Fabrication Guidelines

GENERAL NOTES:

1. Key properties of plastics that should be kept in mind during the machining of plastic stock shapes are:
   a. Plastics have much higher coefficients of thermal expansion than metals.
   b. Plastics have much lower melting points than metals.
   c. Plastics have lower thermal transfer coefficients than metals.
   d. Plastics are substantially softer than metals.
   e. Some plastics will absorb significant amounts of moisture. This will soften the plastic and cause it to swell.
   f. Common cleaners and coolants will cause some plastics to craze, crack, and/or become brittle.

2. Most plastic materials can be machined with the same tools and methods that are used for machining soft metals like aluminum and brass. Because plastics are much softer than metals, material can be removed from plastic work pieces at rates that are several times the rates typically utilized with metal pieces.

3. Due to the softness and high thermal expansion rates of plastics, typical tolerances for machined plastic parts are 10 times that typically used for metals. For example, typical machining tolerances for acetal parts are a minimum of +/- 0.001" per inch of part dimension.

4. Because plastic is an excellent thermal insulator, heat generated during the machining operation does not dissipate through the work piece. Excessive heat can affect the surface finish of the work piece, prematurely dull the tool, and in the worst case, melt the work piece. Dull tools generate frictional heat. To avoid heat build up, keep cutting tools as sharp as possible.

5. For most machining of non-reinforced plastic materials, High Speed Steel (HSS) cutting tools are sufficient. Carbide tools are recommended for machining of plastic materials reinforced with abrasive fillers (glass fibers, glass beads, and carbon fibers). For large volume production jobs on plastics with abrasive fillers, diamond coated tools may prove to be economical because of the added life that they provide.

6. High Speed Steel (HSS) cutting tools can be ground to a sharper edge than carbide tools, but HSS will not maintain an edge as long as carbide. Carbide tools with ground peripheries and polished surfaces minimize frictional heat generation and promote chip removal.

7. Always use tools with positive geometries and adequate chip clearance to prevent chip build up.

8. For most plastics machining operations, fast tool speed and slow material feed is recommended.

9. Surface Feet Per Minute (SFPM) = 0.262 x diameter (in.) x RPM.

10. During turning, the best surface finishes are produced by using a broad nosed tool with a rounded end.

11. Most plastic materials can be milled and turned without the use of coolants. For a.) all drilling operations and b.) machined parts that require premium surfaced finishes and tight tolerances, compressed air or water soluble coolants can be used. Please note: Traditional petroleum based coolants/cutting fluids can degrade some plastics. Always check the chemical compatibility of the plastic material you are machining before putting it in contact with any chemical solution.

12. Plastic materials are significantly softer than metals and high tool pressures will deflect plastic work pieces away from the cutting tools. Always assure that work pieces are adequately supported to prevent excessive deflections during machining.

13. To minimize internal stresses and assure the highest levels of dimensional stability, all plastic stock shapes manufactured by Nytef Plastics, Ltd. are annealed during manufacturing. However, due to the morphology created by filler/reinforcement packages, some stock shape materials (example: glass fiber filled nylon) tend to retain significant levels of residual stresses even after factory annealing. These materials should be pre-machined to the approximate shape and dimensions of the finished part and then set aside and allowed to "relax" for two to three days. The parts can then be finish machined to their final dimensions and tolerances. In worst case scenarios, parts may require a secondary annealing cycle after pre-machining and prior to final machining.

14. Machined plastic parts that are non-symmetrical will always tend to warp towards the side with the least material. This warpage can be minimized by:

    a. removing material from the opposing sides of the part in gradual steps. When a large amount of material is to be removed, remove 1/4" from one side and then flip the part and remove 1/4" from the other side. Repeat the process until the machining if complete.

    b. machining the part to 80% of it's finished dimensions and then re-anneal the semi-completed part before machining to the finished dimensions.

    c. utilizing a material that is less prone to warpage. Unfilled materials warp less than composites and amorphous materials usually warp less than crystalline materials.

15. Some plastics (ex: Nylon) will absorb significant amounts of moisture when they are in contact with liquids and also directly from humid air. This absorbed moisture will cause the plastic material to swell. This swelling should be considered when part tolerances are determined.

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