



Tip Shield

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Summary: A low surface energy baffle attached near the tip of a pump or extruder will reduce radiant heating of fine features, reduce accumulation of plastic on the tip, and improve adhesion of small features to the part.

In fused deposition modeling (FDM), a thermoplastic material such as ABS is metered out of a small tip as the tip is moved with respect to a part under construction. The tool paths determining that motion and the rate that the material is metered out collaborate to gradually build up the part with a predetermined geometry. The metering is generally done by a pump or liquefier. The tip is a thermally conductive orifice with an inner diameter between 2 and 40 mils, an outer diameter of between 4 and 60 mils, and a flat exit face normal to the axis of symmetry.

The tip is generally stainless steel. Operating temperatures are between 280°C and 650°C. Several undesirable processes can occur as the tip extrudes fine features onto a part under construction. The exit face of the tip, the bevel around the exit (and all of the heated components of the pump or liquefier) radiate heat onto the part under construction, softening it so that accuracy and feature detail can be lost. The tip is both hot and a high surface energy material, so newly extruded material might adhere to the tip instead of to the part under construction. The motion of the tip face across the part under construction can skive plastic only the tip, which can oxidize and discolor, and then occasionally be deposited back onto the part under construction.

Various tip shield designs have proven effective in eliminating these undesirable processes. Generally the tip shield surface oriented towards the part under construction is a convex low surface energy high melting point material, such as Teflon. The tip face protrudes through the tip shield by a modest amount, typically 5 to 50 mils. The tip shield blocks radiation from the bulk of the pump or liquefier from reaching the part under construction. The tip shield reduces the accessible area of heated tip to the small area cleaned by the tip wipe mechanism. The tip shield can snap or clip onto the end of a replaceable liquefier, or it can attach to the gantry housing. The tip shield is generally round or rectangular, with a radial extent of about 100 to 1,000 mils from the tip.