ME 333
MANUFACTURING PROCESSES-II

SPECIAL PURPOSE METAL FORMING PROCESSES
Shape Rolling

Steps in the shape rolling of an I-beam part. Various other structural sections, such as channels and rails, also are rolled by this kind of process.
Roll Forging

Roll forging is a deformation process used to reduce the cross-section of a cylindrical (or rectangular) workpiece by passing it through a set of opposing rolls that have grooves matching the desired shape of the final part.

Roll forging is a forging process that utilizes the rolls.

Two examples of the roll-forging operation
Roll Forging

The rolls do not turn continuously, but rotate through only a portion of one revolution corresponding to the desired deformation to be accomplished.

Roll-forged parts are generally stronger and possess favorably grain structure compared to competing processes such as machining.
Skew-Rolling

(a) Production of steel balls by the skew-rolling process,

(b) Production of steel balls by upsetting cylindrical blank. Note the formation of flash. The balls made by these processes subsequently are ground and polished for use in ball bearings.
Thread Rolling

Thread rolling is a cold-forming process by which straight or tapered threads are formed on round rods or wire.

The threads are formed on the rod or wire with each stroke of a pair of flat reciprocating dies or rotary dies.

Thread rolling processes:
(a) and (b) reciprocating flat dies; (c) two-roller dies; (d) A collection of thread-rolled parts made economically at high production rates.
Rolled thread has good strength (due to cold working) and without any loss of material (scrap). The surface finish is very smooth, the process induces compressive residual stresses on the surface, thus improving fatigue life.

Thread rolling is superior to other methods of thread manufacture, because machining the threads cuts through the grain-flow lines of the material, whereas rolling the threads results in a grain-flow pattern that improves the strength of the thread.

(a) Features of a machined or rolled thread. Grain flow in (b) machined and (c) rolled threads. Unlike machining, which cuts through the grains of the metal, the rolling of threads imparts improved strength because of cold working and favorable grain flow.
Coining

A close-die forging process that is typically used in the minting of coins, medallions and jewelry. In order to produce fine details, the pressure required can be as high as five or six times the strength of the material.

(a) Schematic illustration of the coining process. The earliest coins were made by open-die forging and lacked precision and sharp details, (b) An example of a modern coining operation, showing the workpiece and tooling. Note the detail and superior surface finish that can be achieved in this process.
Heading

(a) Heading operation to form heads on fasteners, such as nails, bolt heads, screws and rivets,
(b) Sequence of operations to produce a typical bolt head by heading.

Tendency for the bar to buckle if its unsupported length to diameter ratio is too high (3:1).
The part is fairly complex and must be produced in a progressive manner in order to produce the required details and fill the die completely.

Solid bar → extrusion (cylindrical blank) → upsetting (conical cross section in the die) → piercing (to bore)

(a) The stepped pin  (b) Illustration of the manufacturing steps used to produce the stepped pin.
Orbital Forging

(a) Various movements of the upper die in orbital forging (also called rotary, swing, or rocking-die forging); the process is similar to the action of a mortar and pestle.

(b) An example of orbital forging. Bevel gears, wheels, and rings for bearings can be made by this process.
(a) Schematic illustration of the rotary-swaging process, (b) Forming internal profiles on a tubular workpiece by swaging, (c) A die-closing swaging machine showing forming of a stepped shaft, (d) Typical parts made by swaging.
Production steps for a cold-extruded spark plug
(a) Impact extrusion of a collapsible tube by the Hooker process, (b) and (c) Two examples of products made by impact extrusion. These parts also may be made by casting, forging, or machining. The choice of process depends on the materials involved, part dimensions and wall thickness, and the product properties desired. Economic considerations also are important in final process selection.
Several examples of impact extrusion: (a) forward, (b) backward, and (c) combination of forward and backward.