Process and Design Considerations for TECHNOMELT

Material Handling

Receiving: When receiving TECHNOMELT materials, all bags should be inspected for any rips, tears or punctures. Any damaged bags where the integrity of the bag is compromised should be quarantined and Henkel Customer Services contacted. (The material will require drying prior to use.) The material is shipped in triple-lined bags with a one-way valve, sealing out moisture, and is shipped at ~0.2% moisture content per industry standard for plastics. Material with more than 2% moisture will require drying prior to use (80°C for 3 hours, preferably using pre-dried air).

Storage: Material in unopened bags has a shelf life of 2 years (from date of manufacture). Expiration date is printed on the bags. Once a bag has been opened, it is recommended that the unused material be moved into a new, moisture-sealed container to prevent absorption of moisture from the air. If the material is not moved to a moisture-tight container, pre-drying of the material is recommended at 80°C for 3 hours, preferably using pre-dried air. Moisture absorption will have a negative impact on the final material properties after processing, included decreased mechanical strength, molecular weight and adhesion.

Use: Material placed in the melt tank of any low pressure molding (LPM) machine should be used as quickly as possible to ensure optimal properties. The amount of residence time a material should see above melt point varies from material to material (consult the material TDS for more information), but should not exceed 16 hours or 3 heat-up and cool-down cycles, except where the TDS specifically states residence time.

PCB/Assembly

The assembly to be overmolded should be clean and free from grease and other contamination. Removal of no-clean post-soldering flux residues is desirable but not essential. If a board is contaminated, the assembly should be cleaned prior to molding. Gaps between tall components (greater than 3 mm) should be at least 1 mm to facilitate complete filling. Components with open moving parts (e.g., mechanical switches) must be sealed off during the molding process, as should connectors. This can often be achieved by mold design.

Joints should ideally meet ICP CC 610 rev E class 3 for best results. Overmolding of class 2 or class 1 joints should be tested, as they may result in premature failure of the joints. (This will depend on the reliability requirements.)

Mold Process:

The basic mold process is a three-step process consisting of:

1. Fill the cavity
2. Pack the mold
3. Cool the part

The cavity fill should be as quickly as possible – preferably below 3 sec., ideally 1 to 1.5 sec. The pressure is not always controlled during the fill stage (equipment dependent). A fast fill will improve adhesion by minimizing cooling and viscosity increase during this step, maximizing wetting of the substrate.

Packing should be no more than 500 psi and preferably less than 300 psi, with the minimum recommended packing pressure to be no less than 100 psi, since packing is intended to inject more material to compensate for the shrinkage of the material as it solidifies. Consequently, the larger the cavity, the longer the packing time; typical packing times start at 10 sec. Packing pressures are kept low to prevent flashing and damage to sensitive components, such as hollow cans. The packing step allows/ensures that the surface finish of the part is consistent. Parts that do not fill well or have insufficient packing will frequently exhibit lack of replication of any mold surface texture, sink marks, and have a glossy, shiny appearance after cooling, while well-packed and filled parts have a matte appearance and a faithful replication of any mold surface texture. If the part is over 6 mm thick on one side of the PCB, overmolding in 2 steps is recommended. It’s difficult to control shrinkage of parts thicker than 6 mm. The duration and pressures used during the packing step are machine- and part-geometry dependent, and it is recommended that the equipment manufacturer and/or mold designer be consulted to determine appropriate start points. Often it is beneficial to do mold flow analysis to determine any potential trouble spots prior to molding. Typical packing cycles will run 10 sec. per 5-10 grams of material molded. Variations in cross-sectional thickness will affect this number; thinner parts require less packing time.

The cooling step takes up the bulk of the process time and will depend on multiple factors, including the temperature of the mold (is it chilled?), size and shape of the part, and molding temperature of the material. Sufficient time should be allowed for the part to be cooled sufficiently to be handled after removal from the mold. A good way of determining this is to run blank shots (shots with no assembly present). Mold cooling is dependent on the size of the part being molded, the thickness of the overmold and the mold set material (steel or aluminum). When molding using an aluminum mold set, cooling is recommended because the mold set will heat up with time (due to the low specific heat capacity and the low density of the metal), and this will affect the cool rate of the material. Stainless steel molds do not have this issue to the same extent and do not always require cooling. For particularly thick or large overmolded parts, cooling the mold is also recommended; this will decrease cycle times by cooling the overmold faster.

Ejector pins should be utilized to free the part from the mold with a minimum of distortion. (Flexing of part during removal from the mold can result in localized delamination of the TECHNOMELT from the substrate.) Ejector pins should be equally spaced over the part to ensure even force distribution during ejection so that the part is not damaged. The part should ideally remain in the bottom mold after the mold separates. This is achieved by having a slight draft of 1 to 3 degrees on the part, allowing for easy removal.

Use the recommended application temperatures given on the material TDS. Increasing temperature will typically increase adhesion, reduce viscosity and allow better flow in the cavity and improved wetting of the substrate. TECHNOMELT materials are typically thermally stable for up to 16 hours at mold temperatures without any loss of mechanical or adhesive properties. In severe cases the TDS will call reduced times due to the resin stability. The materials also should not see any more than three heat-up and cool-down cycles prior to use. The recycling of runners to the melt tank for re-melting should be limited to no more than 20% by mass of the material in the melt tank.

The maximum substrate size will be dependent on the equipment used, and typically can be found on the equipment manufacturer’s machine documentation. Most LPM equipment will specify a maximum mold set size that can be used with the equipment, as well as a maximum flow rate/injection speed. These factors will determine what equipment to use and how many cavities can be filled by the machine at one time.

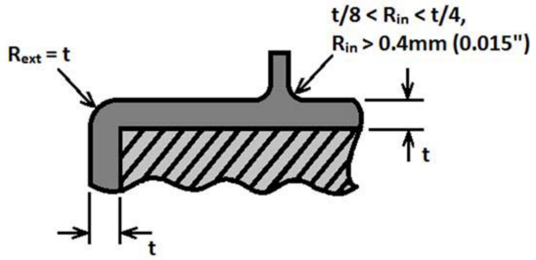
Thickness

The TECHNOMELT should have a thickness preferably of not less than 1 mm and ideally not more than 6 mm in a single mold shot. Thicknesses above 6 mm can lead to excessive sinkholes due to shrinkage on cooling.

A second molding process can be performed to obtain overmold thicknesses up to 12 mm. Exceeding this thickness is not desirable.

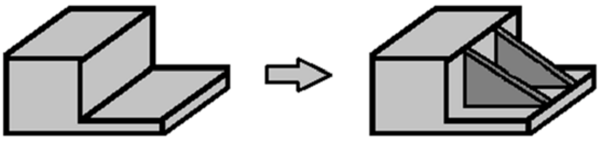
The thickness of material should be ideally the same on both sides of the substrate but should not exceed 2.5:1, as this can result in board warpage and damage to components and interconnects.

The corners of the external overmold material should be rounded at between $1/_4$ and $1/_8$ of the nominal wall thickness; the wall thickness should not reduce along edges and at corners compared to the sides, as this can cause stress concentrations and failures. It is also recommended that any overmolded metal, (i.e., heat sinks, etc.) have rounded corners; sharp corners can sometimes become crack-initiation sites during thermal cycling.



Design Considerations

The mold cap should have a draft of at least 2 degrees to facilitate easy removal from the mold. Gussets should be used for tall or thin features.



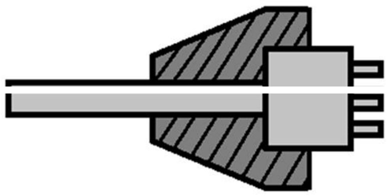
Avoid sharp steps near corners and edges. Sharp steps are defined as rapid changes in the thickness of the overmold material.

Metal bushings should be molded into the part to facilitate mounting to a substrate. It is not recommended to use the material itself as the mechanical support; this can often result in overtightening of the fixture due to the soft nature of the material, ultimately leading to cracking around the site and potential failures.

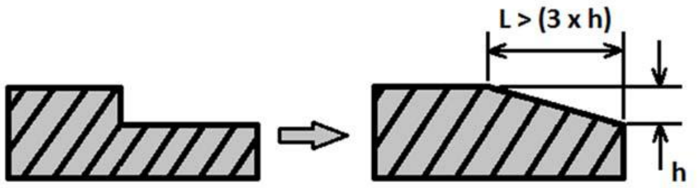
Holes through the PWB will enhance the adhesion by providing a keying effect.

Shutoff areas (areas where the overmold is prevented from contacting the substrate) should not come within 1 mm of any components on the PWB.

Butt joints to connectors are not recommended (they are weak and prone to failure under flexing). The overmold should extend over a portion of the connector; avoid tapering the material along the connector.



Recommended tapering of overmold



It is desirable to have strain relief on all wires leaving the assembly. Lack of strain relief can result in delamination of the wire at the surface and allow water ingress.

Substrate considerations

Care should be taken when dealing with large heat sinks. If the polymer cools too much as it wets the heat sink, it can impact the adhesion and the flow of the material in the cavity. In such cases, preheating the substrate can significantly improve adhesion and flow within the cavity. A large heat sink is typically any large metal part of the assembly, such as aluminum plates, metal frames, etc.

Although TECHNOMELT adheres well to many surfaces, the following materials have been shown to have problems unless an adhesion promoter or equivalent are utilized.

Types of Adhesion Promotors:

1. Plasma treatment
2. Corona treatment
3. Chemical primers
4. Preheating of substrate

Difficult-to-Adhere-to Substrates

1. PTFE and other highly fluorinated polymers
2. Cross-linked polyethylene
3. Plastics containing an unreacted plasticizer that can migrate.
4. Certain silicone materials
5. Some metal surface treatments
6. Some flux residues (flux residues can represent a weak interface, and failure within the flux can initiate failure between the TECHNOMELT and the substrate)

Adhesion to these substrates will vary from material to material and will require testing to determine adhesive strength. Processing temperatures and pressures may also influence adhesive strength.