

Core Concept: Manufacturing

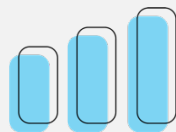
Engineering Literacy Dimension: Engineering Practices

Practice: Material Processing

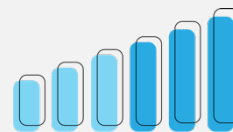
Overview: *Manufacturing* is the process of using technology to transform resources into valuable products. This core concept includes knowledge related to (a) *design for manufacturability*, (b) *additive manufacturing processes*, and (c) *subtractive manufacturing methods*. This core concept is important to the practice of Material Processing as the design of products is affected by factors that are specific to the ability to effectually manufacture the product itself. Accordingly, engineering professionals are required to apply the appropriate knowledge, processes, tools, and equipment for developing effective and efficient processes for producing quality products.

Performance Goal for High School Learners

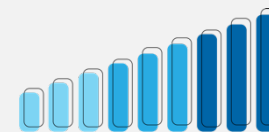
I can successfully design a product in such a way that it is easy to produce and then make the product by applying appropriate manufacturing processes.



Basic



Proficient



Advanced

DESIGN FOR MANUFACTURABILITY

I can identify design criteria and constraints related to manufacturing (e.g. types and forms of raw materials, tolerances, secondary processing, etc.).

I can analyze and evaluate my design in terms of manufacturability, considering the criteria and constraints related to manufacturing.

I can revise my solution to facilitate manufacturing processes, considering the criteria and constraints related to manufacturing.

ADDITIVE MANUFACTURING

I can describe the concept, types of additive manufacturing processes (e.g. inkjets, aerosol jetting, electron beam melting (EBM), 3-D printing, and laser sintering), raw materials (e.g. metals, plastics, and other substances in the form of liquids, sheets, powders, and filaments) and desirable situations for application (e.g. time, cost of materials, and manufacturability).

I can intentionally use an additive manufacturing tools, such as 3D printer or injection molding.

I can, using design for manufacturing principles and guidelines, use additive manufacturing tools, such as a 3D printer or injection molding, to create a specific product.

SUBTRACTIVE MANUFACTURING

I can describe the concept, types of subtractive manufacturing process (e.g. CNC machining, laser cutters, machining through drilling, cutting, milling, turning, grinding, and reaming), raw materials (e.g. metals, composites, polymers, and ceramics) and desirable situations for application (e.g. time, cost of materials, and manufacturability).

I can intentionally use subtractive manufacturing tools, such as laser cutters or bandsaw, milling machines, and lathes.

I can, using design for manufacturing principles and guidelines, use subtractive manufacturing tools, such as laser cutters or bandsaw, milling machines, and lathes, to create a specific product.