Manufacturing process

Manufacturing process consists of steps and activities involved in converting raw materials or components into finished goods.

Types of manufacturing processes

1. Casting: Molten material is poured into a mold or cavity to get the desired shape.

Types of casting process:

1. Sand casting: Molten materials are poured into the sand mold to get the desired shape.
2. Die casting: Molten material is forcibly injected into a metal mold (die) under high pressure.
3. Investment Casting (or Lost Wax Process): Wax pattern is coated with refractory material to create a mold and molten metal is poured and melted into the wax pattern to get the desired shape.
4. Permanent Mold Casting: Molten materials are poured into a reused, permanent mold typically made of metal to get the desired shape.
5. Centrifugal Casting: Used for cylindrical shapes, Molten material is poured into a continuously rotating permanent mold centrifugal force pushes the material towards the mold walls and helps to get the desired shape.
6. Plaster Mold Casting: Similar to sand casting, but instead of sand uses a mold made from a plaster mixture.
7. Forming: Changing the shape or size of metal into desired shape through various techniques such as bending, stretching, and deformation.

Types of forming process:

1. Forging Processes: Reshaping of metal using compressive forces. The force can be delivered with a hammer (often a power hammer) or a die.
2. Hot forging: Reshaping of metal when it is heated to a high temperature, typically above its recrystallization temperature, which reduces its strength and force required to change the shape and size.

Improve mechanical properties like ductility, toughness and strength due to grain formation.

1. Warm forging: Reshaping of metal when it is heated above the room temperature but below the recrystallization temperature typically between 800 and 1000 degrees. Less force require than hot forging and increase ductility.

improve the precision quality of forgings

1. Cold forging: Reshaping of metal when it is heated at or below the room temperature (below the recrystallization temperature). Preferred for the metal that are already soft like aluminium.

Provide high dimensional accuracy, good surface roughness and high production efficiency. Cold forging can also replace machining sometimes. Cold forging can make metal reinforcement, improve the strength of parts and decrease ductility.

1. Rolling Processes: Metal stock is passed through one or more pairs of rolls to reduce the thickness and to make the thickness uniform. Parts obtained by rolling process are more rigid than the original material.

Types of rolling process:

1. According to temperature.
2. According to roller type.
   1. According to temperature
3. Hot rolling: Metal is heated above its recrystallization temperature and passed through rollers to change its thickness. Commonly used for steel. Enables manufacturers to shape and form metal into large lengths.
4. Cold rolling: Metal passed through rollers at or near the room temperature to change its thickness. Improve the surface finish and hold tighter tolerances.
   1. According to roller type.
   2. Thread rolling: Create threads on cylindrical metal parts by compressing and stretching the material with rollers.
   3. Ring rolling: Create seamless rings, typically used for bearings, by rolling a cylindrical blank between two rollers.
   4. Profile rolling: This process is used to create complex shapes, such as angles or channels, by passing the metal through a set of profiled rollers.
   5. Tandem rolling: This process involves passing the metal through multiple sets of rollers to achieve the desired thickness and shape.
5. Extrusion Processes: material in Hot, Semi liquid state is forced through a shaped opening, called a die, to produce a continuous shape or profile. Material can be metals, plastics, and ceramics

There are several types of extrusion processes, including:

1. According to the direction of flow of metal
2. Direct extrusion: Forcing a material through a die to obtain a uniform cross-section.
3. Indirect extrusion: Die moves towards the material, which is held stationary to obtain a uniform cross-section.
4. Hydrostatic extrusion: Submerging the material in a fluid to exert uniform pressure from all sides, creating a uniform shape. This is commonly used for creating tubing and wires.
5. According to the temperature:
6. Hot Extrusion: Material is heated to a high temperature before extrusion to reduce the force required and increase malleability.
7. Cold Extrusion: Conducted at room temperature or slightly above it. Used for smaller materials, which require precise shape and dimensions this method provides an improved dimensional accuracy, superior surface finish, and increased strength due to the work hardening that occurs during the extrusion process.
8. Sheet Metal Processes: used to form and shape metal sheets into different products.

Different types of sheet metal processes are :

1. Cutting operation

1. Piercing: creating holes or opening in sheet metal.
2. Blanking : cutting action must be about a complete or enclosed section
3. Notching: removing the piece of scrap from the edge of sheet metal
4. Parting off: cut the material between two component to separate it from the parent material.
5. Lancing: three side cut and one side bending operation.
6. Cut off: the cutting action must be along a line
7. Nibbling: cut out the sheet to size with the help of punching.
8. Trimming: to cur excess material which is left out on the flange of the drawn component
9. Shaving: to give a finish cut to the blank or pierced holes
10. Non-Cutting operation
11. Bending: Bend the sheet at a specified angle.
12. Drawing: changing of flat, precut metal blank into a hollow vessel.
13. Embossing
14. Coining: making impression and depression on sheet metal
15. Hemming: joining two sheets together.
16. Bulging: It expands the cup along a narrow band and at the same time reduces its height.
17. Machining: Cutting tools are used to remove material from a workpiece to create the desired shape.

There are many types of cutting processes used in various industries, some of the most common ones are:

1. Abrasive Cutting: Abrasive particles such as sandpaper or grinding wheels to cut through materials. use for precision cutting or shaping of materials.
2. Plasma Cutting: use of a high-velocity jet of ionized gas (plasma) to melt through metal and separate it.
3. Waterjet cutting: High-pressure jet of water, sometimes mixed with abrasive particles to cut through materials. Use for cutting materials that are sensitive to heat, such as glass or certain metals.
4. Laser Cutting: High-power laser melts, burns, or vaporizes the material to create precise cuts. Often employed for metal, plastic, or wood cutting.
5. Electrical Discharge Machining (EDM): Electrical discharges is used to remove material from a workpiece.
6. Flame Cutting: flame generated by the combustion of fuel gases, typically acetylene or propane, combined with oxygen to heat and melt through materials.
7. Ultrasonic Cutting: High-frequency vibrations are used to cut through materials such as plastic, rubber, and composites.
8. Sawing: Sawing: Saw blade is used to cut through various materials such as wood, metal, and plastic.
9. CNC machining: Computer-controlled machines are used to create complex and precise parts and components from various materials. A computer program controls the movement of cutting tools and other machines to perform various operations, such as drilling, cutting, milling, and turning.
10. Joining: joining two or more components or materials together to create a single, u structure or product.

Types of joining

1. Assembly: Combining multiple components or parts to create a finished product.

Types of assembly

1. On the basis of techniques
2. On the basis of automation
   1. On the basis of automation: Automated systems are used in manufacturing or production of goods significantly improve efficiency, productivity, and accuracy while reducing costs and manual labor

Types of assembly on the basis of automation:

1. Manual Assembly Process: Suitable for small-scale production and simple products with the help of human hands and basic tools to assemble products. This process
2. Semi-Automated Assembly Process: Combined with the method of manufacturing that blends the benefits of both manual and automated processes. Machines or automated tools are used for typical tasks that are high-volume, repetitive, or require precision and speed.

Human workers are reserved for tasks such as quality checks, assembly of complex or sensitive components, and adjustments for custom orders.

1. Fully Automated Assembly Process: Advanced technologies such as robots, conveyor belts, and computer-controlled machines are used to assemble products, and do not require human intervention, except during the setup and maintenance phase.
   1. On the basis of technique: joining the different components with the help of various techniques like bolting and fastening , adhesive bonding etc.
2. Adhesive Bonding: Adhesives are used to join parts, common in the assembly of composite materials and plastics.
3. Bolting and Fastening: Joining different parts with screws, bolts, nuts, and other fasteners.
4. Snap-Fit Assembly: Interlocking features to connect plastic or other components without additional fasteners.
5. Press-Fit Assembly: Assemble the parts by pressing them together, often used in bearing and bushing installations.
6. Welding: Joining of similar or dissimilar metals by means of heat & pressure to make a permanent joint.

Types of welding process

1. Gas welding: Gas flames are used to heat the metals above the melting point and join metals together. The gas flame is created by mixing oxygen and a fuel gas, such as acetylene, propane, or natural gas
2. Arc welding: Arc is used to join metals by using electricity to create enough heat to melt
3. Resistance welding: Metals are joined together by applying pressure and passing current through the metal which melts and fuses the metal.
4. Friction welding: friction is used to heat and join metals, typically by rotating one object against another until they fuse together.