UNIT C: Manufacturing Processes

Competency: D403.00

Demonstrate basic concepts of manufacturing processes.

Objective: D403.01

Explain the concepts of manufacturing processes.

Introduction: Before preparing a drawing for the production of a part, the drafter/designer must consider what manufacturing processes are to be used. These processes will determine the representation of the detailed features, choice of dimensions, and machining accuracy.

The purpose of this unit is to provide the student with information about terms and processes used in manufacturing that will assist them with the skills needed to development mechanical drawings for industry.

Manufacturing: *R1 (271)*

A. The word manufacturing is derived from the Latin "*manu factus*", meaning "made by hand". Modern meaning of the word manufacturing is the process of converting raw materials into products.
B. The manufacturing process involves three important phases: 1) product design, 2) selection of materials, and 3) the selection of various manufacturing production methods and techniques.
C. Any number of process methods may be used by industry. For this reason, the designer and the drafter must have a working knowledge of the various processes that could produce a part in order to lower cost and reduce production time.
D. The information needed to produce a part in a manufacturing department, most often comes in the form of a working drawing.

Manufacturing Processes: *R1 (281), R3 (226), R4 (293)*

A. In the actual processing of a part consists of three main stages: 1) Rough forming, 2) Finishing, and 3) Assembly.
B. *Rough Forming* – consist of shaping the part by casting, forging, and welding.
    1. Casting
        a. Sand Casting is made by pouring molten metal into a cavity in damp sand. Once it cools and is removed from the mold the part is then machined.
        b. Die Castings are formed by forcing molten metal into cavities between metal dies.
            i. This process is much faster than sand casting and is used where rapid production is used.
            ii. It also requires little or no machining.
    2. Forging
        a. Drop forging is produced by hammering heated bars of metal between dies.
        b. Press forging is produced by applied by a slowly squeezing action.

c. Advantage of forgings over castings is that forgings are much stronger.

3. Welding
   a. The process of fusion or joining of two pieces of metal by means of heat.
   b. Usually a part is built up from cut stock forms, assembled, and welded together.

C. *Finishing* – is largely done in the machine shop to finish sizing holes and surfaces.
1. Machining
   a. Machining might require the use of a grinding machine, lathe, milling machine, and or drill press
   b. The above machines will allow the machinist to: turn, bore, ream, mill, and grind a part to a specific size and shape.
2. Finishing might include: polishing, burnishing, deburring, surface treating, coating, and plating.

D. *Assembly* – various parts are put together to complete the product. This may require additional machining however this retooling costs money and downtime. Manufacturers look to their company designers and engineers to keep manufacturing cost in check. One way of accomplishing this is to produce 3D solid models using CAD software that allows designers and engineers to update and modify their assembly drawings to fit changing criteria.

Manufacturing Materials: *R1 (279), R4 (287)*

A. There is a wide variety of materials available for production manufacturing that fall into three general categories: metal, plastic, and inorganic materials.
B. Metals are classified as ferrous, nonferrous, and alloys.
1. Ferrous metals contain iron, and steel.
2. Nonferrous metals do not have iron content, such as copper and aluminum for examples.
3. Alloys are a mixture of two or more metals.

C. Inorganic materials include carbon, ceramics, and composites.
1. Carbon and graphite or classified together and have low tensile strength (ability to be stretched).
2. Ceramics are clay and glass materials. These materials are resistant to heat, chemicals, and corrosion.

D. Plastics - *See "Plastics Processing" below for more information.*

Heat-Treating: *R3 (240)*

The process of changing the properties of metals by heating and cooling is referred to as heat-treating.

A. *Annealing* – is the process generally used to soften metal by heating followed by slow cooling.
B. *Hardening* – requires heating and then rapid cooling in oil or water.

Plastics Processing: *R3 (242), R4 (290)*

A. The plastics industry represents one of the major manufacturing segments. There are two main families of plastics, thermosetting and thermoplastic.

1. *Thermosetting Process* – These products are formed into a permanent shape by heat and pressure and may not be altered after curing. This process is more expensive and can be more difficult than others because thermoset materials cannot be remelted once they have been melted and formed for the first time. Thermoset products are the choice when the product is used in an application where heat exists such as plastic parts found on or near the engine of a car. The most common production process is casting.
2. *Thermoplastic Process* – Plastic material may be heated and formed by pressure. Upon reheating, the shape can be changed. Most plastic products are made with this process because they are easier to mold into various shapes. These products cannot be used where heat might exist.

B. Typical plastic processing operations include:
1. *Extrusion Process*– used to make continuous shapes such as moldings, tubing, bars, water hose, weather stripping, and any part that has a constant shape. This process creates the desired continuous shape by forcing molten plastic through a metal die.
2. *Blow Molding Process* – used in the production of hollow products such as bottles and containers. The molten plastic enters around a tube that also forces air inside the material, which forces it against the interior surface of the mold to create the shape desired.
3. *Injection Molding* – is the most commonly used process for creating thermoplastic products. The process involves injecting molten plastic material into a mold that is in the form of the desired shape. Injection molding is used to create products such as housings for electronic implements, automotive interior components, food storage containers, and components for medical applications.

C. *Thermoforming of Plastic Process* – is used to make all types of thin-walled products, such as containers, guards, fenders, food packages, and cosmetic packaging. The process works by taking a sheet of plastic material and heating it until it softens. Vacuum pressure is then applied to suck the hot material down against the mold to conform to the desired shape.

Computers in Manufacturing: *R1 (273), R3 (242), R4 (322)*

A. Computer-aided drafting / computer-aided manufacturing (**CAD/CAM**) is the process of developing a design drawing on a CAD system and producing the part on a computerized machine.

B. Computer Numerical Control (**CNC**) is the method of controlling the movements of machine components by direct insertion of coded insertion of coded instructions in the form of numerical data.

C. The advantages of the CNC machining are: better production and control, increased productivity, decreased labor, and production costs.

Measuring Devices Used in Manufacturing: *R1 (284), R3 (233)*

A. Machinist Steel Rule.
1. Used for common fractional measurements.
2. The smallest division of this rule is 1/64".

B. Caliper
1. Used when more precise measurements are required.
2. Measurements may be given in decimal, fractional, or metric.

3. Often used by drafters to record dimensions from a machined prototype or part.
4. Caliper instrument will give the machinist four types of measurements; Step, Inside, Outside, and Depth. See Figure 1.

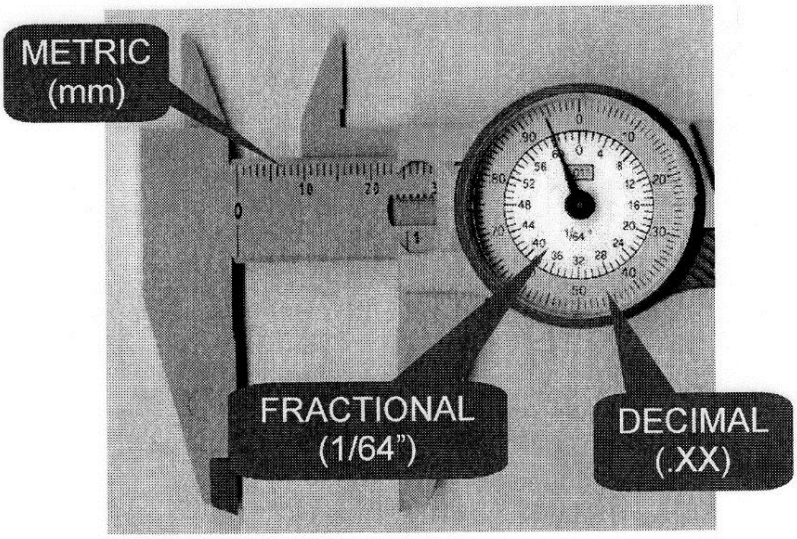

Figure 1. 6 Inch Dial Caliper