools and equipment, guidance was less likely to be needed. The student will be more comfortable with using information obtained.

To achieve a grade A, students will also show:

The development of the production plan was carried out independently and key aspects of the given product specification were met in every aspect. The actual plan was presented to a high standard, accurate and would be acceptable in many industrial situations.

The completed engineered product was produced with relevant competencies, reflecting higher levels of skill and accuracy. During the selection and investigation into the use of materials, components, tools and equipment guidance was not needed. The student will be confident with using information obtained and will know whether or not additional information is required in order to make valid selections and judgements.

Links to other units

There are links with *Unit 1: Design and Graphical Communication* where the product identified and designed may well become the product chosen for manufacture. However, the teacher should consider that linking these two units would produce a long 'design and make' task that may prove too long for some students, but may improve the motivation of others.

This unit builds on the experiences and prior learning from design and technology work. It also provides knowledge, skills and understanding for several National Vocational Qualification units in Performing Engineering Operations (PEO) NVQ at level 2, particularly for units in machining engineering material, identifying and selecting engineering materials, finishing surfaces by applying coating or covering and joining using welding techniques.

The wider curriculum

Delivery of this unit can also contribute to the students' understanding of moral, ethical, social and cultural issues, health and safety considerations and European initiatives consistent with relevant international agreements in the following manner:

Social: when considering how a product is to be made and when considering health and safety legislation within a production plan and ensuring safety in the workplace.

Health and Safety: when using materials, components and particularly processes.

European initiatives: when considering quality standards and health and safety legislation affecting the use of materials and processes.

Overview of learning and assessment strategies

Teaching and learning strategies

Centres should use a wide range of learning methods in order to achieve the learning outcomes of this unit. These include:

- question and answer sessions
- practical demonstrations
- discussions
- practical use of workshop equipment
- practical activities
- research activities
- use of mathematical and scientific techniques and principles
- use of case study material and videos
- visits etc.

The teaching and learning activities should draw on material based in industry wherever possible. This will help students develop vocationally, focused transferable skills.

Although this unit does not contain a mandatory requirement for the assessment of mathematical and scientific techniques and skills, these need to be applied in a variety of ways and will need to be embedded into the delivery and learning of the whole programme. Engineers need to be able to use mathematical techniques and skills and scientific principles.

Excellent use can be made of visits and speakers to:

- aid the introduction of quality control and its 'real' application in industry
- provide a clear understanding of industrial practices
- raise awareness of health and safety procedures/hygiene requirements in the work place.

Students should be actively involved in their learning and should have an opportunity to fully experience and understand the types of learning situations outlined above and apply these to their own work.

To involve all students with all manufacturing processes is not required. A sensible approach may be to ensure that each student covers the mandatory requirement of evidence by using one process from each category, working as part of a team, thereby covering a wide range of processes. This would make it possible to introduce a wider range of products or slightly more complex products. This approach is however dependant upon the centres' resources.

The centre should develop a range of product specifications and production plans for the students to use. Alternatively, a product specification and production plan developed from the work within the first unit may be suitable if being delivered as a 'design and make' project.

Students wishing to attain grades around the grade C boundary will need to be given opportunities to provide evidence that they did not need help when developing their production plan. They must also be given scope to carry out a wide range of processes to a consistent standard in order to achieve the important features outlined in the product specification. Opportunities must be available for students to produce their product with relevant competencies, reflecting a higher level of skill.

Students wishing to attain grades around the grade A boundary will need to be given the freedom to provide evidence of independent planning. They should be given opportunity to demonstrate their ability to produce a detailed evaluation, which outlines how the product/outcome meets all the requirements of the product specification. Teachers should try to ensure that students can show confidence when using information to make valid selections and judgements.

Assessment strategies

Learning should be supported by an assessment programme. Opportunities should be available for peer and self-assessment in order to develop students' skills in being responsible for their own learning and development. Although this is not a mandatory requirement within the programme or unit, it is good practice to develop candidates skills in these areas.

Assessment can consist of a combination of formative and summative assessments, depending on the method of delivery.

The assessment grid for this unit indicates the different levels of performances (1 to 3) expected from students. Each level shows descriptors that are attached or linked to the Assessment Objectives (AO) in the specification for the award.

These objectives cover:

- recalling and applying knowledge, skills and understanding
- planning and carrying out investigations and tasks in which they analyse vocational issues and problems

- gathering, recording and analysing relevant information, data and other forms of evidence
- evaluating evidence, making reasoned judgements and presenting conclusions.

In awarding the higher grades the teacher should ensure that students have taken opportunities to work in an independent way, producing comprehensive work in a confident manner.

The formative assessment in the suggested teaching schedule would occur while the students are working through the initial stages covering the 'what you need to learn' section of the specification. It may also occur during the making of the product, with the teacher monitoring the students log. The summative assessment will match the Assessment Evidence grid to the students log.

As this unit is internally assessed, the assessment for this unit, although treated holistically, is in four parts:

- the development of a production plan from a given product specification
- the manufacture of a product, using a range of processes
- the testing of the product for compliance
- the selection and investigation into the use and limitations of materials, tools and equipment.

Suggested delivery/activity schedule

The suggested delivery/activity schedule indicates to the deliverer, the order in which to teach the topics, the learning activities and resources associated with Unit 2. The teacher may wish to use or adapt this schedule for use with this unit. The following schedule is for centres wishing to deliver this as a stand-alone unit.

Activity number	Title	Learning/assessment activity	Resources
1	Using a product specification	Teacher input – links between client requirements And the design brief Group activity Industrial visit or guest speaker	Handouts Textbooks Examples of products and their specifications
2	Producing a Production Plan	Teacher led discussion/ explanation. Student activity – questions and answers	Specifications Textbooks Examples of production plans Pre-prepared questions Case study
3	Use of materials	Teacher explanation Student activity – matching products to materials	Textbooks Examples of products and materials

Activity number	Title	Learning/assessment activity	Resources
4	Use of parts and components	Teacher led discussion Student activity – matching products to parts and components	Textbooks Examples of products, parts and components
5	Properties, characteristics and features	Teacher input Student activity – research	Handouts and question papers Case studies Manufacturer catalogues Internet access
6	Using processes	Practical demonstration Training on equipment H+S briefing	Workshop equipment to cover range within specification. Tools H+S procedure
7	Testing a product	Practical demonstration Training on equipment Practical work testing against specification	Workshop equipment Testing equipment Product specification

It is appropriate that students concentrate on one process from each of the following five process categories:

- material removal, such as turning, drilling, etching, milling and grinding
- shaping and manipulation, such as hammering, forming and bending
- joining and assembly, such as crimping, soldering, adhesion, wiring, threaded fasteners, welding and brazing
- heat and chemical treatment, such as tempering, hardening, etching, plating
- surface finishing, such as polishing and coating.

The teacher should try to match the production plan requirements to the resources available in the centre.

Suggested learning activities

These provide examples of activities that may be used by the teacher to cover the 'What you need to learn' part of the unit. They are designed to give the student the opportunity to practice specific areas of knowledge, understanding and practical skills.

Activity 1

Developing a product specification

Teacher explanation of the product specification including:

- size, shape, form
- materials, parts and components
- process methods, where these are specified
- quantities required, for example single unit, batch and volume production
- time scales.

Links should be made to the requirements of the client and the development of the product that emanates from this. Students could work in groups to identify the specification of several products supplied by the teacher. Following an open discussion, sample specifications could be distributed, matching these to the individual interests of students where possible. Utilising an industrial visit or guest speaker would be an advantage.

Activity 2

Preparing a production plan

General discussion led by tutor considering the product to be made and the importance of a production plan. The students need to understand and know how to make use of the information contained in a production plan. A suitable response from the students may be a question and answer session, ensuring they understand how to obtain relevant information from a given production plan.

The teacher should ensure that the students are aware of the importance of:

- materials, parts and components to be used
- processes to be used
- tools, equipment and machinery to be used
- the sequence of production, including critical production and quality control points
- production scheduling, including realistic deadlines
- how quality will be checked and inspected
- health and safety factors.

The teacher presents a case study production plan. This should be of a simple nature so as to challenge those students working at the higher level and provide them with opportunities to work towards meeting the high band mark criteria in the Assessment Evidence grids.

Activity 3

Identification of materials

The teacher explains the use of materials within the following range:

- ferrous and non-ferrous metals and alloys
- polymers, such as thermosetting polymers and thermoplastic polymers
- ceramics
- composites which combine the properties of different materials, eg bi-metal strips, carbon composites and sintered metals.

Group activity where students are involved in matching a range of products to a range of materials, recognising that some products may have more than one component.

Activity 4

Identification of parts and components

The teacher explains the use of parts and components within the following range:

- mechanical components, such as nuts, bolts, screws, springs, rivets, pins, clips, keys and drive mechanisms, including gear trains
- electrical/electronic components, such as resistors, capacitors, diodes, LED's, bulbs, wire, cable, insulators, batteries, motors, buzzers, variable resistors, thermistors, transistors and integrated circuits
- pneumatic/hydraulic components, such as directional and flow control valves, cylinders, reservoirs and filters.

Group activity where students are involved in matching a range of products to a range of parts and components, recognising that some parts and components within the products may be outside the scope of this level of qualification. It is therefore important to keep focussed on those within range.

Activity 5

Materials and processes

Teacher led discussion outlining the properties and features of materials, parts and components. The input should consider:

- ability to be shaped and formed, for example by hammering, casting, forging, forming, bending and coiling
- ability to be treated, for example by heat or chemicals
- ability to be given a surface finish, for example by painting or chrome plating
- ease of handling, for example by being small, light, no sharp edges
- cost, for example by being very expensive compared with other materials and components
- availability, for example by being available in standard sizes and standard values.

When students start to link this input with the decisions they need to make about their own product, they should be encouraged to use a range of sources such as textbooks and the internet. They should also be invited to adopt a mathematical and scientific approach to making the correct selection of parts and components. Reference to manufacturer catalogues should also be encouraged.

Activity 6

Developing manufacturing skills

Developing training skills which match the suggested processes within the students' production plans. There may be restrictions within the centre due to lack of some workshop resources. Links with local further education engineering departments may prove useful for training and practical work. This may be a particularly helpful way of introducing and using Computer Aided Manufacture (CAM) equipment.

Activity 7

Testing products

The tutor leads a practical demonstration on testing and measuring a product for fitness, for purpose against the product specification and drawings. Sufficient guidance and training on the required equipment is carried out. Students discover whether their product meets compliance with the product specification and engineering drawings.

The Production Plan

The Production Plan is an essential document, which is used to present information regarding the manufacture of a product.

The plan should contain information about materials, parts and components to be used, processes to be used, tools, equipment and machinery to be used, the sequence of production. It should include critical production and quality control points, production scheduling including realistic deadlines, how quality will be checked and inspected and health and safety factors.

The Production Plan may be presented in many different formats, designed to suit particular applications.

A production schedule can be developed utilising the information included in the Production Plan and is seen to be part of the production plan itself, albeit a separate document.

The following is an example of a typical Production Plan.

Example of an Engineering Manufacturing Production Plan

Customer Sykes Engineering Ltd		Product Alternator		Drawing number AL 04098			Date required 15th May 200X		Quantity 1200 off	
Part number	**Material type and size**	**Parts and components**	**Sequence of production**	**Process**	**Tools and equipment**	**Speeds and feeds**	**Health and safety aspects**	**Quality control checks**	**Quality standards**	**Notes**

Additional resources

Books

- *Basic Manufacturing* (Timings, Newnes) ISBN 0 7506 3650 5
- *GNVQ Intermediate Engineering* (Chapman et al, Longman) ISBN 0 582 29089 9
- *GNVQ Intermediate Engineering* (Darbyshire et al, Stanley Thornes) ISBN 0 7487 2936 4
- Norman, Riley, Urry and Whittaker – *Advanced Design and Technology Book* (Longman) ISBN 0582328314
- *NVQ 2 Engineering Mech Option Units* (Salmon, Longman) ISBN 0 582 30299 4
- TEP GNVQ Manufacturing Handbooks 14-16 and 16+ CD ROM – TEP GNVQ Manufacture

More advanced books suitable for teachers, but not students:

- *Fundamentals of Engineering* (Timings, Longman) ISBN 0 582 30583 7
- Fundamentals of Manufacturing for Engineers (Waters, UCL Press Ltd) ISBN 1 85728 338 4

An extensive list of resources can be found in *Appendix A*.

An integrated schedule unit 1 and unit 2

Suggested delivery/activity schedule – integrated schedule

The suggested delivery/activity schedule indicates to the deliverer the order in which to teach the topics, and learning activities associated with Unit 1 and Unit 2, listing the resources required. The teacher may wish to use or adapt this schedule for use these units.

The following schedule is for centres wishing to deliver this as an integrated schedule for Units 1 and 2.

Activity number	Title	Learning/assessment activity	Resources
1	What are the clients needs?	Tutor input – description and examples. Student activity	Specifications Textbooks Examples of design briefs Incomplete description statements
2	Analysis of the design brief	Tutor outlines features and examples Student group activity	Examples of design briefs
3	Using a product specification	Teacher input – links between client requirements and the design brief. Student activity Industrial visit or guest speaker	Handouts Textbooks Examples of products and their specifications
4	Choosing a design brief	Teacher input on design briefs Students make choice	Examples of design briefs
5	The design specification	Teacher input – relationship between brief and specification Student activity – group discussion Students develop their own specification	Examples of design briefs and design specifications
6	Identify client needs	Student activity – group discussion	Specifications
7	Researching client needs	Teacher describes 'How to' Student research activity	Textbooks Technical information Specifications

Activity number	Title	Learning/assessment activity	Resources
8	Use of materials	Teacher explanation Student activity – matching products to materials	Textbooks Examples of products and materials
9	Use of parts and components	Teacher led discussion Student activity – matching products to parts and components	Textbooks Examples of products, parts and components
10	Properties, characteristics and features of parts and components	Teacher input Student activity – research	Handouts and question papers Case studies Manufacturer catalogues Internet access
11	Initial designs	Teacher activity Student response	Textbooks Teacher support Drawing equipment
12	Producing a Production Plan	Teacher led discussion/explanation Student activity – questions and answers	Specifications Textbooks Examples of production plans Pre-prepared questions Case study
13	Production constraints	Teacher input – reference to unit 2, setting the scene, workshop scenario Student activity – research produces conclusions	Textbooks Examples of production constraints Specifications
14	Standard Symbols	Group activity – matching symbols to names	Pre prepared exercise British Standards
15	Engineering Drawing	Tutor input – drawing techniques Student activity	Drawing equipment Drawing exercises British Standards
16	Using processes	Tutor input – practical demonstrations, H+S procedures/briefing Student activity – training on equipment, H+S procedure	Workshop equipment to cover range outlined in specification. Tools H+S procedure/briefing

Activity number	Title	Learning/assessment activity	Resources
17	Selecting an idea	Teacher input Student activity	Evaluation criteria
18	Use of CAD	Teacher led practical activity	CAD CAM Practical activities
19	Presentation techniques	Teacher input – outline presentation techniques Student activity – plan presentations	Textbooks Presentation resources OHPs etc
20	Testing a product	Practical demonstration Training on equipment Practical work testing against specification	Workshop equipment Testing equipment Product specification

It is appropriate that students concentrate on one process from each of the following five process categories:

- material removal, such as turning, drilling, etching, milling and grinding
- shaping and manipulation, such as hammering, forming and bending
- joining and assembly, such as crimping, soldering, adhesion, wiring, threaded fasteners, welding and brazing
- heat and chemical treatment, such as tempering, hardening, etching, plating
- surface finishing, such as polishing and coating.

The teacher should try to match the production plan requirements to the resources available in the centre.

Suggested learning activities – integrated schedule

These provide examples of activities that may be used by the teacher to cover the 'What you need to learn' part of the unit. They are designed to give the student the opportunity to practice specific areas of knowledge, understanding and practical skills.

Activity 1

Identifying the clients needs

The tutor outlines the clients needs ie:

- Function – where and what the product will be used for
- Quality standards – sector and/or client quality standards
- Styling aesthetics – the appearance and appeal of the product
- Performance – how well the product has to perform

- Intended markets – who might use the product, competition with other similar products, clients own customer base
- Size – the approximate size in three dimensions
- Maintenance –planning for this during the design and manufacturing stage and for when the product is in use
- Cost – including design, production and material costs
- Regulations – including health and safety
- Scale of production – quantity required, use of mass or batch production

A suitable response would involve students completing sentences/missing words etc.

Activity 2

Analysis of the design brief

The tutor discusses examples of design briefs. Working in small groups/pairs, the students choose a favourite product and write a design brief for that product, perhaps using the 'key features' headings from the unit specification.

Activity 3

Developing a product specification

Teacher explanation of the product specification including:

- size, shape, form
- materials, parts and components
- process methods, where these are specified
- quantity required, for example single unit, batch and volume production
- time scales.

Links should be made to the requirements of the client and the development of the product that emanates from this. Students could work in groups to identify the specification of several products supplied by the teacher. Following an open discussion, sample specifications could be distributed, matching these to the individual interests of the students where possible. Utilising an industrial visit or guest speaker would be an advantage.

Activity 4

Selecting a design brief

The tutor discusses the design briefs, helping the students choose the most suitable one. It is best if the brief is based on a topic that the student has shown interest in. However, it is appropriate that the brief chosen allows the student to produce a design solution that is appropriate for this level.

Activity 5

Developing a design specification

Following a general discussion regarding the design brief and how it develops into a design specification, the students discuss and discover the relationship between the brief and the specification. Examples are required for this. Focussing back on the example material, students develop their own design specification.

Activity 6

Identifying the clients needs

Following a general discussion regarding the client needs for the chosen design brief the students' list the client needs under headings previously used in activity 1.

Activity 7

Developing research techniques

The tutor discusses research techniques and students research the areas they have identified.

Activity 8

Identification of materials

The teacher explains the use of materials within the following range:

- ferrous and non-ferrous metals and alloys
- polymers, such as thermosetting polymers and thermoplastic polymers
- ceramics
- composites which combine the properties of different materials, eg bi-metal strips, carbon composites and sintered metals.

Group activity based on students matching a range of products to a range of materials, recognising that some products may have more than one component.

Activity 9

Identification of parts and components

The teacher explains the use of parts and components within the following range:

- mechanical components, such as nuts, bolts, screws, springs, rivets, pins, clips, keys and drive mechanisms, including gear trains
- electrical/electronic components, such as resistors, capacitors, diodes, LEDs, bulbs, wire, cable, insulators, batteries, motors, buzzers, variable resistors, thermistors, transistors and integrated circuits
- pneumatic/hydraulic components, such as directional and flow control valves, cylinders, reservoirs and filters

Group activity where students are involved in matching a range of products to a range of parts and components, recognising that some parts and components within the products may be outside the scope of this level of qualification. It is therefore important to keep a focus on those within range.

Activity 10

Materials and processes

Teacher led discussion outlining the properties and features of materials, parts and components. The input should consider:

- ability to be shaped and formed, for example by hammering, casting, forging, forming, bending and coiling
- ability to be treated, for example by heat or chemicals
- ability to be given a surface finish, for example by painting or chrome plating
- ease of handling, for example by being small, light, no sharp edges
- cost, for example by being very expensive compared with other materials and components
- availability, for example by being available in standard sizes and standard values.

When students start to link this input with the decisions they need to make about their own product, they should be encouraged to use a range of sources such as textbooks and the internet. They should also be invited to adopt a mathematical and scientific approach to making the correct selection of parts and components. Reference to manufacturer catalogues should also be encouraged.

Activity 11

Developing initial design proposals

Teacher input regarding initial design proposal techniques:

- research and analysis of information and data
- consideration of scientific principles, for example recognition and use of structures and how to support and reinforce them
- generation of ideas and solutions
- evaluation of ideas, solutions, testing and subsequent modifications
- 2D and 3D drawing and sketching techniques
- modelling techniques.

Students need to develop some initial ideas through to at least two design proposals, including all relevant information (production, materials, cost, and market and quality standards). Practice freehand sketching and perspective drawing. Simple block, flow, schematic and circuit diagrams.

Activity 12

Preparing a production plan

General discussion led by the teacher considering the product to be made and the importance of a production plan. The students need to understand and know how to make use of the information contained in a production plan. A suitable response from the students may be a question and answer session ensuring they understand how to obtain relevant information from a given production plan.

The teacher should ensure that the students are aware of the importance of:

- materials, parts and components to be used
- processes to be used
- tools, equipment and machinery to be used
- the sequence of production, including critical production and quality control points
- production scheduling, including realistic deadlines
- how quality will be checked and inspected
- health and safety factors

The teacher presents a case study production plan This should be of a simple nature so as to challenge those students working at the higher level and provide them with opportunities to work towards meeting the high mark band criteria in the Assessment Evidence grids.

As a final design has not yet been decided upon and approved, the teacher should guide students to use one of their current design ideas to begin to prepare a production plan. At the discretion of the teacher and student, this may be changed, in the light of the final design and access to the manufacturing processes.

Activity 13

Production constraints

The tutor describes and gives examples of production constraints eg labour, relevant quality standards, and then 'setting the scene' provides the students with information about workshops etc. Discussion could include what the students are doing in Unit 2. The students then need to add this information to their design specification.

Activity 14

Standard symbols

A group activity where students match a symbol to an electrical component or mechanical/pneumatic/hydraulic feature. Set this as a competitive activity, ie which group can produce the most correct matches?

Activity 15

Engineering drawing techniques

Following tutor input, students practice drawing techniques. Generation of first and third angle projection drawings. Generation of assembly and exploded diagrams. Use of isometric and oblique projection. A suitable standard and range of skills are required to enable the final design solution to be drawn. Appropriate standards to be used.

Activity 16

Developing manufacturing skills

Developing training skills which match the suggested processes within the students' production plans. There may be restrictions within the centre due to lack of some workshop resources. Links with local further education engineering departments may prove useful for training and practical work. This may be a particularly helpful way of introducing and using Computer Aided Manufacture (CAM) equipment.

Activity 17

Selecting a design proposal

The tutor describes methods of applying product evaluation criteria to the students design proposals. One method may be the use of a score chart where students award points depending on how well each proposal meets the design specification. The students can then choose one proposal to become the design solution.

Activity 18

Application of CAD/ICT

A teacher led activity to allow students to gain sufficient skills to produce part of their design solution, using this technology. It is appropriate to include this learning opportunity at this stage of the course, as students will be motivated to do preceding work if they know that they will be allowed access to CAD upon completion of their work and activities. Where possible, designs should be linked to computer aided manufacture (CAM). There may be restrictions within the centre due to lack of some workshop resources. Links with local further education engineering departments may prove useful for training and practical work. This may be a particularly helpful way of introducing the link between computer-aided design (CAD) and Computer Aided Manufacture (CAM).

Activity 19

Developing presentation techniques

The tutor outlines various examples of presentation techniques, highlighting the need to understand audience requirements in terms of understanding and interest. Students need to produce a plan for the presentation of their design solution using their preferred technique, addressing the key features of the solution, including information on production constraints and how their solution meets the clients' design brief.

Activity 20

Testing products

The tutor leads a practical demonstration on testing and measuring a product for fitness, for purpose against the product specification and drawings. Sufficient guidance and training on the required equipment is carried out. Students discover whether their product meets compliance with the product specification and engineering drawings.

Unit 3: Application of technology

Introduction

This unit attempts to identify the way technology affects products and companies, particularly in the stages of design and manufacture. It focuses on interesting developments that have changed the ways items are produced. The positive aspects of technology are stressed. Appropriate considerations to improvements in quality through using technology and the benefits and implications modern technology has for the work force, the wider community, the global environment and sustainability are considered.

This is a practical unit, in which the student will investigate the impact of technology covering the following fields:

- information and communication technology
- new components and a range of modern materials, including smart materials
- control technology.

Unit overview

Background

The aim of the unit is to give the students an understanding of the application of appropriate technology in the design and manufacture of engineered products.

Summary of learning outcomes

This unit is assessed through an external assessment. The student must be entered for an assessment in one of the six following sectors:

- engineering fabrication
- mechanical, automotive
- electrical and electronic, process control, computers, telecommunications
- food and drink, biological and chemical
- printing and publishing, paper and board
- textiles and clothing.

Students are asked to answer a range of questions, which relate to the sector chosen. The unit grade will be based on the performance in this external assessment and will be within the range U, G to A, A*. The higher achievers will show increasing depth and breadth of knowledge, skills and understanding, increasing coherence, evaluation and analysis and increasing independence and originality.

The learning from this unit will give students opportunities to:

- investigate the impact of technology on the design and manufacture of different products across engineering and manufacturing sectors
- look at the use of ICT, modern materials and components, systems and control in the application of design and manufacture of products
- understand the impact of these technologies and the advantages and disadvantages it has brought to society
- investigate stages in engineering and manufacture and the use of modern technology.

To achieve a grade F, students must provide evidence to show:

In the external test, students will be able to show that they can link products to sectors, know the stages of production and describe technology and its development. Their answers to questions are likely to be short and limited to simple concepts.

To achieve a grade C, students will also show:

In the external test, students will be able to demonstrate that they can use technical terms correctly, explain and describe technology and it's benefits and limitations. Their answers are likely to show greater depth.

To achieve a grade A, students will also show:

In the external test, students will be able to demonstrate that they can explain and describe technology, its benefits and limitations and predict trends in the use of technology. Their answers to questions are likely to expand on details more fully.

Links to other units

This and other units will utilise prior learning in design and technology. This unit links with *Unit 1: Design and Graphical Communication* and *Unit 2: Engineered Products*, where students will have the opportunity to use new technology and materials. This unit may also help them to progress on to Vocational A levels in Engineering or Manufacturing. This unit also forms part of a Vocational GCSE in Manufacturing.

This unit provides some of the underpinning knowledge and understanding for the National Vocational Qualification in Performing Manufacturing Operations and Performing Engineering Operations.

The wider curriculum

Delivery of this unit can also contribute to the students' understanding of moral, ethical, social and cultural issues and European initiatives consistent with relevant international agreements in the following manner:

- *Social*: when considering the impact and implications of technology such as the use of robots etc.
- *Environment*: the use of certain materials.
- *European initiatives*: when considering health and safety legislation affecting the use of new materials, components and processes.

Overview of learning and assessment strategies

Teaching and learning strategies

Centres should use a wide range of learning methods in order to achieve the assessment outcomes of this unit. These include:

- question and answer sessions
- visiting speakers
- general instruction in advances in new technology
- interviews and research to determine uses of new technology
- website access
- discussions
- practical use of workshop equipment
- practical activities
- examining individual products
- group 'quiz' on technical terminology
- practical use of CAD systems etc
- producing basic diagrams and mock-ups of designed products using ICT
- research activities
- use of mathematical and scientific techniques and principles
- use of case study material and videos
- visits etc.

The teaching and learning activities should draw on material based in industry wherever possible. This will help students to develop vocationally focused transferable skills.

Excellent use can be made of visits and speakers, to study the impact of technology and see its 'real' application in industry. Students should be actively involved in their own learning and should have an opportunity to fully experience and understand the types of learning situation outlined above, and apply these to their own work.

Students will be asked to investigate a given product through pre-release material, which will be notified in September each year. When examining a product, it is useful if it can be taken apart and examined. This helps introduce a practical activity into the unit and provides information about materials and components. When doing so, this will not only maintain student interest but will also allow them to see clearly how products are structured and how they work. An outcome of this work could take the form of a sectioned display, which is annotated by students. Research on the internet will consolidate their findings.

It is helpful if students have seen a modern production process. Students should appreciate that changing technologies affect many aspects of engineering, including design, production planning and operations. For example, automation can be used for quality monitoring. Good simulations of automation and other new technologies can be achieved by using the equipment available from educational suppliers.

The external assessment for this unit will be in the form of a graded test. The sample test provided by Edexcel consists of a series of open-ended questions, some of which indirectly relate to the practical research that students have carried out as part of their learning and established in their portfolio. The students should draw upon their learning in response to the questions to achieve the higher grades. Other questions are more general and will test the students understanding of general principles and practices of technology.

Assessment strategies

Learning should be supported by an assessment programme. Opportunities should be available for peer and self-assessment, in order to develop students' skills in being responsible for their own learning and development. Although this is not a mandatory requirement within the programme or unit, it is good practice to develop the candidates' skills in these areas.

Assessment should consist of formative assessments depending on the method of delivery. Feedback of student performance is vital to ensure that learning is taking place at an appropriate rate to allow all students access to the external assessment.

The formative assessment in the suggested teaching schedule would occur while the students are working through the initial stages covering the 'what you need to learn' section of the specification. Edexcel will carry out the summative assessment in the external assessment.

Suggested delivery/activity schedule

The suggested delivery/activity schedule indicates to the deliverer the order in which to teach the topics, learning activities and resources associated with Unit 3. The teacher may wish to use or adapt this schedule for use with this unit.

Topic	Title	Learning/assessment activity	Resources
1	Introduction to unit and the required product	Tutor input Tutor led example of technology used in relation to a particular product. Group exercise on choosing possible products to investigate. The pre-release requirement.	Notes and handouts Assignment on new technology Product identification pro-formas List of examples of possible products that could be used. Pre-release material
2	Engineering sectors and fields of application	Tutor input Recognising the products of different engineering sectors. Recognising the products of different fields of application	Notes and handouts Exercise on relating a list of products to a list of sectors and fields.

Topic	Title	Learning/assessment activity	Resources
3	Information and Communications Technology (ICT)	Tutor input Exercise on types of new technology The advantages and disadvantages of new technology Costs and savings	Notes and handouts Access to practical areas eg CAD, CAM etc Samples of the products Industrial visit Group exercise
4	New Materials and Components	Tutor input Exercise to identify where new materials are used	Notes and handouts Visiting speaker Video Group exercise
5	Control Technology	Tutor input Exercise to identify different types of control technology, application of automation, robotics and PLC's	Access to new Technology Tutor briefing and demonstration by practitioner. Health & Safety check Industrial visit
6	Stages in Engineering and Manufacturing	Tutor input Company visit – identifying stages	Company visit Check list and brief
7	Investigating a product	Practical investigation and research	Pre-release material and instructions Access to research material and internet etc.
8	External Assessment Preparation	Revision of test papers Guidance on performance	Specimen test papers

Please note students must be **fully** briefed, appropriately supervised, provided with all safety equipment and suitably trained in accordance with the requirements of Health and Safety legislation, before operating any dangerous item of new technology

Suggested learning activities

These provide examples of activities that may be used by the tutor to cover the 'What you need to learn' part of the unit. They are designed to give the student the opportunity to practice specific areas of knowledge, understanding and practical skills.

At this level students only need to learn about new technology at an introductory level. It is not necessary for students to know how to use the technology at this stage, although practical use or demonstration in areas such as CAD and CAM is usually stimulating and motivational.

Activity 1

Introduction to the unit and the required product

Using product identification pro-formas and a list of examples of possible products that could be used, the tutor outlines the requirements of the unit and explains the requirements of the pre-release material. Students carry out a group exercise in choosing a product, identifying reasons for their selection.

Activity 2

Learning about engineering sectors and fields of application

The aim of this activity is to provide the student with a basic appreciation of what constitutes a 'sector' of the engineering industry and what sort of products might be produced in any sector and where they are used.

After tutor input on the features of an engineering sector and the different fields where products are used and a general class discussion, the following exercise is conducted. The class is divided in teams of not more than three persons. Suitably displayed, for the student's use, is a list of the major engineering sectors including:

- engineering fabrication
- mechanical, automotive
- electrical and electronics, process control, computers, telecommunications
- food and drink, biological and chemical
- printing and publishing, paper and board
- textiles and clothing.

Students are then provided with a list of about 30 products, all of which are known to the students and they are then asked to place each product in one or more engineering sectors (eg a compression spring might be placed in both automotive and mechanical sectors). It is likely that at the feedback stage, some discussion will ensue. It is important that the tutor is flexible and that where there is ambiguity, teams are encouraged to justify their decisions. The teams should also discuss and decide which field of application is suitable for the given products.

Activity 3

Learning about the types of Information and Communications Technology (ICT)

The aim of this activity is to establish the range of Information and Communications Technology (ICT). This is important because the student will appreciate the range of ICT applicable to their product. An important part of this activity is for the tutor to arrange a visit to an engineering company in advance and obtain as much information as possible on that organisation's operations.

A visit to the company takes place, before which students are issued with a questionnaire (if the company is co-operative, then they could have notice of the questionnaire). This questionnaire is designed to encourage the students to observe all the various stages of application of Information and Communications Technology (ICT) and to 'spot' and make a note of the application on their tour of the operations. The students should be encouraged to seek information about advantages and limitations that could promote findings on costs and savings. On their return to the centre, the students work in groups to identify what Information and Communications Technology (ICT) were seen and at what stages they were encountered.

Activity 4

Identifying new materials and components

This activity will vary widely between centres and will depend upon the centres' links with industry. Not all centres will have access to many modern material structures, such as modern alloys. Using the same product list as in activity 1, with alterations to suit the centre, arrange the students into groups of 3 or 4 and ask them to think about what the materials need 'to be' or 'have'. You are trying to get them to realise where materials have been improved with the use of new technology to suit their function.

Activity 5

Identifying different types and application of automation, robotics and PLC's

Again, the best way to achieve this is through an industrial visit. If this is not possible, videos can be used or demonstrations on practical kits. If a visit is used, the students **must** be briefed on health and safety matters first. A similar exercise to that in activity 3 should be used.

Activity 6

Stages in Engineering

A company visit to identify the important stages and activities involved in making a product. If the company produces different products, students could independently discover the stages for a particular product by talking to company personnel. Upon returning to the centre, they could present their findings to the rest of the group, justifying why these stages are used.

Activity 7

Investigating a product

Using the pre-release material, the students investigate the product for their chosen sector. They should mirror image the activities previously carried out.

Activity 8

External assessment preparation

Teachers must ensure students are prepared for the external assessment. This will include, familiarising students with the format and structure of the assessment. They should be clear about the rules and regulations of external assessments and they should also be reminded of the duration and aims of the assessment. In other words, they should be well rehearsed in the format and structure of external assessments.

Students should understand the terminology of assessment, eg describe, explain and evaluate. Teaching time should be allocated to support students with this. The external assessment aims to assess the vocational knowledge skills and understanding of the student. Teachers should be aware of marking schemes and their implications and students should practise effective time management for the external assessment. Using exemplar and past papers allows students to practice in examination conditions.

Suggested assessment activities

These are examples, which you can develop to provide students with opportunities to demonstrate their knowledge and understanding.

These activities are only **examples** and should **not** be regarded as the assessment activities for this unit. They can be used as a formative assessment tool to allow feedback of student performance, during their learning.

Activity 1

Choosing and analysing a product and planning research for the investigation

After fully briefing the students and working through an example, the tutor should allow the students to choose an engineered product around which they will base their investigation. Bearing in mind the level of the course, it is advisable for students, in conjunction with the tutor, to pick a product that is:

- relatively non-complex products (eg *not* a car, computer, central heating boiler etc, but something like a small child's toy or a CD player)
- supported by information from the manufacturer, trade papers, advertising, the internet or publicity material
- ideally produced locally, thus allowing a direct approach and possibly a visit by the student.

Students should draw up an action plan of what information they need to obtain about the product, how they will obtain this and when this will be achieved. Again, this should be done with the support of the tutor. Students should make a clear note of their reasons for choosing the product (eg it may be produced at a factory where a relative is employed) and what engineering or manufacturing sector they consider the product to be in, with justification.

Activity 2

Researching the product of their choice

Students now carry out the research action plan they prepared in the above activity. To ensure that all the investigative requirements stated in the unit specification are being met, the tutor should check what the student plans to research. The tutor may supply the students with a form on which to collect information or may allow students to prepare their own form. Students then conduct the research in the ways that they have planned, revising and modifying their action plan as necessary. It is worthy of note that many companies are slow in responding to requests for information, especially if they have websites on which information can be requested or is already provided. This information is then collated and is incorporated into sections, possibly in a portfolio under the areas of:

- information about their chosen products based on data from manufacturers and suppliers
- an investigation of the product
- details of the impact this product has had on people and companies
- a description of the importance of new technology on the sector of engineering that makes the product.

External assessment

The external assessment for this unit will be in the form of a graded test. The sample test provided by Edexcel consists of a series of open-ended questions, some of which directly relate to the practical activity that they have carried out as part of their learning and pre release activity. The students should draw upon their learning in response to the questions, to achieve the higher grades. Other questions are more general and will test the students understanding of general principles and practices of appropriate technology.

The assessment may require additional materials such as pre-released material and case studies. This may require additional support, which should be planned for as part of the teaching strategy.

This is an open ended test, where students are able to bring their research into the examination room and use it as reference material. Non of this research is to be sent to Edexcel or marked as part of the examination.

Students need to be able to apply the knowledge, skills and understanding of the unit to the demands of the questions set. The ability to transfer knowledge, skills and understanding to different situations is an invaluable preparation for employment, training and further education. External assessment is one example where this transference is critical, eg coping with the controlled conditions of an external assessment, the imagined scenarios and responding to questions.

Additional resources

Because of the nature of this unit, it is unlikely that textbooks will be of much use to the student and much reliance will be placed upon materials prepared by the teacher or materials supplied through manufacturing organisations' own literature. The internet will be of particular interest to students wishing to gain a broad range of information on products and technology.

For an extended list of potential resources, consult *Appendix A*.

Employers and manufacturers federations, consult *Appendices B*, *C* and *D*

A comprehensive range of products, parts and components are required for product investigation.

Internal assessment procedures

Supervision of students and authentication of work submitted

Students must submit a portfolio of work for each of Units 1 and 2. Teachers are expected to guide and advise students in the production of their portfolios. Teachers should monitor progress, to ensure that the work is appropriate for the requirements of the specification. While some work, particularly in the early planning stages, may take place in groups, the input of the individual student should be clearly identified and the judgements and conclusions reached must be their own. The GCSE, GCE, VCE and GNVQ Code of Practice requires that assessors record full details of the nature of any assistance given to individual candidates, that is beyond that of the teaching group as a whole, but within the parameters laid down in this specification. The level of assistance should be taken into account when assessing students' work, as indicated in the guidance section that accompanies each internally assessed unit in the specification. In addition, sufficient work must take place under direct supervision to allow the teacher marking the work to authenticate each student's work with confidence.

If student process skills are being assessed, it is important that Witness Statements and Observation Records are completed by assessors to authenticate student work and provide evidence that students have achieved the level of performance required in the assessment grid.

Assessment

The work of each student must be assessed using the assessment evidence grids, which contains criteria statements and bands of response. The assessment must be completed by centres on the Mark Record Sheets which are used to convert achievement levels to marks. A copy of these forms are contained in the appendix at the back of this document and should be photocopied and attached to each students portfolio.

Annotation

Annotation is a mandatory requirement for internally assessed work and is used to:

Help the moderator to understand how and where marks for each assessment criteria have been awarded.

Describe where students have received help beyond normal learning support or where students have been rewarded for initiatives that are not immediately apparent from the evidence presented.

Explain any other features of a students work that will assist the moderator in understanding how a particular assessment was arrived at

The minimum requirement for annotation is to complete the annotation column on the Mark Record Sheet by listing the portfolio page numbers where evidence can be found for each of the assessment criteria.

Further comments can be carried out on the back of the Mark Record Sheet. Detailed annotation will help a moderator to agree a centres marks.

Annotation should not be written directly onto students work.

Standardisation within the centre

It is the centres responsibility to ensure that where more than one teacher has marked the work, internal standardisation has been carried out. This procedure ensures that the work of all students at the centre is marked to the same standards and that an accurate rank order is established.

Internally assessed portfolios

Following assessment, all portfolios must be available for inspection by Edexcel. Each students portfolio should contain only the work used for awarding marks for the assessment.

Portfolios must have a title page with the relevant specification name and number, candidate name, candidate number, centre name, centre number, and date. The first page of the portfolio should be a contents list and pages should be numbered throughout the portfolio.

A sample of the work will be requested and must be sent to Edexcel to arrive no later than 15 May in the year of the examination. No practical work is to be submitted to Edexcel unless specifically requested.

The moderated coursework will be returned to centres in the Autumn term in the year of the examination. Edexcel reserves the right to retain examples of folders for archive, grading or training purposes.

Support and training

There is a full range of support material designed for each GCSE in a vocational subject. The range includes:

- specimen tests and associated mark schemes
- sample materials for delivering the units – tutor support packs
- sample materials for assessing the internal units
- examiner reports
- the Edexcel website – www.edexcel.org.uk.

Edexcel delivers a full INSET programme to support these GCSEs. This includes generic and subject-specific conferences, seminars, workshops and customised events for individual centres.

Further information on INSET programmes can be obtained from Customer Services on 0870 240 9800.

E-mail for enquiries – trainingenquiries@edexcel.org.uk

E-mail for bookings – bookingenquiries@edexcel.org.uk

Information concerning support material can be obtained from:

Edexcel Publications
Adamsway
Mansfield
Notts NG18 4FN

Tel: 01623 467467
Fax: 01623 450481
E-mail: publications@linneydirect.com

Appendices

Appendix A

Publications and materials list

The following list contains resources that have been found useful by teachers.

The list is divided into two sections: Books and Websites.

Books

Nuffield Secondary Design and Technology produce materials for students at KS3 and KS4. These materials are designed to meet the requirements of the National Curriculum and are suitable for all GCSE Examination Board Syllabuses.

The project has revised the Key Stage 3 publications

14 – 16 Nuffield Design and Technology materials

Product Design: Student's Book (ISBN 0582 234697)
Product Design: Teacher's Guide (ISBN 0582 290732)

Food Technology: Student's Book (ISBN 0582 234662)
Food Technology: Resource Task File (ISBN 0582 290759)
Food Technology: Teacher's Guide (ISBN 0582 290716)

Graphics: Student's Book (ISBN 0582 234689)
Graphics: Resource Task File (ISBN 0582 290767)
Graphics: Teacher's Guide (ISBN 0582 290724)
Textiles: Student's Book (ISBN 0582 234670)
Textiles: Resource Task File (ISBN 0582 290775)
Textiles: Teacher's Guide (ISBN 0582 290708)

Electronic Products: Student's Book (ISBN 0582 317754)
Electronic Products: Resource Task File (ISBN 0582 317657)
Electronic Products: Teacher's Guide (ISBN 0582 317703)

NB At KS4 the Teacher's Guide contains the photocopiable masters of the Capability Tasks.

Free sample materials are available for all these titles – just call the freephone number 0800 579 579.

Gatsby Technical Education Project

The Gatsby Technical Education Project has been established for the advancement of education for the benefit of the public, by the support and development of excellence in mathematics, science, technology, engineering, information technology and other academic areas.
GTEP is developing programmes to:

- demonstrate innovative, effective teaching of science, mathematics and technology
- involve industry
- collaborate with industry and the government in the direction of support and funding.

Some relevant TEP publications

Transmitting power: engineering product design for KS4

Case study: Backhoe loader

Projects: (1) Pneumatics, (2) Micro-rover

Library: components, design strategies, equipment and tools, manufacturing processes, materials, technical terms, workshop techniques, technical concepts

Text files: various parts of the CD ROM may be printed or text saved for inclusion in other documents

Virtual Reality Library

Animations illustrating mechanical, electrical and manufacturing key concepts

Material selection and processing

The machine tool industry – manufacturing innovation. This provides a huge number of industrial examples, covering 'A bountiful world', 'A productive world', 'A happier healthier world', 'A smaller world', 'A safer world', 'Just another world'. It could provide the basis of a good research exercise, to see the impact of the machine tool industry. There is also a curriculum support section that comes with a 'Manufacturing Innovation Curriculum Support Pack'. It includes a competition to make a model F1 racing car driven by a small CO2 cylinder. This is a national competition run by Denford.

Nuffield GNVQ Intermediate Assignments

Nuffield Science in Practice (GNVQ Intermediate Science Assignments):

An automatic night light, p 152-155

A rain alarm, p 156-161

Messages at light speed, p 162-164

Making a seed propagator, p 165-168

Some useful textbooks

Engineering GNVQ: Intermediate

Mike Tooley, Second Edition, Newnes, 2000

Introducing Electronic Systems

MW Brimicombe, Nelson, 1987

Design in the Making

Longman
(Publication is aimed essentially at 11-14 year olds, but with useful information and worksheets)

Nelson Thornes

Design & Make It! for Key Stage 3 has been written by teachers to support pupils as they work through their Key Stage 3 course in D+T. It is designed to prepare pupils for their GCSE course, by presenting material at an introductory level, for subsequent review and extension. There are colour textbooks for Food Technology, Textiles Technology and Product Design (which incorporates Resistant Materials, Graphic Products, Electronic Products and Systems and Control). Design & Make It! Key Stage 3 Assessment Resources give reliable judgements of pupils' levels of attainment at the end of Key Stage 3, by the use of structured 'design & make' assignments. Design & Make It! For GCSE, consists of fully integrated teaching materials and syllabuses, including support for teachers leading to better results for students. There are colour textbooks for Electronic Products, Food Technology, Graphic Products, Resistant Materials Technology, Systems and Control Technology and Textiles Technology. A team of authors and examiners has prepared each textbook, to give a clear indication of the appropriate work needed for success with coursework and written papers. The following products all form part of the series:

Design & Make It! – Electronic Products Revised Edition

Design & Make It! – Product Design for Key Stage 3

Design & Make It! – Product Design for Key Stage 3 Teacher Support Pack

Design & Make It! – Systems and Control Technology Revised

Engineering Materials 1: An Introduction to their Properties and Applications
David R H Jones, Michael Ashby
Price: £20.99
ISBN: 0750630817
Published: 09/10/1996
This book gives a broad introduction to the properties of materials used in engineering applications

Materials Selection in Mechanical Design
Michael Ashby
Price: £25.99
ISBN: 0750643579
Published: 04/06/1999
New materials enable advances in engineering design. This book describes a procedure for material selection

Electronic and Electrical Servicing: Level 2
Ian Sinclair
Price: £16.99
ISBN: 0750654236
Published: 18/02/2002
Servicing Electronic Systems is the key to success in City & Guilds / EEB courses in electronic servicing.

Mechanical Engineering: Level 2 NVQ
David Salmon, Penelope Powdrill
Price: £16.99
ISBN: 0750654066
Published: 21/01/2002
A thoroughly accessible and engaging workbook-style text, ideal for all NVQ students.

Electronic Circuits: Fundamentals and Applications
Mike Tooley
Price: £16.99
ISBN: 0750653949
Published: 10/12/2001
The essential textbook for students following pre-degree level courses, technician engineers, and all.

IEE Wiring Regulations: Explained and Illustrated
Brian Scaddan
Price: £9.99
ISBN: 0750654686
Published: 12/11/2001
The classic handy reference guide for everyone involved in electrical installation such as contractors and designers.

IEE Wiring Regulations: Inspection, Testing and Certification of Electrical Installations
Brian Scaddan
Price: £9.99
ISBN: 0750654694
Published: 12/11/2001
Brian Scaddan's guides to the IEE Wiring Regulations have established themselves as an industry standard.

IEE Wiring Regulations: Design and Verification of Electrical Installations
Brian Scaddan
Price: £9.99
ISBN: 0750654708
Published: 12/11/2001
Designed to provide all the key data and information needed by engineers.

Fundamental Electrical and Electronic Principles
C R Robertson
Price: £15.99
ISBN: 0750651458
Published: 01/10/2001
Fundamental Electrical and Electronic Principles covers the essential principles that form the foundations.

Electronics Made Simple
Ian Sinclair
Price: £12.99
ISBN: 075065368X
Published: 04/02/2002
Electronics Made Simple is a thorough, and thoroughly readable guide to modern electronics.

Basic AC Circuits
Clay Rawlins
Price: £25.00
ISBN: 0750671734
Published: 14/09/2000

Basic AC Circuits, 2/E is a step-by-step approach to AC circuit technology for the beginning student, hobbyist, technician, or engineer. The book is built into a series of self-paced, individualised learning goals covering electronics concepts, terms and the mathematics required to fully understand AC circuit problems-simple or complex. Each chapter includes learning objectives, fully illustrated examples, practice problems and quizzes providing teachers, trainers and students a complete AC technology resource. Basic AC Circuits, 2/E has been a staple of the electronics educational market since 1981, but in the new edition the author has updated the book to reflect changes in technology, especially the test equipment available today.

Mechanical Engineering: Level 2 NVQ
David Salmon, Penelope Powdrill
Price: £16.99
ISBN: 0750654066
Published: 23/01/2002

A thoroughly accessible and engaging workbook-style text, ideal for all NVQ students, including Foundation Modern Apprentices. Mechanical Engineering: NVQ 2 is a practical and interactive engineering book, written by practising lecturers and designed for college students and Foundation Modern Apprentices. A highly readable text is supported by numerous assignments, provided to build up a portfolio of evidence. Designed so that students can complete the blanks, this book can be used as evidence for assessment purposes and as an essential reference guide for their subsequent employment.

Engineering GNVQ: Intermediate
Mike Tooley
Price: £15.99
ISBN: 0750647566
Published: 10/07/2000

This book presents the content of the GNVQ in a way that encourages students to explore engineering for themselves, developing the expertise and knowledge required at this level. As well as a clear and accessible text, emphasis is placed on learning through activities and self-evaluation through frequent knowledge-checks. Practice questions are also provided and will prove particularly helpful for externally assessed units. Much of this book is completely new – reflecting a major syllabus revision that has taken place. The inclusion of the key optional unit, Applied Science and Mathematics for Engineering, extends the book in a way that will really make it core reading for all Intermediate GNVQ students.

Science for Engineering
John Bird
Price: £14.99
ISBN: 0750647477
Published: 15/05/2000

Ideal for BTEC National, HNC and other courses, as it includes over 1,000 problems and 500 worked examples. In this book John Bird introduces engineering science through examples rather than theory, enabling students to develop a sound understanding of engineering systems in terms of the basic scientific laws and principles. The maths that students will require is also provided in a separate section within the book.

Engineering GNVQ: Advanced
Mike Tooley
Price: £17.99
ISBN: 0750647558
Published: 01/05/2000

This book presents the content of the GNVQ in a way that encourages students to explore engineering for themselves, developing the expertise and knowledge required at this level. As well as a clear and accessible text, emphasis is placed on learning through activities, and self-evaluation through frequent knowledge-checks. Practice questions are also provided, and will prove particularly helpful for externally assessed units. Much of this book is completely new, reflecting a major syllabus revision that has taken place, thus making this text even more essential for students following the full VCE/Advanced GNVQ or a single award programme.

A Practical Approach to Motor Vehicle Engineering
Derek Newbold, Allan Bonnick
Price: £16.99
ISBN: 0340692316
Published: 28/04/2000

A Practical Approach to Motor Vehicle Engineering explains the fundamental principles for each system found in the motor vehicle, including engines, brakes, electrical systems and transmission. This core information is then set in the relevant context of health and safety, customer relations and the testing and replacement of engines, enabling the student to gain a wider understanding of motor vehicle engineering. The authors make the text accessible to a broad range of abilities, by preparing a basic foundation of theory and exercises before including more taxing problems as knowledge is built up. Practical exercises are included to demonstrate the theory and these can be used in schools, colleges and garage workshops to assess understanding as each task is undertaken.

AutoCAD 2000i: An Introductory Course
Ian Mawdsley
Price: £16.99
ISBN: 0750647221
Published: 02/07/2001

The step-by-step instructions and clear explanations make the book ideal for courses with limited contact time and also for independent study. Numerous exercises throughout enable students to develop their own CAD skills, as well as reinforcing their understanding of AutoCAD commands. Ian Mawdsley has drawn on his own extensive teaching experience, to produce material for use in a CAD suite where the lecturer will be supporting a number of students who are progressing at different rates. His book is the only Auto CAD resource available written with a real understanding of teaching requirements – a breath of fresh air for lecturers, who have been working with hefty application manuals or superficial software guides.

Materials for Engineering
W. Bolton
Price: £14.99
ISBN: 0750648554
Published: 13/03/2000

Materials for Engineering provides a straightforward introduction for pre-degree level students and technician engineers. Learning summaries, examples and practice questions support a clear and accessible text. This book is designed to help students develop a clear understanding of:

- properties and testing of materials
- the relationship of the properties and structure of materials
- how properties change with modifications in composition, structure and processing
- the selection of materials for a wide range of engineering applications.

Creativity in Product Innovation
Jacob Goldenberg, David Mazursky Cambridge
ISBN: 0521800897
Binding: Hardback (Paperback)
Price: GBP 55.00
Published: 03/01/2002
Creativity in Product Innovation describes a remarkable new technique for improving creativity in product design.

Smart Structures: Analysis and Design
A V Srinivasan, D M McFarland
ISBN: 0521659779
Binding: Paperback (Hardback)
Price: GBP 21.95
Published: 14 December 2000

Introductory text on the analysis and design of smart devices and structures.

'Recent devastating earthquakes prove that building smart structural designs could be a lifesaver. This book provides an excellent basis for training engineers to do just that.' Steven Hill, New Scientist

Complete Technology and Design
Raymond Caldwell
Published: 30/3/2001
Clear, informative and stimulating. This book guides students through the stages involved in the design and manufacturing process. Opportunities are provided throughout for students to practise and develop the skills they will use in their own design projects. Includes up-to-date examples and relevant illustrations and is suitable for use with all GCSE specifications.

Oxford University Press
Design and Technology – Resistant Materials to GCSE
Andy Fair, Head of Design and Technology, Queen Elizabeth's Community College, Crediton, and Nick Rose, Head of Design and Technology, St Augustine's, Oxford
ISBN: 0198327900
Price: £10.50 (Paperback)
Published: 22 June 2000
Design and Technology – Graphic Products to GCSE

Philip Buckle, Head of Design and Technology, St Peter's School, Huntingdon, and Abigail Buckle
ISBN: 0198327897
Price: £10.50 (Paperback)
Published: 4 December 1997

Design in the Making
Longman
A book with a Teachers Guide aimed essentially at 11-14 year olds, but with a quantity of useful information and worksheets suitable for GCSE Double Award Engineering at Key Stage 4.

Resistant Materials: Student Book,
ISBN: 0582365899
(Teachers Pack, ISBN 0582365872)

Royal College of Art Routes series
Hodder and Stoughton
(Food ISBN 0340673923, Textiles ISBN 0340673915, Graphics ISBN 0340673931, Systems and Control ISBN 0340673907, Resistant Materials ISBN 034067394X and post-16 ISBN 0340705280)
A series of books and Teachers Guides aimed at Key Stages 3 and 4, containing useful information for GNVQ students across all material areas, including examples from various manufacturing industries.

Design & Make It! Resistant Materials Technology; Stanley Thornes
ISBN: 0748724702
This book has been designed essentially to support GCSE Design and Technology, but provides a good foundation in the use of resistant materials.

For more advanced candidates and teachers:

Advanced Manufacturing Design & Technology
Hodder & Stoughton
ISBN: 0340705280
A book developed by the Royal College of Art Technology Project, aimed at VCE and A level students of manufacturing and engineering.

Manufacturing Technology
Delmar Publishers Inc
ISBN: 0827334621
An American students™ book, offering a broad approach to issues across manufacturing technologies. Care needs to be taken as measurements and financial data are in US units

Fundamentals of Mechanical Engineering
R L Timings; Longman
A book aimed at NVQ Engineering students. It has some good practical content.

Engineers in Business
Mike Lanigan; Addison Wesley Publishing
ISBN: 0201416956
This is a book aimed at degree level students, but contains a large amount of useful information.

Intermediate GNVQ Engineering
Colin Chapman, Gillian Whitehouse
ISBN: 058238138X

Engineering GNVQ: Intermediate
Mike Tooley

Practical Engineering Drawing
Brian Hadley
ISBN: 0582369835

Websites

Robot World (BBC)
www.bbc.co.uk/science
www.bbc.co.uk/science/robots/teachers/

The second site works together with the main Robot World site. This site is authored by John Cave at Middlesex University. At the moment however, there are no materials for 14-16 year olds although these are being developed.

Denford Limited
www.denford.co.uk/

Denford is the World Leader in the Manufacture and Supply of Computerised Machines, Systems and Software for Education and Training.

Design Council
www.design-council.org.uk/design/

Technology Insight
www.technology.org.uk/

Fluidex
www.elsevier.nl/homepage/sah/spd/site/locate_fluidex.html

Each **FLUIDEX** record contains the full bibliographical citation, indexing terms and codes; 97% of records contain an English-language abstract. The database provides current coverage of nearly 500 periodicals and archival coverage of several hundred additional titles, including refereed scientific papers, trade journal and magazine articles, product reviews, directories and any other relevant material. FLUIDEX contains close to 410,000 records from 1974, with 15,000 records added annually.

EMTA careers focal point
www.enginuity.org.uk/

F1 in Schools
www.f1inschools.com/

The F1 Team in Schools Challenge is a competition, open to all UK based secondary schools and colleges, to design and manufacture CO2 powered model racing cars. Student teams will compete against each other in a national championship to determine the best engineered and fastest car in the UK. It's just like being in a real Formula One team (well, the nearest most of us will get to that experience, anyway).

SciQuest E-solutions for science
www.sciquest.com/cgi-bin/ncommerce3/ExecMacro/sci_index.d2w/report

Aerospace Engineering
Biomedical Engineering
Chemical Engineering
Civil Engineering
Electronic & Electrical Engineering
Environmental Engineering & Bioremediation
Information Technology & Internet
Manufacturing & Quality Engineering
Materials Engineering
Mechanical Engineering & Robotics
Mining
Nanotechnology
Naval Architecture & Ocean Engineering
Nuclear Physics & Engineering
Telecommunications

Nuffield Foundation Secondary Design and Technology
www.nuffieldfoundation.org

Gatsby Technical Education Project
www.gtep.co.uk/gtep/

The Gatsby Technical Education Project has been established for the advancement of education for the benefit of the public, by the support and development of excellence in mathematics, science, technology, engineering, information technology and other academic areas.
GTEP is developing programmes to:

- demonstrate innovative, effective teaching of science, mathematics and technology
- involve industry
- collaborate with industry and the government in the direction of support and funding.

There is also a national competition run by Denford, to make a model F1 racing car driven by a small CO_2 cylinder. Details can be found at the following websites:

- www.f1inschools.com
- www.denford.co.uk

Materials Teaching Educational Resources (MATTER)
www.matter.org.uk/

The MATTER Project is a non-profit consortium of UK materials science departments, founded in 1993 to develop and help integrate computer-based learning (CBL) materials into mainstream teaching.

Led by the University of Liverpool, MATTER was originally one of over 70 different projects funded by the Teaching and Learning Technology Programme (TLTP). This phase of the project resulted in the publication in 1996 of the award-winning Materials Science on CD ROM, with a second version being released in 1998. This has now become the leading software resource of its type and is in use in universities throughout the world.

More recently, our activities have expanded to include the development of science-based software resources for schools, industry and other science disciplines in universities. In keeping with the explosive growth of the internet in the past few years, all our software is now developed for web-delivery. For example, in 1999, we worked in partnership with Corus (formerly British Steel) and the University of Birmingham to produce SteelMATTER – a set of on-line resources for ferrous metallurgy.

Since 1997, MATTER has been producing CD ROMs and interactive web sites designed specifically for school science. By working closely with teachers and their pupils, we can provide resources relevant to their needs. We have also been working with teacher trainees to help equip them with the skills and confidence necessary to use ICT effectively in the classroom.

SETNET
www.setnet.org.uk

SETNET is the Science Engineering Technology Mathematics Network and has 58 member organisations representing Government, industry and the engineering professional institutions, education and education charities. It is one of the outcomes of a Government initiative – *Action for Engineering.* SETNET is about ensuring that there is a flow of well motivated, high quality people from schools who have an interest in and an understanding of engineering related subjects.

What are SETNET's aims?

To present a coherent message to teachers and industry about the schemes and initiatives available to enhance and extend the key curriculum subjects of science, technology and mathematics

To bring about collaboration between the various organisations, so that we may influence more effectively the teaching of engineering related subjects.

To ensure a more effective communication system for schools and industry.

How is SETNET achieving this?

SETNET has established SETPOINTS in the UK, which operate as a focus for teachers, business and industry to obtain information about resources, schemes and initiatives concerned with science, engineering, technology and mathematics.

Nelson Thornes
www.nelsonthornes.com/secondary/d&t/index.htm

Heinemann
www.bh.com/engineering/uk/subindex.asp

Appendix B

Vocational links in the Engineering sector

Introduction

The sites below will provide many links to the engineering sector. However, centres are also encouraged to explore manufacturing industries in their local area. A copy of your local Yellow Pages and a Chamber of Commerce directory will prove invaluable in your endeavour to develop productive industrial links.

Useful websites

British Computer Society

www.bcs.org.uk/

www.bsi-global.com/group.xalter

www.careersinconstruction.com/

Chartered Institution of Water and Environmental Management

www.ciwem.org.uk/

The Chartered Institution of Water and Environmental Management (CIWEM), is a multidisciplinary professional and examining body for engineers, scientists and other professionally qualified personnel engaged in water and environmental management.

Chartered Institution of Building Services

www.cibse.org/

With a membership of 15,000, one fifth of which is overseas, CIBSE (The Chartered Institution of Building Services Engineers) is an international body which represents and provides services to the building services profession.

The Institution has two main functions:

It confers an internationally recognised badge of quality.

It undertakes a wide range of learned society activities ranging from producing information services and acknowledged industry good practice publications in its series of Guides and other publications, to running a wide range of events, and to providing extensive networking activities through a series of regional and special interest groups.

Design and Technology Association (DATA)

Engineering and Marine Training Organisation (EMTA)

www.emta.org.uk/ntowsite.nsf?opendatabase

EMTA is the National Training Organisation (NTO) for engineering manufacture – one of the very first bodies to be recognised by the government as an NTO in 1997. It represents the sectors of:

Aerospace
electrical engineering
electronics, including semi-conductors
mechanical engineering and metal trades
motor vehicles
shipbuilding and marine engineering

All manufacturing organisations operating in the above sectors are members of EMTA and the benefits of membership are available to them, without the need for a subscription rate.

Engineering Council

www.engc.org.uk/focus/

Engineering Employers' Federation (EEF)

www.eef.org.uk/

The EEF, Engineering Employers' Federation, is the representational voice of Engineering and Manufacturing in the UK. They are a nation wide federation of 13 regional Associations and the ECIA (Engineering Construction Industry Association).

The EEF has a growing membership of over 5,700 member companies of all sizes, employing over 900,000 people from every sector of engineering, manufacturing, engineering construction and technology-based industries.

Details of regional EEF Associations can be found on the following website; www.eef.org.uk

Centre Interuniversitaire Euroqual

www.euroqual.org/presentation/english.htm

The inter-university centre EUROQUAL has been created with the support of many companies (La Genevoise Assurances, Logitech, Nestlé, Manufactures des Montres Rolex, Chaillot Bouchons, Swisscontrol). It is in charge of managing and co-ordinating high level teaching in quality management, with the help of numerous Swiss and foreign universities.

EUROQUAL is in link with other Swiss and foreign quality organisations: ASPQ – SAQ, EOQ, EFQM.

The Institution of Civil Engineers

www.ice.org.uk/

Institute of Cast Metals Engineers

www.icme.org.uk/

The Institute of Cast Metal Engineers is the professional body to represent you throughout your career in the cast metals industry. Whether you are a student at the start of your career, or the Chief Executive of the company, membership shows that you are committed to the industry and confirms your competence to others. It allows you to register with the Engineering and Technical Board (formerly the Engineering Council), as a professional engineer and keeps you abreast with all the new issues in the industry.

The Institution of Design Engineers

www.ied.org.uk/

Design is the foundation on which the material world around us rests. The machines, products and processes on which our modern technological age depends, began with the work of the designer. The Institution of Engineering Designers, established in 1945, is a professional body for designers, who operate in widely diverse fields of design practice. In addition, there are members who operate in fields such as consultative practice, management and education.

The Institution of Fire Engineers

www.ife.org.uk/

Fire engineering
The application of scientific and engineering principles, rules [Codes], and expert judgement, based on an understanding of the phenomena and effects of fire and of the reaction and behaviour of people to fire, to protect people, property and the environment from the destructive effects of fire.

A fire engineer, by education, training and experience:

- understands the nature and characteristics of fire and the mechanisms of fire spread and the control of fire and the associated products of combustion
- understands how fires originate, spread within and outside buildings/structures, and can be detected, controlled, and/or extinguished
- is able to anticipate the behaviour of materials, structures, machines, apparatus, and processes as related to the protection of life, property and the environment from fire
- has an understanding of the interactions and integration of fire safety systems and all other systems in buildings, industrial structures and similar facilities
- is able to make use of all of the above and any other required knowledge to undertake the practice of fire engineering.

The Institute of Healthcare Engineering and Estate Management

www.iheem.org.uk/

The Institute of Healthcare Engineering and Estate Management, is the Learned Society for all Architects, Builders, Engineers, Estate Managers and Surveyors working in the healthcare field. Employment in healthcare engineering and estate management and departments of estate management in the healthcare sectors provide many employment opportunities for suitably qualified candidates of many disciplines. Nowhere is this better demonstrated, than in a hospital or community NHS Trust where engineers, building officers and other professionals are responsible for designing, constructing, equipping and maintaining a wide range of healthcare and associated buildings.

Institute of Highway Incorporated Engineers

www.ihie.org.uk/

The Institute of Highway Incorporated Engineers is the only national professional institution which puts incorporated engineers first. Nominated and licensed by the Engineering Council since 1972, IHIE is:

- your road to IEng and EngTech
- bringing together all practitioners in traffic and transportation engineering, highway design, maintenance and construction
- delivering new opportunities
- improving members' competence for the benefit of themselves and society.

The Institution of Lighting Engineers

www.ile.co.uk/

The Institution of Lighting Engineers (ILE) is the UK and Ireland's largest and most influential professional lighting association, dedicated solely to excellence in lighting. Founded in 1924 as the Association of Public Lighting Engineers, the ILE has evolved to include lighting designers, architects, consultants and engineers amongst its 2,500 strong membership.

The key purpose of the ILE is to promote excellence in all forms of lighting. This includes interior, exterior, sports, road, flood, emergency, tunnel, security and festive lighting, as well as design and consultancy services. The Institution is a registered charity, a limited company and a licensed body of the Engineering Council.

Recent initiatives supported by the ILE have focused on informing young people about the importance of lighting and encouraging them to consider a career in the profession. In the past six months alone, the ILE's comprehensive campaign has targeted 5-7 year olds by supporting the 'Today's Engineers' competition and secondary schools students, with its involvement in the 'Young Engineers for Britain' challenge. Last but not least, the ILE catered for GCSE and A Level students by arranging a special lecture by Adam Hart-Davis 'Casting Light on the Curriculum', together with a careers exhibition.

The Institute for Surface Technology

www.uk-finishing.org.uk/

A Professional Affiliate of the Engineering Council, the Institute is a professional organisation for individuals, consultants and companies active in the field of surface engineering and surface technology. It provides expert advice through a network of experienced members. It also operates an excellent educational programme of tutored and distance learning courses and is able to award qualifications on completion.

Institute of Acoustics

www.ioa.org.uk/

The United Kingdom Institute of Acoustics was formed in 1974, through the amalgamation of the Acoustics Group of the Institute of Physics and the British Acoustical Society, and is the premier organisation in the United Kingdom concerned with acoustics.

The present membership is in excess of two thousand, and since 1977 it has been a fully professional Institute. The Institute has representation in many major research, educational, planning and industrial establishments covering all aspects of acoustics, including aerodynamic noise, environmental, industrial and architectural acoustics, audiology, building acoustics, hearing, electro acoustics, infrasonic, ultrasonic, noise, physical acoustics, speech, transportation noise, underwater acoustics and vibration.

Institution of Mechanical Engineers

www.imeche.org.uk/

The Institution has been the home of Mechanical Engineers for 150 years. Around 83,000 engineers worldwide are members. The Institution of Mechanical Engineers (IMechE), is the United Kingdom's qualifying body for mechanical engineers. Founded by George Stephenson, of 'Rocket' railway locomotive fame, the Institution has grown to cover the entire range of technologies and industries in which engineers work. It is committed to 'technology transfer', as well as ensuring the highest professional standards.

Members work in research, design, development, manufacturing, installation, commissioning, contracting, consulting and teaching, in fields as diverse as lubrication, satellite launching, surgical implants and in power stations. Anyone involved in engineering will find something in IMechE for them.

Vision statement

'To create the natural professional home for all involved in Mechanical Engineering.'

The strategic aims are:

- To be the leading forum for the exchange of knowledge and expertise in the field of mechanical engineering
- To provide products and services to members, the profession, industry and Government that are affordable and highly valued
- To maintain the financial health of the Institution
- To be a dynamic, innovative, professionally run organisation.

Institution of Water Officers

www.iwohq.demon.co.uk/

IWO is the only professional body that is concerned solely with the day to day running of the water industry. One of its aims, is to provide unparalleled opportunities to help its members increase their knowledge about those topics that are crucial to the future success of the industry. It also takes pride in its social events, where members have a lot of fun and form relationships that can lead to further sharing of knowledge across the industry. As a nominated body of the Engineering Council, it is able to register members at Chartered Engineer, Incorporated Engineer and Engineering Technician levels and sets similar standards for non-engineering disciplines.

The International Journal of Engineering Education

www.ijee.dit.ie/

This journal serves as an international interdisciplinary forum of reference for engineering education. A balance between papers on developments in educational methods technology, case studies, laboratory applications, new theoretical approaches, educational policy and survey papers is aimed for.

Comprehensive coverage of new education schemes and techniques makes the journal a unique source of ideas for engineering educators, who are keen to keep abreast of latest developments in educational applications in all fields of engineering.

Institution of Railway Signal Engineers

www.irse.org/

The Institution of Railway Signal Engineers (IRSE) was founded in 1912, as a professional body whose objective is the advancement of the science and practice of railway signalling, telecommunications and related matters.

Membership extends to most countries where there are railways and is open to any person engaged in the management, planning, design, installation, maintenance or manufacture of railway signalling or associated equipment.

The Institution of Structural Engineers

www.istructe.org.uk/Welcome/index.asp

Structural engineers are concerned with the safety, efficiency and elegance of buildings and engineering structures. They work with other professionals in design and construction, but take particular responsibility for how buildings and other structures respond to loadings. The effects of accidents, together with the possible incidence of fire, earthquake and explosion damage have to all be considered. Designs must not only be sufficiently safe, but also be efficient and easy to build. The aim should also be to produce structures that enhance the environment and give a feeling of elegance and satisfaction. Many structural engineers work in design but there are others in contracting – actually building the structures, research, advanced teaching in Universities and in government service. In essence, all are dedicated to the mission of achieving Safety, Efficiency and Elegance in designing structures.

Institution of Agricultural Engineers

www.iagre.org/

The Institution of Agricultural Engineers, is the professional body for engineers, scientists, technologists and managers in agricultural and allied industries, including forestry, food processing and agrochemicals.

Royal Aeronautical Society

www.raes.org.uk/homepage.asp

Throughout the world's aerospace community, the name of The Royal Aeronautical Society is both well known and well respected. But what is The Royal Aeronautical Society and what is the significance of being a member of the world's senior aerospace body?

The Royal Aeronautical Society is 'the one multidisciplinary professional institution dedicated to the global aerospace community'. The RAS is the world's only professional body, which caters for the entire aerospace community. The aerospace industry is global and The Royal Aeronautical Society reflects this. Although centred in the United Kingdom, it has members in almost 100 countries worldwide.

Royal Academy of Engineering

www.raeng.org.uk/

American Society for Engineering Education

www.asee.org/

The American Society for Engineering Education is a non-profit member association, founded in 1893 and dedicated to promoting and improving engineering and technology education.

ASEE has more than 12,000 deans, professors, instructors, students and industry representatives. The ever-increasing influence and rapid advance of technology, demands a skilled, highly educated technical workforce. From defence, to infrastructure, to telecommunications, to consumer gadgetry, the quality of our engineers affects the quality of our lives.

The British Institute of Non-destructive Testing

www.bindt.org/

Non-destructive testing, is the branch of engineering concerned with all methods of detecting and evaluating flaws in materials. Flaws can affect the serviceability of the material or structure, so NDT is important in guaranteeing safe operation, as well as in quality control and assessing plant life. Non-destructive testing is used for in-service inspection and for condition monitoring of the operating plant. It is also used for measurement of components and spacing and for the measurement of physical properties, such as hardness and internal stress.

The British Library

www.bl.uk/

The Institute of Electrical Engineers

www.iee.org/

Founded in 1871, IEE is the largest professional engineering society in Europe and has a worldwide membership of just fewer than 140,000.

The Institute of Marine Engineers

www.imare.org.uk/

The Institute of Marine Engineers is a professional institution and learned society and is the largest in its field in the world. It was founded in 1889, to provide a forum for discussion on engineering matters and to enhance the status of the profession. The principles, then established, have been maintained and today the Institute, with in excess of 15,000 members throughout the world, is a respected authority in every maritime country. It is a truly international organisation and has non-governmental consultative status of the International Maritime Organisation (IMO).

The members of the Institute are drawn from all areas of maritime technology, naval architecture, offshore and sub-sea engineering and structural, mechanical, civil and electrical engineering with marine applications. They are also deployed throughout the marine industries in consultancies, Government agencies, classification societies and marine insurance.

The Institute of Materials

www.materials.org.uk/

The Institute of Materials serves the international materials community, through its wide range of learned society activities and by acting as the professional body for materials scientists and engineers.

The Institute of Measurement and Control

www.instmc.org.uk/

The Institute of Plumbing

www.plumbers.org.uk/

Founded in 1906, the Institute of Plumbing is the UK's professional body for plumbers and others in the plumbing industry. It has a membership of 11000, some 3500 of whom are listed in our Member Directory where a local registered Plumber can be found by simply entering a postcode. All members listed, have had to prove their plumbing competence through recognised qualifications or extensive experience.

The Institute is supported by some 250 of the leading manufacturers and service providers in the UK plumbing industry, collectively known as Industrial Associates. Many of these also participate in the Institute's Continuing Professional Development programme, designed to allow members to keep right up to date with technological advances in the industry.

The Institution of Nuclear Engineers

www.inuce.org.uk/

This is the official web site of the Institution of Nuclear Engineers – a nominated Body of the Engineering Council. Here you will find information about careers in nuclear engineering and the services provided by the Institution, in particular the conferences they organise.

The Royal Institution of Naval Architects

www.rina.org.uk/

The Royal Institution of Naval Architects (RINA) is an internationally renowned professional institution, whose members are involved at all levels in the design, construction, repair and operation of ships, boats and marine structures. Members of the RINA are widely represented in industry, universities and colleges and maritime organisations in over 80 countries.

The Society of Engineers

www.society-of-engineers.org.uk/

A truly multi-disciplinary learned institution that believes there is always room in the engineering profession for all practitioners at any level. Engineering practitioners are encouraged to become members of The Society, so they may be afforded the privilege of contributing to matters affecting the practice of engineering.

Members:

- benefit from shared knowledge and a quarterly magazine called 'Engineering World' periodic newsletters and circulars updating members on The Society's news and activities
- are encouraged to attend Ordinary Meetings to hear experienced and senior professionals in various disciplines speak
- are encouraged to take part in technical visits
- are encouraged to form Branches in countries outside the UK.

Society of Operations Engineers

www.soe.org.uk/

The Welding Institute

www.twi.co.uk/j32k/Menu/4

TWI is one of the World's foremost independent research and technology organisations. It is a company limited by guarantee, organised on behalf of some 3,500 Member companies worldwide, reinvesting all surpluses back into the organisation. Based at Abington near Cambridge since 1946, TWI provides industry with technical support in welding and joining, through information services, advice and technology transfer, consultancy and project support, contract R&D, training and qualification and personal membership. It is the only single source of expertise in every aspect of joining technology for engineering materials.

Institution of Chemical Engineers

www.icheme.org/

IChemE is a UK-based membership organisation for chemical engineers and the like, with a worldwide membership approaching 25,000 and with offices in Rugby, London and Melbourne.

What do they do?

Things like professional qualifications, books, journals, training, conferences, courses, monthly TCE magazine, member networks (subject groups, branches, virtual branch) and raising awareness of the profession (to public and schools).

The Institute of Physicists and Engineers in Medicine

www.ipem.org.uk/

The Institute of Physics and Engineering in Medicine is a Registered Charity that exists to promote, for the public benefit, the advancement of physics and engineering applied to medicine and biology. Also to advance public education in the field and to represent the needs and interests of engineering and physical sciences in the provision or advancement of health care.

The World Plumbing Council

www.worldplumbing.org/

Mission

The mission of the World Plumbing Council is to unite the world plumbing industry, so that they may safeguard and protect the environment and the health of nations, for the benefit of all.

The Institute of Physics

www.iop.org/

The Institute of Physics is an international learned society and professional body for the advancement and dissemination of physics, pure and applied, and promotion of physics education, which works through:

- activities to support, progress and present physics research, education and understanding to other scientists, decision-makers and the public
- activities to identify and meet the needs of physicists in all sectors of employment, and to award recognised qualifications in physics
- publishing to disseminate knowledge and to generate a financial surplus used to further the Institute's mission.

The Institute is a registered charity, no. 293851. It has over 30,000 members worldwide and it operates under a Royal Charter headed by a Council. The Institute is a member of the Science Council, and a nominated body of the Engineering Council. The Institute works in collaboration with national physical societies and plays an important role in trans-national societies, such as the European Physical Society and represents British and Irish physicists in international organisations. In Great Britain and Ireland, the Institute is active in providing support for physicists in all professions and careers, encouraging physics research and its applications, providing support for physics in schools, colleges and universities and influencing government and informing public debate.

Appendix C

Employers – Engineering manufacturing companies

Introduction

The addresses below are all employers in the engineering sector. However, centres are also encouraged to explore manufacturing industries in their local area. A copy of your local Yellow Pages and a Chamber of Commerce directory will prove invaluable in your endeavour to develop productive industrial links.

BAE Systems Operations Ltd
Preston Technology Park
Marsh Lane
Preston
PR1 8RT
Airframe

GKN Westland Aerospace Ltd
Castle Street
East Cowes
Isle of Wight
PO32 6RH
Airframe

GENII Engineering & Technology
B111 Sellafield
Seascale
Cumbria
CA20 1PG
Inst (E)

Humberside Engineering Trng Assoc Ltd
Copenhagen Road
Sutton Fields Estate
Hull
HU7 OXJ
Inst (E)

Isle of Wight Industrial Group
36 Dodnor Lane
Dodnor Industrial Estate
Newport
Isle of Wight PO30 5XA
Inst (E)

Norfolk Training Services
Harford Centre
Hall Road
Norwich
NR4 6DG
Inst (E)

Salford & Trafford Engineering
First Floor, Dock Office
Trafford
Salford Quays
Manchester
Inst (M)

BAE Systems Operations Ltd
Prestwick International Airport
Ayrshire
Scotland KA9 2RW
Inst (M)

Westland Helicopters Ltd
Lysander Road
Yeovil
Somerset
BA20 2YB
Inst (M)

National Aviation Training Centre
Hunting Contract Services
Pembroke House
East Midlands Airport
Castle Donington
Derbyshire
Maintenance

RAF Sealand
Deeside
Flintshire
Clwyd
CH5 2LS
Testing

Dera Boscombe Down
Engineering Training School
Boscombe Down
Salisbury
Wiltshire SP4 OJF
Testing

RAF St Athan, Barry
Dara St Athan
Pickerton Site (BLD 872)
Vale of Glamorgan
CF62 4WA
Testing

Britax Aircraft Cabin Interiors
Watchmoor Point
Camberley
Surrey
GU15 3AQ
Bond Compos

Dunlop Aviation Ltd
Aviation Division
Holbrook Lane
Coventry CV6 4AA
Bond Compos

Monarch Aircraft Engineering Ltd
Prospect Way
London Luton Airport
Luton
Beds LU2
Bond Compos

Alstom Power UK Ltd
P O Box 1
Waterside South
Lincoln LN5 7FD
Complex Assembly

British Engines Ltd
St Peters
Newcastle Upon Tyne
NE6 1BS
Complex Assembly

British Nuclear Fuels Ltd
Springfield Works
Salwick
Preston
Lancs PR4 OXJ
Complex Assembly

Land Rover
Gaydon Test Technology Centre
Lighthorne Road
Lighthorne
Gaydon
Complex Assembly

M I Technologies Ltd
91 Holmfauld Road
Linthouse
Glasgow
G51 4RY
Complex Assembly

Westwind Air Bearings Ltd
Holton Road
Holton Heath
Poole
Dorset BH16 6LN
Complex Assembly

BAE Systems (Operations) Ltd
Woodford Aerodrome
Chester Road
Woodford
Cheshire SK7 1QR
Complex Assembly

BP Exploration Company Ltd
Forties Department
Farburn Industrial Estate
Dyce
Aberdeen AB2 0PB
Config Equipt

Sparrows Offshore Services Ltd
Denmore Road
Bridge of Don
Aberdeen AB23 8JW
Config Equipt

BAE Systems Marine Ltd
South Street
Scotstoun
Glasgow
G14 0XN
Machining

Prospects
Prospects House
10 Fairfax Drive
Southend
Essex SS0 9AR
Config Equipt

Castle Precision Engineering Ltd
241 Drakemire Drive
Castlemilk
Glasgow G45 9SZ
Machining

British Aerospace
Military Aircraft & Aerostructures
Saltsground Road
Brough
East Yorks
Machining

Centrax Ltd
Turbine Components Division
Shaldon Road
Newton Abbot
TQ12 4SQ
Machining

Corus Construction and Industrial
P O Box 1
Brigg Road
Scunthorpe
DN16 1BP
Machining

Delphi Diesel Systems
Courtney Road
Hoath Way
Gillingham
Kent ME8 0RU
Machining

GKN Hardy Spicer Limited
Chester Road
Erdington
Birmingham B24 0RB
Machining

Infast Manfacturing Division (Philidas Ltd)
P O Box 10
Monkhill Lane
Pontefract
West Yorkshire WF8 1RL
Machining

Marconi Applied Technologies
106 Waterhouse Lane
Chelmsford
Essex CM1 2QU
Machining

Marconi Electronic Systems (GMRDS)
Broad Oak Works
The Airport
Portsmouth
Hants PO3 5PQ
Machining

Bass Cardiff
Cardiff Brewery
Crawshay Street
Cardiff CF1 1TR
Maintenance

Birds Eye Walls
Martins Score
Lowestoft
Suffolk
NR32 1JG
Maintenance

Blue Circle Industries Plc
Hope Business Unit
Hope Valley
Derbyshire
S33 6RP
Maintenance

GlaxoSmithKline
Priory Street
Ware
Hertfordshire
SG12 0DJ
Maintenance

JEB Engineering Design Ltd
Hampstead Avenue
Mildenhall
Suffolk
IP28 7AS
Maintenance

Offshore Crane Engineering Ltd
Burnside Drive
Farburn Industrial Estate
Dyce
Aberdeen AB21 0HW
Maintenance

Sela Fasteners Ltd
153 Kirkstall Road
Leeds
LS4 2AT
Maintenance

Solectron Scotland Ltd
Queensferry Road
Dunfermline
Fife
KY11 5PX
Maintenance

Brown, Root & Marshall Aerospace Ltd
RAF Valley
Holyhead
Anglesey
LL65 3NY
Man Finish

Peta Limited
9 Acorn Business Centre
Northarbour Road
Portsmouth
Hants PO6 3TH
Man Finish

Kirkdale Industrial Training Ltd
Armytage Road
Brighouse
West Yorkshire
HD6 1PT
Prod Compos

Myson Training
Eastern Avenue
Team Valley Trading Estate
Gateshead
Tyne and Wear NE11 OPG
Prod Compos

Appledore Shipbuilders Ltd
Appledore
Bideford
North Devon
EX39 1LX
Shape by m/c

Aylesbury Training Group
Gatehouse Close
Aylesbury
Buckinghamshire
HP19 8DN
Shape by m/c

BAE Systems Airbus
Training Centre (Hangar 76)
Chester Road
Broughton
Flintshire CH4 0DR
Shape by m/c

BMW(UK) Manufacturing Centre Ltd
Cowley
Oxford
OX4 5NL
Shape by m/c

British Sugar Plc
Ipswich Sugar Factory
Ipswich
Suffolk
IP1 5AL
Shape by m/c

Claro Precision Engineering Ltd
Manse Lane Industrial Estate
Knaresborough
North Yorkshire
HG5 8LF
Shape by m/c

Dresser/Ingersoll-Rand
South Moor Road
Wythenshawe
Manchester
M23 9LH
Shape by m/c

Ford Motor Co Ltd
Room 44/800
Fabian Way
Swansea
SA1 8QJ
Shape by m/c

Robert Bosch
Miskin
Pontyclun
South Glamorgan
CF72 8XQ
Shape by m/c

Swindon Pressings Ltd
Bridge End Road
Stratton St Margaret
Swindon
Wiltshire SN3 4PE
Shape by m/c

TR Fastenings Ltd
Hank House
Bellbrook Park
Uckfield
East Sussex TN22 1QW
Shape by m/c

Jaguar Cars Limited
Room 52/380
Halewood
Liverpool L24 9BJ
Shape by m/c

Rochdale Training Association
Fishwick
Rochdale
Lancashire OL16 5NA
Springs

Stanley Tools
Woodside Lane
Sheffield
South Yorkshire
S3 9PD
Toolroom R/R

Thyssen Krupp Automotive
Llethri Road
Felinfoel
Llanelli
Dyfed SA14 8EU
Toolroom R/R

Appendix D

Work placement information

Introduction

Work placements may be the first time a student experiences the real world of work. They are also an opportunity for students to experience the potential career they may be considering.

Relevant work experience can provide students with important experiences such as:

- developing motivation. Students will see their skills and abilities applied in a realistic setting. They will also identify others, which they need to acquire in order to succeed
- acquiring realistic aspirations. Reassuring students' who have less confidence in their abilities and presenting a true picture to those who glamorise careers
- the opportunity to see a range of related work activities in the same environment, such as in a large factory or engineering workshop
- experiencing both the variety and reality of the working week. Seeing the balance between the inspiring, creative activities alongside the repetitive but necessary tasks needed to get a job completed to a deadline.

Liaising with potential organisations

Establishing a partnership with a local engineering company or organisation should be carefully considered.

It is important to take into account the time taken up in planning, participating and reviewing work experience activities. Large organisations may be in a position to absorb these costs, but small organisations or businesses may be less well placed and reluctant to offer work experience. Teachers must be flexible and sensitive to these issues.

Teachers should be able to offer a wide range of work experience opportunities to students if sufficient thought is given to the analysis of engineering opportunities.

Professional development for teachers

It is important that teachers are not isolated from the rapid changes in the engineering industry. Teachers who are continually updated and have recent industrial experience are able to give students confidence and greater motivation. Regular industrial updating, or the opportunity to extend their specialist knowledge, enables teachers to ensure the currency and relevance of all aspects of their work.

There are many benefits to be gained from teacher placements:

Personal benefits – providing the opportunity to look at different working conditions and environments from those in education. Teachers will also benefit from seeing how transferable skills can be used in both education and engineering.

Professional development – reassessing the delivery of the course in light of knowledge gained through the work placement. A greater understanding of the industry's needs should, potentially, motivate both staff and students.

A new perspective on difficult management issues and an understanding between education and the world of engineering will be gained.

Developing work experience contacts to provide a network for future work placements or other engineering-based activities for staff and students.

Work placement information

In working to the specifications, pupils develop their skills in designing, analysing and making engineered products and their knowledge of the processes and materials involved. In order to appreciate the distinctiveness of engineered products and to be able to identify why products are the way they are together with making design and manufacturing decisions themselves, students will need to understand the working practices, opportunities and constraints of the engineering industry. Links with local engineering industry can extend the range of engineering processes to which pupils have access.

Pupils' individual work will be greatly enhanced by planned opportunities for listening to, observing and working with employees from the engineering sector and by having access to their products. Some examples of such opportunities within the three units are outlined below.

Unit 1: Design and graphical communication

Links will provide opportunities:

- to use examples of engineering drawings from local companies, illustrating fitness for purpose and British Standards
- for contact with people who produce or use engineering drawings within their work, perhaps in the form of a visit to a drawing office
- to observe or use industry-standard computer-aided design packages
- to use examples of design briefs and design specifications, from local companies and possibly to work to a design brief set by a local company
- to use examples of design briefs, design specifications and engineering drawings for familiar products
- for contact with product designers and to use case study materials, showing the development of a product from brief to final design solution
- to draw on engineering employees as consultants or to provide an assessment of the fitness for purpose of pupils' design solutions against the specification.

Unit 2: Engineered products

Links will provide opportunities:

- for contact with production engineers
- to see production and assembly processes in action and to observe and talk with employees working in different production/assembly environments
- to observe a service or repair engineer at work on a familiar product
- to work with industry-standard production equipment, in the training school of a local company
- to use examples of production plans, working drawings and progress schedules from local companies

- for contact with quality control personnel, including test engineers and health and safety representatives
- to use drawings produced by manufacturers, disassembling and assembling familiar products.

Unit 3: Application of technology

Links will provide opportunities:

- to see new technologies being used in an engineering context, particularly computer-aided design and manufacture, automation and a range of production processes
- to use a resource bank of technical information sheets from companies about materials, components, products, systems, maintenance and servicing
- to access engineering companies' internet sites
- for contact with employees in marketing, buying and maintenance, to consider the impact of new technologies and new expectations of products and services on their work
- for contact with employees in the engineering sector who have experienced change as a result of new technologies and possibly with representatives of unions, health and safety inspectors or personnel departments
- for contact with representatives from consumer groups, watchdogs and environmental groups, and access to their fact sheets and journals.

Useful resources

Work Experience Learning Frameworks, developed by the Centre for Education and Industry (CEI) at the University of Warwick, have been devised to enable teachers and, employers and young people to plan successful work experience placements that benefit everyone involved.

The *Frameworks* are devised using the relevant National Occupational Standards, which means they are linked closely to NVQ statements applicable to specific vocational contexts. The statements selected and the activities chosen for *Frameworks* are developed with guidance from employers.

Research is carried out involving key employers, who have experience of offering work placements, so that the *Frameworks* represent real skills and experiences that a young person can develop during a placement.

The *Frameworks* can be used to prepare students for placements, set learning targets, debrief students and to prepare employers.

Go For It

A resource pack for work experience preparation, to challenge stereotypes and promote equal opportunities.

CEI/DFEE 2000

Learning from Work Experience, QCA 1998, defines National Quality Standards for work experience.

Work Experience and the Law, Anthony Johns, CEI (new edition forthcoming) is a useful handbook.

Appendix E

LSDA resources

Our resources have a deserved reputation for being practical and accessible. They are prepared with the busy practitioner in mind, who needs clear, accurate and relevant guidance and information. We work closely with the QCA and the awarding bodies to ensure our publications contain relevant and accurate information. Although some have been written for GNVQ and AVCE, the information within the publications and resources can be applied to the new GCSE's.

Industry information packs

Industry information resource packs are designed to enable GNVQ teachers to introduce a greater element of work relatedness into GNVQ programmes, providing students with real work data and making the best and widest use of the available information about industry sectors. Working with the National Training Organisations (NTOs) and employers, the Agency has produced a series of information packs that explain how particular industries operate.

Each pack covers:

- processes and methods used
- statistics
- information on job roles, careers and training
- raw data about production, sales, staffing, transport etc
- guidance on interacting with the industry.

The packs contain authentic working documents supplied by various organisations and companies. Available as manuals for £25 each, order from the helpline.

You can contact the LSDA at:

Learning and Skills Development Agency
Regent Arcade House
19-25 Argyll Street
London
W1F 7LS

The help-line number is: 020 7297 9144

Titles in the series include:

Art and Design
Business and Retail
Construction
Engineering
Health and Social Care
Hospitality and Catering
Information Technology
Leisure and Recreation
Manufacturing
Media
Science
Travel and Tourism

Appendix F

Observation record

Candidate name:	
Unit title:	Candidate number:

Activity context:
This may be provided by the assessor or candidate

Assessment evidence:
Refer to the assessment grids reproduced from the specification.

Observation notes:
Specific comments on candidate performance that demonstrates achievement of the assessment evidence.

Assessor name:	Assessor signature:
	Date:

Observation records

What is an observation record?

An Observation Record is a document which records statements of learner performance it directly relates to the criteria contained within the Assessment Evidence grid included in each Unit Specification. It may confirm achievement or provide specific feedback on candidate performance against national standards.

Guidance on completing an observation record

Since an Observation Record will provide primary evidence, it is essential that the recording of performance is sufficiently detailed to enable others to make a judgement as to the quality and sufficiency of candidate performance and confirm that national standards have been achieved.

Observation Records are often accompanied by supporting/additional evidence. This may take the form of visual aids, handouts, preparation notes, cue cards, diaries, log books, and peer assessment records. It is essential that where present, these are included in the learner evidence. Where visual aids and handouts are used, note should be made on the Observation Record as to how these were used and their effectiveness.

The assessor of the qualification being undertaken by the candidate completes the Observation Record, therefore must have direct knowledge of the specification to enable an accurate assessment decision to be made.

An Observation Record has greater validity than a Witness Statement since it is capable of recording an assessment decision.

All Observation Records must be signed and dated by the assessor.

Appendix G

Witness statement

Candidate name:	
Unit title:	Candidate number:

Activity context:
Outline of the activity and its purpose. This may be written by the candidate prior to the observation.

Assessment evidence:
Refer to the assessment grids reproduced from the specification.

Observation notes:
Specific comments on candidate performance that demonstrates achievement of the assessment evidence.

Witness name:	Witness signature:
Job role:	Date:
Assessor name:	Assessor signature:
	Date:

Witness statements

What is a witness statement?

A Witness Statement is a document which records statements of learner performance. It is completed by someone other than the Assessor of the qualification. This may be someone who does not have direct knowledge of the assessment evidence, but who is able to make a professional judgement about the performance of the candidate (for example, a work placement supervisor, technician, librarian).

Guidance on completing a witness statement

The quality of a Witness Statement can be greatly improved if the 'witness' is provided with the assessment evidence from the specification so that accurate reference can be made to this in relation to the success of learner performance when recording details on the Witness Statement

the candidate may provide a statement of context on the Witness Statement.

A Witness Statement does not confer an assessment decision. When making an assessment decision, the assessor must consider the validity of the information contained within the Witness Statement, noting the relevant professional skills of the 'witness', along with any other supporting evidence, before making a final judgement.

As Witness Statements are often used to record practical performance, especially in the workplace, it is important that the person responsible for the completion of the document is identified by the Assessor at the outset.

All Witness Statements should be signed and dated by the 'witness' together with clear details of their job role.

It is the assessor's responsibility to ensure the authenticity of Witness Statements. It may be helpful to collect specimen signatures. A telephone call to thank the witness for providing evidence may also provide evidence of the authenticity of the Witness Statement.

Witness Statements which are to be taken into consideration for assessment purposes must also be signed and dated by the assessor.

Opportunities for the submission of additional Witness Statements should be encouraged as this provides further evidence of learner performance, for example where candidates have taken part in more than one work placement.

Appendix H

GCSE Engineering (Double Award) Unit 1 Mark Record Sheet

Centre no:	Centre name:	Internal Moderator name:		
Candidate no:	Candidate name:	**Resubmission of work**	All/mostly amended	
			Some amendments	
Series number			No amendments	

Unit 1: Design and Graphical Communication							
Assessment evidence	Annotation and page number	**Mark Band**			**Centre mark**	**Edexcel use only**
		1	2	3		
• an analysis of the brief with key features of the product or service		1 – 2	3 – 4	5 – 6		
• details of the product criteria and production constraints		1 – 2	3 – 4	5 – 6		
• a range of ideas and design solutions		1 – 2	3 – 4	5 – 6		
• evidence of how you tested and selected the final solution		1 – 2	3 – 4	5 – 6		
• evidence of how you selected and used engineering drawing techniques		1 – 2	3 – 4	5 – 6		
• engineering drawings and technical details		1 – 2	3 – 4	5 – 6		
• evidence of how the solution meets the criteria with suggested modifications to improve its fitness for purpose		1 – 2	3 – 4	5 – 6		
		Final total				

Edexcel moderator use only		
Number:	Name:	Signature:

Appendix I

GCSE Engineering (Double Award) Unit 2 Mark Record Sheet

Centre no:	Centre name:	Internal Moderator name:		
Candidate no:	Candidate name:	**Resubmission of work**	All/mostly amended	
			Some amendments	
Series number			No amendments	

Unit 2: Engineered products							
Assessment evidence	Annotation and page number	Mark Band			Centre mark	Edexcel use only
		1	2	3		
• how you used a product specification and interpreted engineering drawings		1 – 2	3 – 4	5 – 6		
• information about details of resources and processing requirements		1 – 2	3 – 4	5 – 6		
• information about production details and restraints		1 – 2	3 – 4	5 – 6		
• how you selected and used materials to safely make your product		1 – 2	3 – 4	5 – 6		
• how you selected and used parts and components to safely make your product		1 – 2	3 – 4	5 – 6		
• how you selected and used processes, tools and equipment to safely make your product		1 – 2	3 – 4	5 – 6		
• how you tested your product and how it compiled to the standards required		1 – 2	3 – 4	5 – 6		
		Final total				

Edexcel moderator use only		
Number:	Name:	Signature:

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