Snap-Fits

- Molded-in pieces in a plastic assembly that are designed to form a mechanical joint system where part-to-part attachment is accomplished with locating and locking features to connect components together.
- Provide for the economical and rapid assembly of plastic parts.

Types of Snap Fits

- Snap-fits are used to assemble parts of all shapes and sizes.
- A snap fit with a tapered finger provides more uniform stress distribution and can be used over and over again.
- There are three types of snap-fits: cantilever, torsion, and annular.
Use of Snap-Fits

- Snap-fits are often used for high-volume production.

- In many products, snap-fits are designed for one-time assembly without any provision for nondestructive disassembly.
  - For example, snap-fit designs, such as those used in the plastic shell of small kitchen appliance or a child’s toy, are not designed to be taken apart without destroying the product.

- Where servicing is anticipated, snap-fits can be designed that allow for release of the assembly with an appropriate tool.
  - For example, snap-fit designs, such as those used in battery compartment covers for calculators and radios, are designed for easy release and re-assembly over hundreds or even thousands of cycles.

Cantilever Snap-Fit

- Consists of a protrusion (some type of bead or hook) at one end of the beam and a structural support at the other end.

- Most common type of snap-fit used for plastic assembly.

- Commonly used in applications such as toys or battery compartment doors.

- Most cantilever snap-fits are usually a one-time use but some designs can be used more than once.

Cantilever Snap-Fit (continued)

- Snap fits that are intended for one-time use have a sharp edge, or tang, that holds the part in place.

- Snaps intended for limited use will have a rounded tang to allow the snap feature to be pulled off yet still have holding ability.
  - With this type of snap fit, the plastic does not experience a lot strain, so multiple flexes are possible without damaging the plastic beam.
  - It also has a built-in stop, so the beam cannot be flexed too much and damaged.

Torsion Snap-Fit

- Spring-loaded lever that snaps into place when the mating part is pressed into place.

- The torsion snap can be released by pressing down on the lever.

- This design can be used for frequently assembled and disassembled parts, or to provide constant pressure to the assembly.

- The complexity of this type of snap-fit, prevents it from being widely used in industry.

- As its name implies, the torsion snap-fit relies for its spring effect on twisting rather than flexing like the other types.

- It is less common than cantilever or annular snap-fits but it is particularly useful when you want to be able to release the catch easily and often.
  - For example, a torsion snap fit can be a good way of fastening a hinged lid on a box or container.
Annular Snap-Fit

- This type of snap fit is best for assembling cylindrical or ring-shaped joints.
  - Classic examples include ballpoint pens with snap-on caps, the child-resistant caps on medicine bottles, and cottage cheese container lids.
- Generally stronger, but needs greater assembly force than their cantilevered counterparts.
- Annular snap-fits are basically interference rings. There is a smaller-diameter male component (plug) which has a bump or ridge feature around its circumference. The ridge diameter of the plug is slightly larger than the inside diameter of its mating tube-shaped female hub.

Benefits of Snap-Fits

- An integral element of the plastic part – no other components are needed.
- Can replace screws, nuts, and washers.
- Easy automation can reduce assembly costs.
- No other fastener, adhesive, solvent, welding, or special equipment is needed.
- Design can minimize the risk of improper assembly.
- Can be designed to engage and disengage.

Factors Regarding Snap-Fits

- Snap-fits that are assembled under stress will allow creep, a plastic's deformation under load (tension, compression or flexure) over time.
- It is difficult to design snap-fits with hermetic seals. If the beam or ledge of the snap-fit relaxes, it could decrease the effectiveness of the seal.
- Snap-fits can be damaged by mishandling and abuse prior to assembly.
- The key to successful snap-fit design is to have adequate holding power without exceeding the elastic or fatigue limits of the material.

Press Fits

- Press fitting refers to two parts being pressed together, making an interference fit.
  - An interference fit occurs when the inner diameter of the hole is slightly less than the outer diameter of the part being inserted. When the two parts are pushed together, they stick.
- A common example is the forced insertion of a metal pin or shaft that is slightly larger than a plastic hub or boss it is inserted into.
- Press fitting is a simple, low-cost method for assembling parts or components.
Use of Press Fits

- Used in the telecommunications and computer industries, as well as in automobiles, airplanes, office equipment, and consumer goods.

- Press fitting is a lower quality fitting process. However, once a press fit is in place, it will not come loose.

- The particular application dictates whether a press fit or other fastening method is used. Press fits are sometimes used to get a complete alignment between two pieces.

- Press fits are also used to prevent bearings from spinning. It is a good fastening method for components that undergo temperature fluctuations, such as automotive assemblies. Regardless of the temperature, the interference fit or force between the two parts is always there.

Living Hinges

- Thin sections of plastic that connect two segments of a part to keep them together and allow the part to be opened and closed.

- Typically these are used in containers that are used in high volume flexing applications such as toolboxes, fish tackle boxes, file card boxes, etc.

- The materials used to make a living hinge are usually a very flexible plastic such as polypropylene and polyethylene. These can flex more than a million cycles without failure.

Bosses

- Projection designed into a plastic part to add strength, facilitate alignment during assembly, or to provide for fastening.

- Bosses are used for the purpose of registration of mating parts or for attaching fasteners such as screws or accepting threaded inserts (molded-in, press-fitted, ultrasonically or thermally inserted).

Hot Gas Welding

- Most widely applied in the fabrication of plastic assemblies.

- Involves the use of various butt joints & hot gas from a welding torch to melt filler material between pieces of an assembly to create a weld.
Ultrasonic Welding

- The most common thermal method for joining small and medium-sized parts of amorphous and crystalline plastics.
- The process normally lasts less than 2 seconds and forms a continuous, leak-proof joint that often is as strong as the base material.
- Done using equipment that applies high-frequency energy (20 to 40 KHz) directly to the interface between parts.

Laser Welding

- Involves use of a laser to melt the bond line between two parts to form a weld.
- This method is a fast, economical, and safe way to weld compatible plastics having similar melt temperatures.

Vibration Welding

- Done by parts being rubbed together to create frictional heat.
- Rubbing usually involves amplitudes of 0.1- to 0.2-in. and frequencies of 120 and 240 Hz.
- It creates strong joints and works best with large parts that have irregular joint interfaces.

Spin Welding

- Joins parts with circular joint surfaces using relatively simple equipment, sometimes just a drill press.
- Involves holding one part firmly and pressing a rotating part against it at a steady pressure.
- The weld usually forms in less than 3 seconds.
Mechanical Fasteners

- Readily available, easy to install, and usually allow for nondestructive disassembly.
- Often have high assembly costs and require that extra parts be stocked.
- Most fasteners used with metals also work with plastics (e.g., screws, bolts, nuts and lock washers).
- When selecting metal fasteners, be aware that these components can overstress plastic parts. This can be prevented through proper design, using the appropriate fastener and torque-limiting drivers.

Threaded Metal Inserts

- Permanently installed in molded bosses, eliminate the need for a nut, simplifying the assembly.
- Can include female threads, threaded male studs, locating pins, and bushings.
- Ultrasonically-installed inserts are especially popular, because the surrounding plastic melts around the insert, make it strong and relatively free of stress.

Self-Tapping Screws

- Cutting-style screws are best because they act like thread-cutting taps and remove material, without generating high stresses on plastic materials as do forming-style screws.
- Screws with multiple lobes and those with alternating thread heights offer excellent holding power and reduced stress levels.

Metal Rivets

- Allow for fast, permanent assemblies.
- Should have large heads to spread the load.
- Rivet should be formed against the metal part of an assembly or against a metal washer if both parts are plastic.
Stamped Sheet Metal Fasteners

- Provide light-duty threads or push-on assemblies. Push-nuts, for example, are simply pressed onto plain, molded plastic studs or bosses in permanent assemblies.
- Easy to install, inexpensive, and vibration-proof.
- Another such fastener, boss caps (cup-shaped parts pushed onto a plastic boss), add partial metal threads for self-tapping or sheet metal screws, and reinforce the boss against the expansion forces of the screw.

Molded Plastic Screws, Rivets and Other Similar Fasteners

- Used for light-duty plastic assemblies, especially where appearance is important, such as to attach trim and faceplates.

Solvent Bonding

- A liquid applied just before assembly dissolves the joint surfaces. This is enough for a weld to remain after the solvent evaporates. This method is limited to compatible materials that dissolve in the same solvent or solvents.
- The chemical resistance of many plastics limit this method from being used.

Adhesive Bonding

- Occurs when a third substance bonds a plastic to another plastic or to metal, rubber, ceramic, glass, or wood.
- Adhesives frequently used with thermoplastics include epoxy, acrylic, polyurethane, phenolic, rubber, polyester and vinyl. Cyanoacrylate (superglue) adhesives are popular because they work rapidly.
- Many adhesives contain solvents that partially dissolve the plastic surface, which improves adhesion.
- Surface preparation is also critical for successful adhesion.
- Many materials must be roughened or etched to eliminate overly smooth surfaces. They also may need thorough cleaning because grease, mold release compound, and other contaminants can spoil a bond.