Model Assignment

Issued September 2008

OCR Level 3 Principal Learning in Engineering

Unit F558: Selection and application of engineering materials

Please note:

This OCR model assignment may be used to provide evidence for the unit above. Alternatively, centres may 'tailor' the assignment within permitted parameters (see 'Notes for Tutors). It is the centre's responsibility to ensure that any adaptations made to this assignment allow learners to meet all the assessment objectives and provide sufficient opportunity for learners to demonstrate achievement across the full range of marks.

The scheme codes for these qualifications are:

OCR Level 3 Principal Learning in Engineering 500/2400/0

The QCA Accreditation Number for this unit is:

Unit F558: Selection and application of engineering materials M/501/1899

This OCR model assignment remains live for the life of these qualifications.

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Model Assignment

Description of Model Assignment.

In this unit you will find out about the structure, properties and classification of engineering materials.

You will:

- understand the properties of materials, their availability and cost implications,
- correctly specify materials for different engineering applications
- understand the key features and applications of new, modern and smart materials
- investigate what causes materials to deteriorate and understand how this can be prevented
- use mathematical and scientific principles within engineering metallurgy

You will work individually or in a team but you will need to record your own results and conclusions independently in the form of a research report.

A number of the tasks contained within this unit will require you to select and carry out a detailed analysis of an engineered product. Care will need to be taken in the selection of a suitable product. The product should contain a wide range of materials to ensure there is sufficient scope to address all the requirements of the unit.

Read through all of the following tasks carefully, so that you know what you will need to do to complete this assignment.

Tasks

Task 1: Atomic structures, periodicity and classification of engineering materials

Assessment Criterion 1.1

Your task is to:

- plan and carry out research into atomic structures, amount of bonding, periodicity and classification of engineering materials
- analyse and evaluate information and judge its relevance and value
- apply your knowledge to the consideration of materials for a particular application

You will need to investigate:

- the crystalline structure of metals, space lattice structures, grain sizes, crystal growth, solidification
- the composition and structure of plastics: thermoplastics - long chain molecules, thermosetting plastics - cross-linking
- co-polymerisation
- the periodic table, atomic bonding, ionic bonding, covalent bonding and metallic bonding

You need to record the outcomes of the task as part of your research report for this assignment.

Task 2: Testing and evaluation of engineering materials

Assessment Criterion 2.1

Your task is to:

- investigate thermal equilibrium diagrams for common alloys
- draw detailed conclusions about properties of materials based upon your investigations
- test a wide range of materials using destructive and non-destructive methods
- analyse and evaluate the information obtained from your testing in depth, judging its relevance and value

You will need to:

- use test equipment safely while utilising some (or all) of the following:

o tensile testing using tensometer
o hardness testing, Brinell, Vickers, Shore-scleroscope
o impact testing Charpy / Izod
o fatigue testing

- compression testing
- penetrant methods of testing
- radiography/ X-ray /ultrasonics

You need to record the outcomes of the task as part of your research report for this assignment.

Task 3: Processing methods

Assessment Criterion 3.1

Your task is to:

- investigate the effects of different processing methods by testing and analysing samples which have been formed and worked in different ways, which may include:
    - crystal forms caused by casting, grain structure in hot forged components/cold formed or turned components
    - changes caused by work hardening and deep drawing
    - heat treatment, annealing, normalising, hardening and tempering
    - the heating and forming of thermoplastic materials
    - the heating and forming of thermosetting plastic materials
    - the effects of alloying – melting points, strength

You need to record the outcomes of the task as part of your research report for this assignment.

Task 4: Safety factors and modes of failure

Assessment Criterion 4.1

Your task is to:

- investigate and research safety factors and modes of failure

You will need to:

- Identify examples where failure has occurred and the measures engineering designers take to:
    - anticipate risk
    - minimise risk
- Show consideration and understanding of:
    - safe working stress
    - uniformity of material

- types of loading: static or dynamic
- effects of failure
- effects of wear
- effects of corrosion on materials

You need to record the outcomes of the task as part of your research report for this assignment.

Task 5: Standard forms and selection of materials

Assessment Criterion 5.1

You will need to select an engineered product made from a wide range of engineering materials for consideration during this task.

Your task is to:

- analyse the product and investigate each material used in its manufacture to establish the:
  - identity of the materials
  - properties of the materials
  - material's standard forms
  - reasons for their selection

You will need to:

- provide evidence of the original forms in which the materials were supplied and the process used to manufacture the product.

You need to record the outcomes of the task as part of your research report for this assignment.

Task 6: New and smart materials

Assessment Criterion 6.1

Your task is to:

- investigate the key features of new and smart materials and their potential applications
- analyse and evaluate the information and knowledge gained and apply this to suggest possible engineering applications for these new materials
- present a persuasive argument to influence others towards the use of new or smart materials.

You will need to:

- develop an awareness of latest developments in a developing technology
- have knowledge of materials such as Shape Memory Alloys (SMAs) and intelligent coatings

- be up to date on new materials and applications as they become available
- be able to discuss (influence) with others the values and merits of using these new materials

You need to record the outcomes of the task as part of your research report for this assignment.

Model Assignment: Tutor Information

OCR Level 3 Principal Learning in Engineering

Unit F558: Selection and application of engineering materials

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Guidance for Centres

1 General

1.1 OCR model assignments are issued free to participating centres and are also available to download from our website: www.ocr.org.uk.

1.2 Centres may choose to:

- use OCR model assignments for formal summative assessment of learners
- tailor OCR model assignments for formal summative assessment of learners

It is intended that this model assignment can be used by centres without modification. However, in order to provide appropriate contextualisation, improve access or increase local relevance, centres may 'tailor' the model assignments within set parameters. Details of the scope of adaptation are provided in the 'Notes for Tutors' section of this document.

1.3 This assignment has been designed to meet the full assessment requirements of the unit. Learners will need to take part in a planned learning programme that covers the underpinning knowledge and skills of the unit.

2 Before carrying out the assignment

2.1 Learners should be provided with a copy of the *Learner Information* section of this assignment or the centre adapted model assignment.

2.2 Learners may carry out preparations prior to undertaking the tasks; there is no time limit for this.

3 When completing the assignment

3.1 All assessment evidence must be produced under **controlled conditions** so that the overall level of permit control secures validity and reliability, provides good manageability for all involved and allows teachers to authenticate the work confidently. Further guidance on **controlled conditions** is provided within the OCR Principal Learning Handbook.

3.2 Learners should be allowed 32 guided learning hours (glh) to complete all of the tasks. The amount of time may vary depending on the nature of the tasks and the ability of individual learners. It is suggested that evidence is produced in several sessions.

3.3 Each learner must produce individual and authentic evidence for each task within the assignment.

3.4 Centre staff may give support and guidance to learners. This support and guidance should focus on checking that learners understand what is expected of them. It is not acceptable for presenters to provide model answers or to work through answers in detail.

3.5 Learners may use information from any relevant source to help them with producing evidence for the tasks.

3.6 Learners must be guided on the use of information from other sources to ensure that confidentiality is maintained at all times.

4 After completing the assignment

4.1 Learners' evidence is assessed by the centre's assessor against the qualification specification contained in the Principal Learning Handbook. When marking learners' work, centres **must** use the descriptors provided within the unit. For further information about assessment please refer to the section on Assessment and Moderation in the Principal Learning Handbook.

4.2 Assessors' decisions should be quality assured across the centre through internal moderation. For further information about internal moderation please refer to the section on Assessment and Moderation in the Principal Learning Handbook.

5 Presentation of work

5.1 Centres may wish to discourage learners from excessive use of plastic wallets for presentation of their evidence as this may hinder the assessment process. Instead centres may wish to encourage learners to present their work so that it is easily accessible, e.g. spiral bound, stapled booklet, CD-ROM.

6 Acceptable evidence

6.1 For guidance on generation and collection of evidence please refer to the section on Assessment and Moderation in the Principal Learning Handbook.

7 Plagiarism and unauthorised collaboration

7.1 Centres should have adequate procedures in place to ensure that plagiarism and unauthorised collaboration are identified and responded to.

7.2 When supervising tasks, teachers are expected to:

- offer learners advice about how best to approach such tasks
- inform learners of the ramifications of unfair practice
- exercise continuing supervision of work in order to monitor progress and to prevent plagiarism
- ensure all copied materials is suitably acknowledged
- ensure copied material is not given credit in the assessment process

7.3 As with all controlled assessments, the presenter must be satisfied that the work submitted for assessment is the learner's own work.

Notes for Tutors

Introduction to the Tasks

The tasks have been designed to enable learners to demonstrate their knowledge and understanding of the selection and application of engineering materials.

Learners will also be able to present persuasive arguments to influence others towards the use of new or smart materials.

The model assignment has been designed so that all of the assessment criteria in Unit F558 are addressed.

Care, guidance and support will be required to assist learners with the selection of a suitable product which contains a wide range of materials to ensure there is sufficient scope to address all the requirements of the assessment criteria.

Learners will need to:

- understand the properties of materials, their availability and cost implications and correctly specify materials for different engineering applications
- understand the key features and applications of new, modern and smart materials
- investigate what causes materials to deteriorate and understand how this can be prevented
- use mathematical and scientific principles (Level 3 Units F563 and F564) within engineering metallurgy

There are direct links with the content of Units F563 and F564 of this Principal Learning.

There are practical elements to this unit and centres will need to employ suitable safety procedures especially during the testing of materials.

These guidance notes should be used in conjunction with the unit specification and Principal Learning Handbook.

Scope of permitted Model Assignment modification

The model assignment is self-contained in its present form. The set of tasks form a coherent whole addressing all the assessment criteria.

No changes to the assessment criteria are permitted

When completing this model assignment it may be possible to generate evidence for completing a task in a variety of formats. This list is not exhaustive and will depend on the approach taken to complete the task or model assignment. In some cases the task or model assignment will require a specific format for the outcome and this will be clearly marked in the table.

Depending on the approach taken to the model assignments it may also be possible to demonstrate additional PLTS coverage and some additional opportunities have been listed below.

Task activity	Nature of evidence generated	Potential Assessment Criteria coverage
Task 1 Atomic structures, periodicity and classification of engineering materials.	The research report will contain evidence of understanding of: • the crystalline structure of metals, space lattice structures, grain sizes, crystal growth, solidification • the composition and structure of plastics-thermo plastics long chain molecules, thermo-setting plastics- cross-linking • co-polymerisation • the periodic table, atomic bonding ionic bonding, covalent bonding, metallic bonding.	**Assessment Criterion** • 1.1 **PLTS** • IE1 • IE2 • IE4 • IE6
Task 2 Testing and evaluation of engineering materials.	The research report will contain evidence of testing and understanding of: • thermal equilibrium diagrams for common alloys • thermal expansion • stress strain diagrams for metals and plastics • tensile testing using tensometer • hardness testing, Brinell, Vckers, Shore-scleroscope • impact testing Charpy / Izod • fatigue testing • compression testing • equipment safety • penetrant methods of testing • radiography/X-ray /ultrasonics	**Assessment Criterion** • 2.1 **PLTS** • IE2 • IE4 • IE6 • EP3 • SM3 • RL5

Task 3 Processing methods	The research report will contain evidence of understanding of: • crystal forms caused by casting, grain structure in hot forged components/cold formed or turned components, changes caused by work hardening, deep drawing • heat treatment, annealing, normalising, hardening, tempering • the heating and forming of thermoplastic materials. • the heating and forming of thermosetting materials • the effects of alloying – melting points, strength	**Assessment Criterion** • 3.1 **PLTS** • IE1 • IE2 • IE4 • IE6
Task 4 Understand factors of safety and modes of failure of engineering materials.	The research report will contain evidence of consideration and understanding of: • safe working stress • uniformity of material • type of loading • static or dynamic • effects of failure • effects of wear and • effects of corrosion on materials	**Assessment Criterion** • 4.1 **PLTS** • IE2
Task 5 Standard forms and selection of materials.	The research report will contain evidence of understanding and use of: • material data charts to select materials for performance requirements, processing selection, Young's modulus/ density, Young's modulus/cost, strength/density, strength/toughness, strength/elongation, strength/cost, strength/maximum service temperature, specific stiffness/specific strength, electrical resistivity/ cost, recycling fraction/cost, energy content/cost • process selection, comparative costs, batch sizes, material costs, start-up costs, running costs, total costs. • reference to manufacturers' data sheets and catalogues to source common materials	**Assessment Criterion** • 5.1 **PLTS** • none
Task 6 New and smart materials and their potential applications.	The research report will contain evidence of: • an awareness of latest developments in a developing technology • knowledge of materials such as Shape Memory Alloys (SMAs) and intelligent coatings should be constantly updated by new materials and applications, as they become available.	**Assessment Criterion** • 6.1 **PLTS** • IE1 • RL3

	• an ability to discuss with others the values and merits of using these new materials	• EP2