CNC vs Injection Molding Guide

Dedicated engineering reference guide for buyers, engineers, and sourcing teams

Based on article:

https://nylonplastic.com/cnc-machining-vs-injection-molding-decision-guide/

Quick Overview

Every plastic part design reaches a fork in the road: machine it or mold it. CNC machining delivers parts in days with no tooling investment and plus or minus 0.05 mm precision. Injection molding requires a $5,000-80,000 mold and 2-8 weeks of lead time, but produces parts at $0.50-5.00 each at volumes where CNC costs $15-50 each. The decision is not about which process is better - it is about which process matches your volume, timeline, tolerance, and material requirements at the lowest total cost.

This guide lays out the process comparison data, volume breakpoints, and hybrid strategies that Nylon Plastic uses with customers every day. The goal is not to steer you toward molding (which is our largest business) or machining - but to help you choose the right process for where you are in the product lifecycle.

The break-even point where injection molding becomes cheaper than CNC machining depends on part complexity and size. Rule of thumb for a palm-sized part (50-100g): Below 250 pcs: CNC is cheaper. 250-1,000 pcs: costs are roughly equal; choose based on timeline, tolerance, and whether design is locked. Above 1,000 pcs: injection molding pulls ahead and the gap widens rapidly. Above 10,000 pcs: injection molding is 3-10x cheaper per part.

Engineering Notes

Process Comparison at a Glance

$20-60 (tooling dominates) Per-part cost (10,000 pcs) 15-30 days (mold) + 1-5 days (parts) plus or minus 0.05-0.10 mm plus or minus 0.10-0.30 mm SPI A3-D3 (0.01-8.0 um Ra) Any rigid plastic (sheet/rod/block) Any injection-grade thermoplastic $1,000-10,000+ (steel-safe mods only) 0.5 mm (1.0 mm preferred for structure) Amortized tooling, low marginal cost

Volume Break-Even Analysis

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When to Choose CNC Machining

Prototyping and design iteration (1-50 pcs): No mold means design changes cost zero in tooling. CNC parts in 3-5 days let you test, modify, and re-make overnight. Bridge production (50-500 pcs): While the injection mold is being built (3-6 weeks), CNC parts keep your assembly line, testing program, or customer demos running. Large-format parts (over 500x400 mm): CNC machines handle large plastic sheets and blocks that would require enormous and expensive injection presses. Ultra-tight tolerances (plus or minus 0.05 mm or better): CNC holds tighter tolerances than injection molding for most geometries. Low annual volume ongoing: If annual demand stays below 500 pcs, the mold may never amortize - CNC is the permanent production solution.

When to Choose Injection Molding

Production volumes above 1,000 pcs/year: The mold cost amortizes to pennies per part at scale. Per-part cost drops 80-95% versus CNC at volume. Cosmetic surface quality: Molded surfaces replicate polished mold steel - CNC leaves tool marks that require secondary finishing for cosmetic parts. Thin walls and fine detail: Injection molding achieves wall thicknesses down to 0.3-0.5 mm and replicates sub-millimeter detail that CNC tools cannot physically reach. Material properties through orientation: Glass-filled materials gain directional strength from fiber orientation in molding - machined parts have random fiber orientation from the stock material. Consistent batch-to-batch quality: Once the mold is qualified, every shot produces the same part. CNC parts have operator-to-operator and setup-to-setup variation.

Design Rules for Process Selection

Start with CNC, transition to molding: The most cost-effective product development path: CNC machine 10-50 prototypes for design validation, then invest in an injection mold once the design is locked. The prototype phase informs gate location, wall thickness sensitivity, and tolerance requirements - all valuable inputs for mold design that reduce the risk of mold modifications. Design for your production process from day one: Even if you are starting with CNC, design the part as if it will eventually be molded: uniform wall thickness (avoid thick sections that are easy to machine but impossible to mold without sink), draft angles on vertical surfaces, and generous radii instead of sharp internal corners. A part that machines beautifully but cannot be molded requires redesign before tooling - doubling your engineering cost. CNC for complex 3D surfaces: Freeform surfaces, undercuts (accessible by 5-axis), and deep pockets with flat bottoms are CNC strengths. Injection molding the same features may require side actions, lifters, or collapsible cores that add thousands to mold cost. If the part has complex 3D geometry that requires 3+ s

Cost Decision Framework

Cost comparison formula: CNC total cost = (Setup time x Shop rate) + (Cycle time/part x Shop rate x Quantity) + (Material cost/part x Quantity). Injection total cost = Mold cost + (Material cost/part + Machine cost/part + Labor cost/part) x Quantity. Typical shop rates: CNC plastic machining: $50-80/hr (3-axis), $80-150/hr (5-axis). Injection molding: machine rate $25-50/hr (shared across cavities). Decision rule: If (CNC unit cost x Quantity) is greater than (Mold cost + IM unit cost x Quantity), injection molding is cheaper. Solve for the break-even quantity: Q = Mold cost / (CNC unit cost - IM unit cost). For our 75g bracket example: Q = $12,000 / ($22 - $1.20) = 577 parts. Below 577, CNC wins; above, injection molding wins. Every part has its own number - this formula gives you the answer in 30 seconds.

Common Mistakes and Solutions

Designing a CNC-only part blind to molding Part has non-uniform walls and zero draft Designing only for the immediate process Design with molding rules from day one - uniform walls, draft, radii Underestimating mold lead time Project delayed because the mold is taking forever Assuming mold = 2 weeks; reality is 3-8 weeks Plan 6 weeks for mold build; use CNC bridge production in parallel Choosing injection too early Mold modification cost exceeds original mold cost Design not yet validated; changes require steel-safe mods Use CNC prototypes to validate design before committing to mold steel Choosing CNC for annual volume over 2,000 Per-part cost never decreases; margin erodes No tooling to amortize; labor and material cost linear Run the break-even calculation; if volume supports it, invest in mold

RFQ Checklist

- Application environment: temperature, moisture, UV, chemicals, sterilization, or outdoor exposure.
- Mechanical requirements: load, stiffness, impact, wear, friction, creep, and fatigue life.
- Drawing requirements: tolerance class, critical dimensions, surface finish, threads, inserts, and inspection method.
- Production needs: prototype or production quantity, expected annual volume, target unit cost, and lead-time window.
- Material notes: preferred grade, color, reinforcement, flame rating, certification, and substitute-material flexibility.

Need manufacturing support?

Share your drawing, target material, working environment, tolerance requirements, and quantity. Nylon Plastic can help evaluate manufacturability, material alternatives, and production quotation details.

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