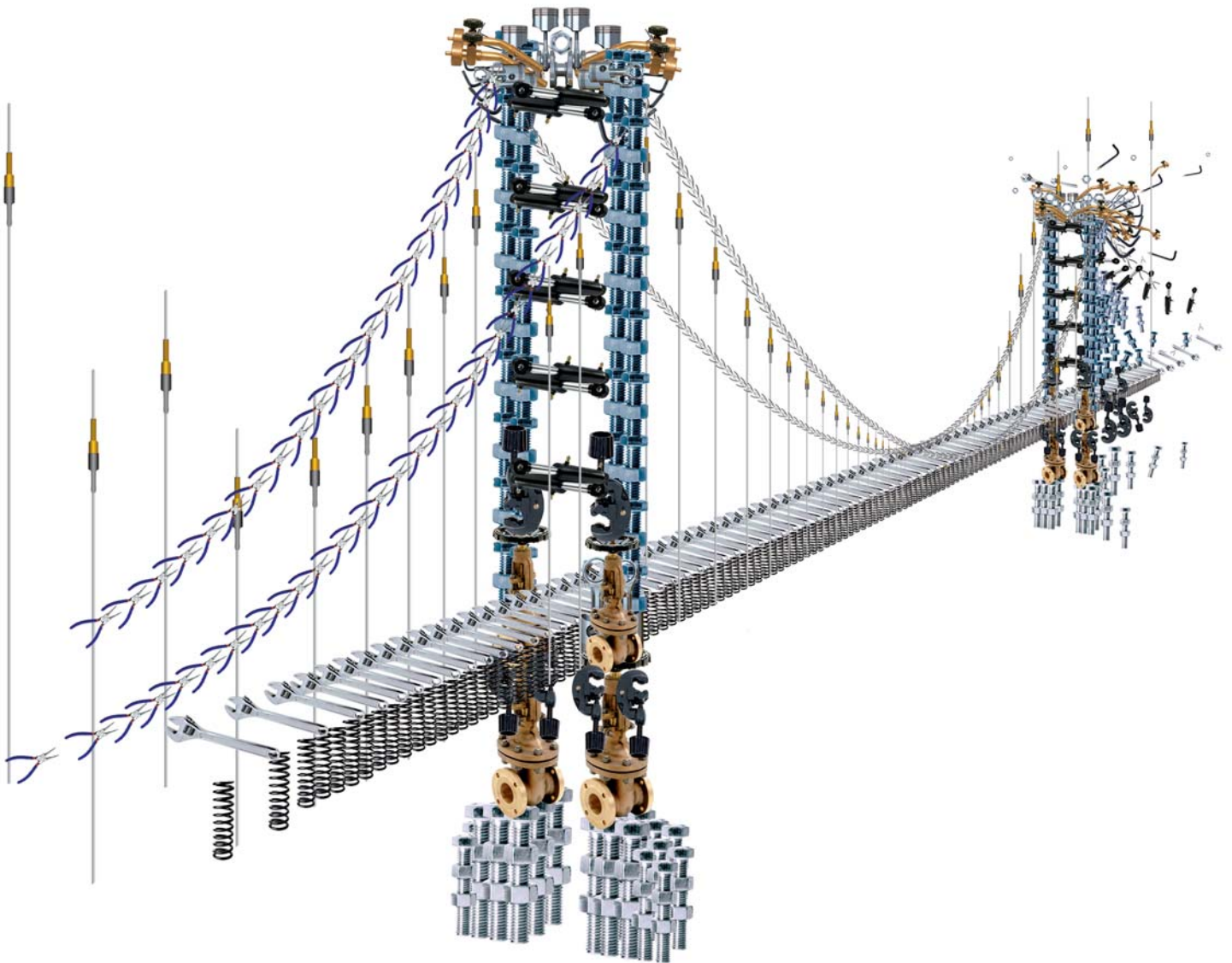


## SAMPLE ASSIGNMENT BRIEF AND COMMENTARY (ALTERNATIVE)

### UNIT 3 - SELECTION AND APPLICATION OF ENGINEERING MATERIALS

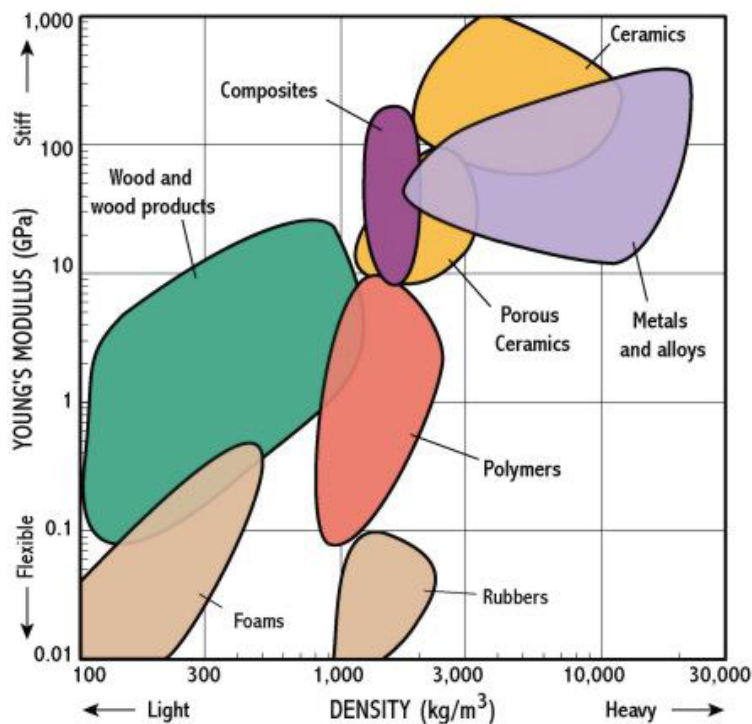


## Engineering

### Level 3 Unit 3 Selection and Application of Engineering Materials (ENG3U3)

#### Sample Assignment Brief and Commentary (Alternative) (Approximately ten hours under controlled conditions)

Please find below an example of an assignment that could be used for this unit of the Engineering Diploma. It must not be assumed that this assignment will be guaranteed to meet the precise needs of all consortia, but it could be used as a basis.



## What is this unit about?

The purpose of this unit is to develop learners' understanding of the link between the materials used for engineering products and the selection of processes used in their manufacture. Learners will also gain an insight into how modern materials have influenced the design and reliability of products and services, and assisted the quality assurance side of manufacturing.

Through the use of workshop and laboratory tests, learners will apply analytical techniques to evaluate and record data.

This unit, alongside the others within the Level 3 Principal Learning in Engineering, has been designed to allow learners the opportunity to develop a range of Personal, Learning and Thinking Skills (PLTS), and to demonstrate these on more than one occasion. This approach will allow them to build towards a full range of PLTS.

## Learning Outcomes

The learner will:

- 1 understand engineering specifications and be able to plan safe investigations and testing operations
- 2 know how to use tools, equipment, engineering materials and components to conduct testing techniques on a range of materials
- 3 be able to gather record and analyse engineering material information.

## Activities

### ***Section 1 – Engineering Specifications, Investigations and Testing Operations***

- 1 Select 4 or 5 elements from the periodic table and do the following:
  - Discuss how the structure of the periodic table is determined and why each element has its position in the table – use figure 1 below.
  - Describe the atomic bonds found in your selected elements and how the bonding affects the properties of each of the elements.
  - List and describe the major bond types – **primary** and **secondary**; your discussion should include an example (preferably including a fully labelled image) of a material in which these bonding mechanisms can be found.
- 2 You are to produce a materials' test schedule to determine the properties of engineering metallic and non-metallic materials as issued to you by your tutor. You are to determine properties such as, but not limited to (centre availability):
  - Hardness
  - Stiffness
  - Elasticity
  - Ultimate Tensile Strength
  - Yield Strength
  - 0.2% Proof Stress
  - Toughness
  - Ductility
  - Resistivity
  - Density
  - Thermal and Electrical Conduction
  - Coefficient of Thermal Expansion (CTE).

You are to produce reports of the various tests to the relevant British / International Standard for that particular test; for example:

- BS EN 10002 – 1 : 2001 Metallic Materials – Tensile Testing. Your report should include (see section 2 activity 1 below):
  - 1 Reference to the appropriate standard
  - 2 Identification of the test piece
  - 3 Specified material, if known
  - 4 Type of test piece
  - 5 Location and direction of sampling test piece, if known
  - 6 Test results.

3 Describe the benefits and limitations of destructive and non-destructive testing methods. See table 1 below for examples of each – this list is by no means exhaustive.

Examples of Destructive Testing Methods	Examples of Non-Destructive Testing Methods
Tensile Testing	Ultrasonic – there are a number of differing applications / methods under this heading
Fatigue Testing	X-Ray
Microscopic Analysis	Eddy Currents
Torsion Testing	Visual Inspection
Izod Impact Tests	Computed Tomography
Charpy Impact Tests	Impulse Excitation Technique
Various Hardness Tests	Dye Penetrant

Table 1 – Examples of destructive and non-destructive test

- 4 Select a range of materials – as determined by your tutor – and discuss the following:
- By using suitable diagrams describe a **crystalline** and **chain molecular** structure; in what classes of materials are these structures found?
  - Describe how the different bonding structures are linked to mechanical, electrical, physical and chemical properties.
  - Describe how the improved properties are achieved in “smart” materials? For example, how **piezoelectric crystals** produce a voltage when stress is applied.

Explore key information about the chemical elements through this periodic table

Group	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
Period																			
1	1 H																		2 He
2	3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne	
3	11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar	
4	19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr	
5	37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe	
6	55 Cs	56 Ba	* 71 Lu	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn	
7	87 Fr	88 Ra	** 103 Lr	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Uub	113 Uut	114 Uuq	115 Uup	116 Uuh	117 Uus	118 Uuo	
			* 57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb			
			** 89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No			

Figure 1 – The periodic table source <http://www.webelements.com/>

## **Section 2 – Use Tools, Equipment, Materials and Components to Conduct Testing Techniques on Materials**

- 1 Produce a report that continues the work from section 1 activity 2 above; you are to perform / complete various tests on sample materials as prescribed by your tutor. Use a similar recording sheet to the example tensile test recording card in appendix 1 of this document. Your report must include as a minimum:
  - All test results and your interpretation of them – this must include a comparison of your results / data with those obtained from a reputable source; for example, [www.matweb.com](http://www.matweb.com) or [www.azom.com](http://www.azom.com) etc.
  - A fully labelled diagram of the test, test procedure and equipment used – these could be digital photographs.
  - A comprehensive list of all PPE and safety procedures required for the testing of the materials – this must include a risk assessment for each test.
  - From the results of the tests you must categorise the materials into their classes / groups etc.
  - Based on the evidence from your tests and the results, provide suitable applications for your tested materials giving alternatives where appropriate.
  - Describe how the material's surface, heat or other treatments would affect the materials' properties.
  - Determine the forms of supply of each of your classes / categories of materials and provide a description of some of the main processing technologies available for each; for example, casting metals, injection moulding of polymers, sintering of ceramics etc.
  - Critically appraise the usefulness, or otherwise, of destructive and non-destructive testing methods.
  - Compare and contrast the latest developments in materials and materials' testing technology; for example, testing of smart materials, cermets etc., and you must provide evidence from reputable sources to substantiate your assertions.

### ***Section 3 – Gather, Record and Analyse Engineering Material Information***

- 1 Continuing the work that you have done thus far in section 2 activity 1 above, your report must include the following:
  - All of your sourced information as appendices – your report discussion must make reference to this information.
  - Your test report card / documents must be of a format agreed with you tutor and the team with whom you are working and must be word processed.
  - You must include evidence and descriptions of the modes of failure of your test pieces during your testing schedule – digital photographs will be useful here.
  - Discuss any modifications to the testing procedure that you feel may be applicable to your selected materials; for example, altering the rate of extension during a tensile test both on metals and polymers.

		The learner has:			Activity Reference	Evidence Requirements	Mark
		Band 1 0 – 5 marks	Band 2 6 – 10 marks	Band 3 11 – 15 marks			
1	<b>Engineering specifications, investigations, and testing operations.</b>	Relied predominantly on a single source of information or data to investigate material structures.	Collected and used information from a variety of sources and made reference to atomic bonding and the position of some elements in the periodic table.	Analysed information and data from a number of sources and described in detail the principles and types of atomic bond; made some reference to polymorphic behaviour of certain elements in the periodic table.	Section 1 activity 1 and section 3 activity 1	1 & 6	
		Prepared a simple laboratory test schedule for determining the key properties of engineering metallic and non-metallic materials.	Produced a detailed and clear test schedule for determining properties of engineering metallic and non-metallic materials; provided additional information on range of values outside the scope of the expected numerical test data.	Produced a comprehensive and well-structured test schedule based on informed decisions, which explain the benefits and limitations of destructive and non-destructive testing methods for obtaining data on material behaviour.	Section 1 activity 1	1, 4 & 6	
		Selected a limited range of different materials and distinguished between crystalline and chain molecular structures.	Selected a range of materials and described how their different structures and types of bonding are linked to physical and chemical properties.	Selected a range of materials and described accurately how the structure and type of bond in each influences its mechanical, electrical and chemical properties; described the improved properties achieved in 'Smart' materials.	Section 1 activity 1	1 & 6	

		The learner has:			Activity Reference	Evidence Requirements	Mark
		Band 1 0 – 12 marks	Band 2 13 – 24 marks	Band 3 25 – 36 marks			
2	Use tools, equipment, materials and components to conduct testing techniques on materials.	Worked with a limited or reduced range of engineering materials and testing techniques.  Needed more than one attempt to produce satisfactory test results; the testing of some materials may be incomplete.  Given a limited explanation of the test and the usefulness of recorded data and, based on the results, identified an application for which the materials would be suitable.  Provided limited information on the forms of supply for the materials under consideration.	Used a range of materials and test equipment to produce suitable results which are within the range recorded in known references for each material.  Completed tests in accordance with the schedule and materials are linked to categories.  Given an acceptable explanation of tests on different categories of material and the usefulness of recorded data and, based on the results, described an application for which each material would be suitable.  Made some reference to processability and influence material treatments would have on the results and provided accurate information on the forms of supply for each material under consideration.  Briefly compared the tests used to those that may be more applicable to recent developments in materials technology.	Used a wide range of materials and testing techniques that highlight key differences between the different categories of materials, with references to structural characteristics.  Completed tests to schedule and recorded all results accurately in the correct format, and accurately linked materials to categories.  Given a detailed explanation of tests on different categories of material and the usefulness of recorded data and, based on the results, fully described an appropriate application for which each material would be suitable.  Given a reasoned explanation on their processability and the type of material treatments that would improve their respective properties and how this influenced the forms of supply for each material under consideration.  Compared the types of test used to those that would be more applicable to recent developments in materials technology.	Section 1 activities 2, 3 and 4 and section 2 activity 1  Section 1 activities 2, 3 and 4 and section 2 activity 1  Section 1 activities 2, 3 and 4 and section 2 activity 1  Section 1 activities 2, 3 and 4 and section 2 activity 1  Section 1 activities 2, 3 and 4, section 2 activity 1 and section 3 activity 1	2, 3 and 4  2, 3 and 4  2, 3 and 4  2, 3, 4 and 5	

		The learner has:			Activity Reference	Evidence Requirements	Mark
		Band 1 0 – 3 marks	Band 2 4 – 6 marks	Band 3 7 – 9 marks			
3	Gather, record and analyse engineering material information.	Gathered and analysed information from a restricted range of reference sources.	Gathered and interpreted relevant information from a range of reference sources.	Gathered, analysed and interpreted complex information from a wide range of sources.	Section 1 activities 1, 2, 3 and 4	1, 2 and 4	
		Used basic methods and formats for recording results and describing material behaviour.	Used appropriate methods and formats for recording results accurately.	Recorded in detail the testing procedures and test results, using appropriate methods and formats.			
		Made conclusions based on insufficient data or evidence with minimal references to modes of material failure.	Made reasoned judgements on a limited range of data and described common modes of material failure.	Analysed complex information and data, justifying judgements in an engineering context; adequately justified any modifications to the testing procedure and given detailed descriptions of failure modes.			
		<b>Total Mark</b>					

**APPENDIX 1 – TENSILE TEST RECORD CARD**

<b>Date of Test</b>	<b>British / International Standard that Test Complies with</b>	<b>Material Class and Specification and Batch Number</b>	<b>Material Condition</b>
	Batch Number: Material Specification and Class:		
<b>Test Machine Serial / Identification Number</b>	<b>Ambient Temperature / Environmental Conditions</b>	<b>Equipment Required – Including PPE., Measuring Equipment and Laboratory Facilities</b>	<b>Type of Test Piece</b>
<b>Location and Direction of Sampling Test Piece</b>		<b>Test Results – See Attached Graph</b>	

# Commentary on Sample Assignment Brief

Assessment assignment review

Level 3 Unit 3

Assignment title: *None provided*

	No	Possibly	Probably	Yes
Is the use of the language and vocabulary appropriate to the level of the candidates?				✓
Is the readability appropriate to the level of candidates?				✓
Is the length of the assignment appropriate?		✓		
Can the assignment be delivered in the control context specified in the unit?			✓	

Accessibility – How accessible is the assignment for the candidate?

*Is the use of the language and vocabulary appropriate to the level of the candidates?*

*Is the readability appropriate to the level of candidates?*

*Is the length of the assignment appropriate?*

*Can the assignment be delivered in the control context specified in the unit?*

*If the diagram is not a part of the assignment - it may be a detractor.*

	No	Possibly	Probably	Yes
Are the tasks set at the correct level?			✓	
Are the tasks appropriate for the unit?				✓
Are only topics covered which are in the unit specification?				✓

Suitability – Are the tasks suitable and appropriate for the unit?

*Are the tasks set at the correct level?*

*Are the tasks appropriate for the unit?*

*Are only topics covered which are in the unit specification?*

*Assignment may have had more relevance for the candidate had it been set in a real engineering situation.*

	No	Possibly	Probably	Yes
Are all the Assessment Criteria covered at the highest levels?				✓
Can the Assessment Criteria be identified reasonably?			✓	
Dose the assignment allow marking to address the Assessment Criteria?			✓	

Assessment Criteria – Are there adequate opportunities to cover the Assessment Criteria at the highest levels?

*Are all the Assessment Criteria covered at the highest levels?*

*Can the Assessment Criteria be identified reasonably?*

*Dose the assignment allow marking to address the Assessment Criteria?*

*Some concern Section 1 Activity 2, “you are to produce a test schedule .....as issued by tutor”, it is not clear who is doing what – tutor/candidate? Section 2 seems to go beyond/deeper than the requirement of the unit i.e., testing is also covered in section 1*

	No	Possibly	Probably	Yes
Is the overall timing of the assignment correct?		✓		
Does the timing of the tasks generally reflect the mark weighting?	✓			

Timing – Is the balance to timing of the assignment correct?

*Is the overall timing of the assignment correct?*

*Does the timing of the tasks generally reflect the mark weighting?*

*It seems that a great deal has to be done in the time available. I would have liked to have seen estimated times on the various activities.*

	No	Possibly	Probably	Yes
Are the Evidence Requirements covered by the assignment?				✓
Are only the units Evidence Requirements included?	✓			

Evidence requirements – Are the Evidence Requirements evident?

*Are the Evidence Requirements covered by the assignment?*

*Are only the units Evidence Requirements included?*

*Overall ERs have been well covered but concern that the assignment may have gone beyond the requirements of the unit.*