# **Higher Nationals**

# Assignment Brief – BTEC (RQF)

Higher National Certificate in Engineering

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| Student Name/ID Number |  |
| **Course** | **2017 Pearson Higher National in Engineering** |
| **Unit Number and Title** | **9. Materials, Properties and Testing** |
| Academic Year | 2020/2021 |
| Unit Tutor | Karen Whitehead |
| **Assignment Title** | **Assignment 2: Testing Techniques, Causes of In-Service Materials Failure** |
| **Issue Date** | 24/03/21 |
| Submission Date | 28/04/21 |
| IV Name & Date |  |
| Allocation of time to complete assignment | Assignment will be completed outside of class. Estimated time for completion of the assignment is 15 hours. |
| **Submission Format** | |
| **Restrictions**  The submission is in the form of an individual written report. This should be written in a concise, formal business style. You are required to make use of headings, paragraphs, and subsections as appropriate. All work must be supported with research and referenced appropriately.  Guided word count 2,220 words, (1040 task 1 and 1180 task 2).  The word count does not include calculations and your reports should be written in Times New Roman or Arial, font size 12, 1.5 line spacing.  Ensure that you reference all sources using Harvard referencing system. Ensure all diagrams are numbered labelled and referred to in your text. Any supporting detail should be included in a suitably referenced appendix. | |
| **Student declaration** | |
| I certify that the work submitted for this assignment is my own and research sources are fully acknowledged.  Student signature: Date: | |
| **Unit Learning Outcomes** | |
| **LO3: Explore the testing techniques to determine the physical properties of an engineering material.**  **LO4: Recognise and categorise the causes of in-service material failure.** | |
| **Assignment Brief and Guidance** | |
| **Part 1**  **Scenario**  Engineering is a profession that is based on an understanding of the supply, use and key properties (features) of a variety of materials, tools, and equipment. Without such an understanding the safety, performance and quality of any product or service could not be guaranteed. Whether it is designing the latest automotive parts or state of the art electrical products, manufacturing basic household objects, such as cutlery, or maintaining a complex engineering plant or system, engineers must understand the properties of the materials with which they work.  This assignment is made up of tasks designed to assess your understanding on testing techniques to determine physical properties of engineering materials and to recognise and categorise the causes of in-service materials failure. | |
| **Task 1**  You are working as a materials laboratory technician in a manufacturing company. Your company has been awarded a contract to produce and supply several engineering components which involve different types of engineering materials. Your task as a laboratory technician is to explore the testing techniques to be used to determine the physical properties of the materials:  **i)** Describe with the aid of labelled diagrams, six most common tests used to identify materials properties.  **ii)** Describe with the aid of diagrams the four common non-destructive testing processes below:   * Dye penetrant * Magnetic particles * Ultrasonic and * Radiography   Include a practical application where each test would be used in an engineering context.  **iii)** Now, your boss has asked you to explain how test results from these processes can influence material selection for the applications you have described above.  **iv)** Finally, your boss asked you to analyse the results of mechanical tests on each of the three materials categories: 0.1% Carbon Steel (as drawn) Identifier: no bands, 0.4% Carbon Steel (normalised) Identifier: 3 bands, Aluminium/Magnesium Alloy (NE4-0) Annealed. Identifier: O stamp and carry out data comparison between them.  Also, determine the Modulus of Elasticity of each material and compare results against industry recognised data sources, explaining any difference found, using data provided below on pages 3, 4 and 5. | |
| **Task 2**  Background Scenario:  Locus is local engineering company specialising in producing small volume topside and subsea equipment for the oil and gas industry. The company specialises in finding new uses for traditional materials as well as using modern materials for the equipment it manufactures. As an engineering apprentice working in the research department of the company, you are invited to analyse the different materials for the array of products under development**.**    **Fig 1, Subsea Valves**  **Task 2**  Locus has recently been awarded a 5-year contract by a major international oil and gas company to manufacture and supply subsea equipment and components of various kinds. To recognise and categorise the causes of in-service materials failure, your boss has asked that you do the following:  **i)** Describe six common mechanism of failure:  Fatigue  Creep  Brittle failure  Ductile failure  Corrosion failure  Stress – corrosion cracking failure  Include diagrams where possible to illustrate your answers  **ii)** Describe working and environmental conditions that lead to failure of the following materials:  Refractory ceramics  Polymers  Metals  Composites  Include diagrams where possible to illustrate your answers.  **iii)** Explain, with examples, the preventative measures that can be used to extend the service life of the following products within their working environment:  Turbine blades – creep.  Car crankshaft – fatigue.  Boat hull – uniform corrosion.  Include diagrams where possible to illustrate your answers.  **iv)** Explain the methods that could be used for estimating product service life when a product is subject to creep and fatigue loading. | |

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| **Learning Outcomes and Assessment Criteria** | | |
| **Pass** | **Merit** | **Distinction** |
| **LO3: Explore the testing techniques to determine the physical properties of an engineering material.** | | **D3** Analyse the results of mechanical tests on each of the four material categories for data comparison and  compare results against industry recognised data  sources, explaining any differences found |
| **P5** Describe the six most common tests used to identify material  properties  **P6** Describe the non-destructive  Testing processes – dye penetrant, magnetic particle,  ultrasonic and radiography - and include an example application for each | **M3** Explain how test results influence material selection for a given application |
| **LO4: Recognise and categorise the causes of in-service material failure.** | | **D4** Explain the methods that could be used for estimating  product service life when a product is subject to creep and fatigue loading |
| **P7** Describe six common mechanisms of failure  **P8** Describe working and environmental conditions that lead to failure for a product made from material from each of the  four material categories | **M4** Explain, with examples, the preventative measures that can be used to extend  the service life of a given product within its working environment |

**Assignment Feedback**

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| **Student:** | | **Assignment:** | |
| **Grade Awarded:** | | **Signed:** | **Date:** |
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| **Constructive Feedback**  **What was good?** |  | | |
| **Opportunities to improve**  **What could be done better?** |  | | |
| **Any referral action needed?** |  | | |
| **Feedback on Resubmission** |  | | |