

There are four main commercial categories of plastics: **thermoset, thermoplastics, foam and elastomers**. The latter two have limited suitability for Insert installation and should an Insert be required, a unique analysis is suggested. Accordingly, these categories are not covered here.

Thermoset plastics, once formed, undergo an irreversible chemical change and cannot be reformed using heat and pressure. These plastics are tough and heat-resistant. Examples are Bakelite, urea and polyester resins. Heat/Ultrasonic Inserts are not suitable for these plastics. Thermoset plastics require the use of Molded-In, Press-In, Expansion or Self-Tapping Inserts.

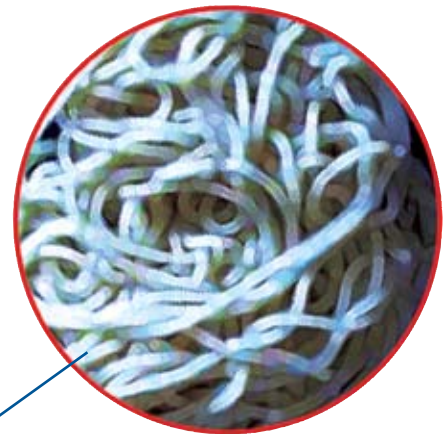
Thermoset Plastics

- Phenolic (Bakelite)
- Epoxies
- Polyimide
- Vulcanized Rubber

Thermoplastics are rigid and solid at normal temperatures but at elevated temperatures they soften and melt. Some of the more common plastics in this category are ABS, Nylon, PVC and Polycarbonate. Heat/Ultrasonic, as well as other types of Inserts, are suitable for plastics in this category.

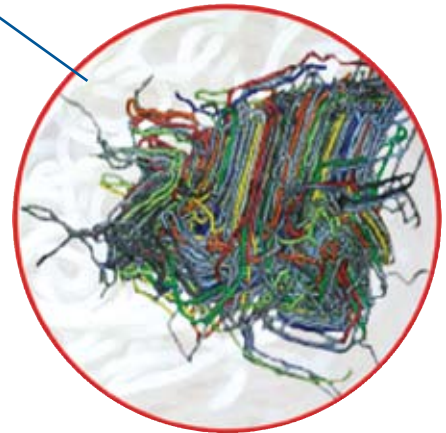
Thermoplastics are further delineated into amorphous and semi-crystalline polymers. **Amorphous polymers** have a random molecular structure that does not have a sharp melting point. Instead, amorphous material softens gradually as temperature rises. Amorphous materials are more sensitive to stress failure due to the presence of hydrocarbons. ABS and PVC are common amorphous thermoplastics. **Semi-crystalline polymers** have a highly ordered molecular structure. These do not soften as the temperature rises, but rather have a defined and narrow melting point. This melting point is generally above that of the upper range of amorphous thermoplastics. PET and PEEK are common semi-crystalline plastics.

Molecular arrangement of polymer chains



Amorphous

Semi-Crystalline



Thermoplastics

Amorphous polymers

- Polymethyl methacrylate (PMMA), Acrylic
- Polystyrene (PS)
- Polycarbonate (PC)
- Polysulfone (PS)
- PVC
- ABS

Semi-crystalline polymers

- Polyethylene (PE)
- Polypropylene (PP)
- Polybutylene terephthalate (PBT)
- Polyethylene terephthalate (PET)
- Polyetheretherketone (PEEK)

- Polyamide (Nylon)

This can be both amorphous and semi-crystalline based on the blending.

A wide variety of fillers and plasticizers are used to achieve the desired characteristics for the application such as strength, stability, stiffness, conductivity, thermal properties and resistance to creep. Fillers are also used to reduce cost. Fillers and plasticizers increase the stress sensitivity. All fillers generally increase the flow or melt point and therefore, they impact post-mold Insert installation. The impact not only correlates to the type of filler, but also to the percentage used.

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