

Student Feedback & Marking Report

Student: Craig Robertson (2418892)

Module: ACMA4000 – Materials and Introduction to Processing

Assessment: Manufacturing Processes and Defects (Report 40% + Video 10%)

REPORT MARKING (40%)

1. Engagement with Literature Skills

Mark Awarded: 15 / 20

The report demonstrates a good breadth of literature drawn from academic journals (e.g. Marschallek and Jacobsen, 2020), professional bodies (British Stainless Steel Association), reputable educational resources (The Open University), and industry/technical sources (Federal Steel Supply; PROCAMLOCK; ResearchGate technical paper on carbon-ceramic brakes). The literature is applied to support material classification, manufacturing routes (sand casting, investment casting, injection moulding), and comparative property arguments between stainless steel and carbon steel, HDPE and ABS, and carbon-ceramic and cast iron brake discs. The inclusion of peer-reviewed sources for casting sustainability and composite brake disc performance demonstrates appropriate engagement with credible material.

However, the literature engagement is often descriptive, with limited synthesis across sources to build comparative or evaluative arguments. Several web-based and secondary sources (e.g. Wikipedia; industry blogs) are used for foundational definitions and process descriptions without triangulation against primary datasheets or standards. The environmental and sustainability dimension is referenced in general terms (e.g. environmental impacts of helmets and ceramics) but is not supported by recent lifecycle assessment (LCA) literature or quantified environmental metrics.

To improve this criterion, the student should integrate at least two recent peer-reviewed LCA or sustainability studies for metals, polymers and composites, and synthesise these findings into a comparative lifecycle discussion. A concise comparative table of environmental impacts (e.g. indicative CO₂ per kg or per functional lifetime for valves, helmets and brake discs) drawn from independent sources would significantly strengthen academic integration and critical use of literature.

2. Knowledge and Understanding Skills

Mark Awarded: 19 / 25

The submission demonstrates solid technical understanding of materials and manufacturing processes across three distinct material classes. The student correctly classifies metals, polymers and ceramics/composites and accurately describes key characteristics such as corrosion resistance of stainless steel, toughness of HDPE for impact protection in safety helmets, and thermal stability and wear resistance of carbon-ceramic brake discs. The manufacturing routes selected are appropriate and correctly described: sand casting and investment casting for stainless steel valves, injection moulding for HDPE helmets, and multi-stage composite processing for carbon-ceramic

brake discs. The explanations show awareness of why different casting routes are chosen depending on dimensional accuracy and surface finish requirements.

Nevertheless, the report remains largely descriptive in its explanation of process–structure–property relationships. For example, while the benefits of stainless steel’s corrosion resistance and ductility are stated, the underlying microstructural mechanisms (e.g. chromium oxide passive film; austenitic FCC structure) are not fully explained. Similarly, the impact behaviour of HDPE helmets is discussed in terms of toughness and flexibility, but the polymer chain mobility and energy absorption mechanisms are not explicitly linked to performance. The ceramic brake disc section acknowledges composite processing but does not clearly explain how fibre reinforcement and ceramic matrix microstructure contribute to the reported thermal and wear performance.

To enhance marks in this criterion, the student should include short explanatory passages linking processing to microstructure and microstructure to properties, for example explaining how moulding conditions influence polymer chain orientation in HDPE helmets, or how the carbon fibre preform and ceramic infiltration process influence the thermal shock resistance of carbon-ceramic discs. Simple schematic diagrams illustrating structure–property relationships would further strengthen conceptual clarity.

3. Cognitive and Intellectual Skills

Mark Awarded: 14 / 20

The report demonstrates some evaluative comparison between original and alternative materials. The comparison of stainless steel with carbon steel appropriately identifies trade-offs between strength, ductility and corrosion resistance, and the HDPE versus ABS comparison correctly highlights differences in stiffness versus toughness in the context of impact protection for safety helmets. The ceramic brake disc versus cast iron comparison is particularly effective in identifying trade-offs between performance (thermal stability, wear resistance, reduced brake fade) and cost, with a justified conclusion that carbon-ceramic discs are suitable for high-performance applications while cast iron remains appropriate for conventional vehicles.

However, much of the comparison remains qualitative, with limited structured evaluation or quantification of trade-offs. For instance, while ABS is noted as stiffer than HDPE, the implications for helmet performance under different impact scenarios are not explored in detail. Environmental or sustainability trade-offs are mentioned but not critically analysed using consistent metrics. The reasoning is sound but could be strengthened by more explicit engineering judgement and structured decision-making.

To improve this criterion, the student should adopt a more formal comparative framework, such as a weighted decision matrix for each product, evaluating candidate materials against criteria including cost, durability, manufacturability, safety performance and environmental impact. This would demonstrate more advanced cognitive and intellectual skills and strengthen the justification of material and process choices.

4. Practical Application Skills

Mark Awarded: 18 / 25

The selection of products from the energy sector and industrial safety contexts is appropriate and allows meaningful application of materials and manufacturing theory to real-world products. The report effectively links material properties to service requirements, for example corrosion resistance and temperature tolerance for stainless steel valves in LNG environments, impact absorption for HDPE helmets in hazardous industrial settings, and thermal stability for carbon-ceramic brake discs in high-performance braking applications. The manufacturing processes selected are relevant to industrial practice and reflect realistic production considerations.

The practical application would benefit from deeper discussion of design-for-manufacture and design-for-safety considerations. For instance, while injection moulding of HDPE helmets is described, the report does not discuss how mould design, wall thickness distribution or ribbing influences energy absorption and helmet performance. Similarly, while casting routes for valves are discussed, there is limited consideration of how casting defects or post-processing (e.g. heat treatment, machining) influence service reliability. End-of-life and sustainability considerations are only briefly mentioned and not tied to specific recycling or disposal pathways.

To significantly enhance this criterion, the student should include a simple lifecycle flow diagram for each product (raw material extraction → manufacturing → use → end-of-life), and briefly discuss realistic recycling or disposal routes. A process flowchart illustrating critical manufacturing steps and potential defect introduction points for one of the products (e.g. casting defects in valves or moulding defects in helmets) would strengthen the application of theory to practical engineering considerations.

5. Transferable Skills for Life and Professional Practice

Mark Awarded: 7 / 10

The report is well structured and professionally presented, with a clear abstract, objectives, literature review, product selection, manufacturing processes, comparative analysis and conclusion. Figures are clearly listed in a table of figures and appropriately referenced within the text, demonstrating good academic practice. The writing style is generally clear and coherent, and the referencing is broadly consistent with Harvard style.

Minor weaknesses include occasional inconsistencies in formatting and limited integration of figures into the analytical narrative. Some figures are presented as illustrative rather than being explicitly discussed in terms of what they demonstrate about manufacturability or material behaviour. The report would benefit from more explicit cross-referencing between figures/tables and the evaluative discussion.

To improve this criterion, the student should ensure each figure is explicitly linked to a point in the analysis, with short interpretive commentary in the main text explaining its relevance. A summary comparison table consolidating key properties, manufacturing routes and trade-offs across all three products would further enhance clarity and professional communication.

VIDEO PRESENTATION MARKING (10%)

Video file reviewed: Yes (meeting recording submitted)

Video Technical Content and Communication

Mark Awarded: 6 / 10

The video introduces the three selected products and correctly identifies their materials and general manufacturing processes. The student explains, at a basic level, why each material is suitable for its application and mentions alternatives. The delivery is clear and understandable, and the presentation broadly follows the expected structure of introducing objects, processes and comparative considerations.

However, the video remains largely descriptive and closely mirrors the written report without sufficient emphasis on comparative trade-offs or explicit engineering reasoning. The discussion of alternatives and sustainability considerations is brief, and the presentation would benefit from clearer signposting of sections (e.g. manufacturing processes, properties, alternatives). Visual support is limited; the inclusion of simple on-screen process flow diagrams or comparative property tables would significantly improve clarity and professional quality.

To improve the video mark, the student should structure the narrative more explicitly around engineering trade-offs (e.g. performance versus cost in carbon-ceramic versus cast iron brake discs) and include at least one concise visual aid per product to reinforce understanding of manufacturing routes and material behaviour.

Overall Summary

Report marks:

Engagement with Literature: 15/20

Knowledge and Understanding: 19/25

Cognitive and Intellectual Skills: 14/20

Practical Application: 18/25

Transferable Skills: 7/10

Video mark: 6/10