

# Higher National Certificate/Diploma Assessment

Qualification		Pearson BTEC Higher Nationals for England (2024)			
Unit number and title		4017. Quality and Process Improvement			
Assignment title		Quality Control Tools and Costing			
Assessor		Engineering Team			
Academic year	1	Unit Code	H/615/1491	Assignment	1 of 2
Internal Verifier	Dr Michael Shaw		Verification Date	1st September 2025	
Issue Date	1st September 2025		Final Submission Date	No later than 31st August 2026	

## Policy on the Use of Artificial Intelligence (AI)

- Students are required to acknowledge the use of AI in the preparation of any assignment.
- AI tools **may be** permissible for use as learning aids, subject to the AI Assessment Scale designation given below.
- AI cannot be used to generate the final, submitted work in its entirety.
- AI cannot be used to substitute for a student's own critical thinking, analysis, and original expression.
- Assignments must reflect the student's original thought and understanding.
- Assignments are checked automatically on submission for AI content, through Turnitin.
- Assignment grades are only confirmed following viva voce examination at the end of each unit.

## Artificial Intelligence Assessment Scale (AIAS)

Full details of the Artificial Intelligence Assessment Scale (AIAS) are available at [this link](#).

### The AI Assessment Scale (AIAS)

Level	Description	Guidelines
1 NO AI	The assessment is completed entirely without AI assistance in a controlled environment, ensuring that students rely solely on their existing knowledge, understanding, and skills.	You must not use AI at any point during the assessment. You must demonstrate your core skills and knowledge.
2 AI PLANNING	AI may be used for pre-task activities such as brainstorming, outlining and initial research. This level focuses on the effective use of AI for planning, synthesis, and ideation, but assessments should emphasise the ability to develop and refine these ideas independently.	You may use AI for planning, idea development, and research. Your final submission should show how you have developed and refined these ideas.
3 AI COLLABORATION	AI may be used to help complete the task, including idea generation, drafting, feedback, and refinement. Students should critically evaluate and modify the AI suggested outputs, demonstrating their understanding.	You may use AI to assist with specific tasks such as drafting text, refining and evaluating your work. You must critically evaluate and modify any AI-generated content you use.
4 FULL AI	AI may be used to complete any elements of the task, with students directing AI to achieve the assessment goals. Assessments at this level may also require engagement with AI to achieve goals and solve problems.	You may use AI extensively throughout your work either as you wish, or as specifically directed in your assessment. Focus on directing AI to achieve your goals while demonstrating your critical thinking.
5 AI EXPLORATION	AI is used creatively to enhance problem-solving, generate novel insights, or develop innovative solutions to solve problems. Students and educators co-design assessments to explore unique AI applications within the field of study.	You should use AI creatively to solve the task, potentially co-designing new approaches with your instructor.

This assignment is based on the AIAS level indicated by the colour above.  
Follow the instructions for that level.

If the submitted work falls outside the scope of the AIAS designation above, the assignment will be failed.

## References

- Prepare your references and correctly cite them within the body of your assignment using [zbib.org](https://www.zbib.org).
- Use the Harvard referencing standard of any of the listed UK universities.
- In [zbib.org](https://www.zbib.org), create a 'Link to this Version' and copy it into your References section.
- **Assignments will be rejected if this process is not followed correctly.**

## Submission Format

All text elements of your submission should be word processed, mathematical solutions can be handwritten (neatly) and scanned into your document.

### Assignment Format

- **Organisation:** Use clear headings, paragraphs, and sub-sections, to ensure clarity and ease of reading. Refer to Task numbers or sections to make it clear which question you are answering.

### Assignment Structure

Your assignment **MUST** include the following sections:

- **Cover Page:** Your Course, Name, Unit Name and Assignment number/name
- **Contents Page:** List tasks or questions with page numbers.
- **References:** Correctly cite and list all sources used, but do not use Wikipedia. Please see the detailed advice on page 1.

### Submission Requirements

By submitting your assignment, you confirm the following:

- **Originality:** The work is your own, with all sources properly cited.
- **Plagiarism:** You acknowledge that plagiarism and collusion are forms of academic misconduct and are strictly prohibited.
- **Plagiarism Detection:** Your assignment will be submitted to TurnItIn, a plagiarism detection service, that compares your work against databases, online sources, and other students' work.
- **False Declaration:** Making a false declaration is academic misconduct.

<p><b>Vocational Scenario or Context</b></p>	<p>You've recently joined a small electronic circuit manufacturing company as a quality manager, with the aim of introducing quality management systems to improve operational performance. A recent survey by the production manager highlighted an unacceptably high defect rate in the post-production circuits, leaving output at an all-time low. Simultaneously, the overall unit cost of production has escalated, directly impacting the company's profitability.</p>
<p><b>Task 1</b></p>	<p>In a bid to convince the CEO that proactive quality management is essential, you are tasked with completing a comprehensive report on the topic of <b>statistical process control (SPC)</b> and its tangible impact on both <b>quality and cost-effectiveness</b>.</p> <p>a) Your report will include a detailed discussion on the following:</p> <ul style="list-style-type: none"> <li>• <b>Core Principles of Statistical Process Control:</b> Explain the fundamental concepts of SPC and how it differs from traditional "inspection-based" quality control. Provide concrete examples of how these principles could be applied on the manufacturing floor to monitor key process variables like solder temperature or component placement accuracy.</li> <li>• <b>Control Charts:</b> Describe the function and application of at least two different types of control charts (e.g., X-bar and R charts, or P charts) and explain how they are used to distinguish between common cause and special cause variation. Justify why this distinction is critical for process stability and improvement.</li> <li>• <b>Benefits of SPC:</b> Argue for the implementation of SPC within the engineering environment. Focus your justification on how it can lead to improved product quality, reduced waste, and enhanced customer satisfaction.</li> </ul> <p>b) To provide a practical, industry-specific context, your report will also include a discussion on:</p> <ul style="list-style-type: none"> <li>• <b>The "Seven Basic Tools of Quality":</b> Select and explain how at least three of these tools (e.g., Pareto chart, Fishbone diagram, Histogram) can be used to analyze and solve quality-related problems in the electronics manufacturing process. For each tool, provide a specific example of its application.</li> <li>• <b>Cost of Quality (COQ) Model:</b> Analyze the four main components of the COQ model (prevention, appraisal, internal failure, and external failure costs). Using a real-world example from the electronics industry, demonstrate how an investment in prevention and appraisal costs can lead to a significant reduction in failure costs and a positive return on investment.</li> </ul>

## Task 2

Further to your discussion in Task 1, you will complete the below practical to highlight the effects of implementing a quality control tool.

A company manufactures **LED drivers** in batches of **200**. Each driver is tested by quality control for the **output voltage** when connected to a constant load. The acceptable limits for the output voltage are between **11V and 15V**. Any drivers that fall outside these limits are non-conforming and must be reworked or scrapped. The typical test results pre and post the introduction of quality control are shown in **Table 2.1**.

**Table 2.1: Number of Drivers vs. Output Voltage**

Output Voltage (V)	Before QC	After QC
< 5	5	1
5 - 7	8	2
7 - 9	15	5
9 - 11	25	10
11 - 13	60	85
13 - 15	50	80
15 - 17	25	15
> 17	12	2
<b>Total</b>	<b>200</b>	<b>200</b>

Using the data from Table 2.1, create a comparative **histogram** or a **dual-axis bar chart** to visually represent the impact of implementing a quality control process. You should then write a brief analysis of the key findings from your graph, highlighting the improvement in product conformity and the reduction of non-conforming units.

Further to your discussion in Task 1, you will complete the below practical to highlight the effects of implementing a quality control tool.

A company manufactures electronic control modules. You are tasked with producing a basic account sheet using the standard costing method and the template shown below, to calculate the net profit/loss for a month both pre and post the introduction of quality control. Assume that the values before QC are the standard, and you have also been given the following information:

The company produces **50 batches** of modules each day.

There are **20 production days** in a month.

Raw materials for each module cost **£0.25**.

Each module is sold for **£1.50**.

All modules that pass quality control are sold.

The monthly wage bill is **£20,000** before the new manager is hired, and **£22,000** afterwards.

The company pays **£4,000** a month in rent.

Overheads were **£400** in the month before QC, and **£350** in the month after QC.

Variances were **£5,000** in the month before QC, and **£7,500** in the month after QC.

### Task 3

Month	Before QC	After QC
<b>Units Produced</b>		
<b>Gross Sales</b>	£	£
<b>Units Sold</b>		
<b>Material Cost</b>	£	£
<b>Net Sales</b>	£	£
<b>Wages</b>	£	£
<b>Rent</b>	£	£
<b>Overheads</b>	£	£
<b>Variances</b>	£	£
<b>Net Profit/Loss</b>	£	£

## Recommended Resources

*Note: See HN Global for guidance on additional resources.*

### Print Resources

- Amsden R.T. (2019). *SPC simplified: Practical steps to quality*. Routledge.
- Begum S., Rajendran C., Prakash Sai L., Ganesh K. and Mohapatra S. (2021) *Total Quality Management in Higher Education: Study of Engineering Institutions*. 1st Edition. Routledge India.
- Cachon G. and Terwiesch C. (2023) *Operations Management*. 3rd Edition. McGraw-Hill
- Cottmon R.J. (2020) *Total Engineering Quality Management*. 1st Edition. CRC Press.
- Goetsch D.L. and Davis S. (2021) *Quality Management for Organizational Excellence: Introduction to Total Quality*. 9th edition. Pearson.
- Lim J.S. (2020) *Quality Management in Engineering: A Scientific and Systematic Approach*. 1st Edition. CRC Press.
- Mathur S. (2021) *Book Review of Total Quality Management in Education*. Management Dynamics.
- Montgomery D.C. (2019) *Introduction to statistical quality control*. John Wiley & sons.
- Stevenson W.J (2021) *Operations Management*. 14th Edition. McGraw-Hill.
- Slack, N., Chambers, S. and Johnston, R. (2016) *Operations Management*. 8th Ed. Essex: Pearson Education Limited.

### Journals

*Note: Example journals listed below provide a broad range of articles related to unit content and those relevant for the qualification. Staff and students are encouraged to explore these journals and any other suitable journals to support the development of academic study skills, and subject specific knowledge and skills as part of unit level delivery.*

[Journal of Quality in Maintenance Engineering](#)  
[The TQM Journal](#)  
[Quality Management Journal](#)

### Links

This unit links to the following related units:

*Unit 5016: Lean Manufacturing*

Relevant Learning Outcomes and Assessment Criteria				
Pass		Merit		Distinction
<b>LO1</b>	<b><i>Examine the applications of statistical process control when applied in an industrial environment to improve efficiency</i></b>		<b>LO1</b>	
<b>P1</b>	Review the tools and techniques used to support quality control.			Suggest justified recommendations for the application of statistical process control in an industrial environment to improve efficiency.
<b>P2</b>	Examine the processes and applications of statistical process control in a production environment.	<b>M1</b>		<b>D1</b>
		Explain the role and effectiveness of the quality tools and techniques used within an industrial environment.		
<b>LO2</b>	<b><i>Analyse cost effective quality control tools</i></b>		<b>LO2</b>	
<b>P3</b>	Analyse the effective use of quality control tools and techniques.			Develop a process for the application of an extensive range of quality control tools and techniques with emphasis on costing.
<b>P4</b>	Compare costing techniques used within industrial environments.	<b>M2</b>		<b>D2</b>
		Determine with justification the quality control tools and techniques that could be used to improve business performance.		