SPI Surface Finish Guide

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

Based on article:

https://nylonplastic.com/spi-surface-finish-standards-plastic-injection-molding/

Quick Overview

The SPI (Society of the Plastics Industry, now PLASTICS Industry Association) surface finish standards are the universal language for specifying mold cavity polish levels. Introduced decades ago as a way to standardize communication between product designers and toolmakers, the SPI system divides finishes into four grades — A, B, C, and D — each with three sub-levels. Grade A represents the highest gloss, diamond-polished surfaces, while Grade D denotes coarse blasted textures. Every mold maker worldwide who's worth their salt understands these designations, making SPI the default reference system in technical drawings, RFQs, and quality inspection reports across the injection molding supply chain.

Getting the finish spec right isn't just about aesthetics — it directly impacts part cost, mold life, and demolding performance. An SPI A-1 diamond polish adds $800-1,500 per cavity to tooling cost and requires re-polishing every 50,000-100,000 shots to maintain the spec. Meanwhile, an SPI D-2 blast finish costs essentially nothing extra and stays consistent for millions of cycles. The spec you call out on the drawing determines whether your part releases cleanly from the mold, whether sink marks telegraph through to the visible surface, and whether your per-part cost stays competitive. Understanding the Ra (roughness average) values behind each grade empowers you to specify exactly what you need — nothing more, nothing less.

SPI Grade A finishes are achieved through progressive diamond polishing, starting with coarse diamond paste and working down to ultra-fine grades. A-1, the highest possible polish, requires a #3 diamond compound producing an Ra of 0.012-0.025 ;ÆÒ r W76VçF– ÆÇ’ Ö—'&÷"× V Æ—G•. Achieving this requires the mold steel to be hardened to at least 48 HRC and demands 8-16 hours of skilled hand polishing per cavity for a typical consumer product mold. A-2 uses #6 diamond compound for Ra 0.025-0.05 ;ÆÒÂ v†–ÆR Ó2 6 2 B 3 R F– ÖöæB compound delivering Ra 0.05-0.10 ;ÆÒà These finishes are specified for optical lenses, transparent medical components, reflective automotive lighting, and any part where surface clarity is non-negotiable.

Engineering Notes

What Are SPI Surface Finish Standards?

The SPI (Society of the Plastics Industry, now PLASTICS Industry Association) surface finish standards are the universal language for specifying mold cavity polish levels. Introduced decades ago as a way to standardize communication between product designers and toolmakers, the SPI system divides finishes into four grades — A, B, C, and D — each with three sub-levels. Grade A represents the highest gloss, diamond-polished surfaces, while Grade D denotes coarse blasted textures. Every mold maker worldwide who's worth their salt understands these designations, making SPI the default reference system in technical drawings, RFQs, and quality inspection reports across the injection molding supply chain. Getting the finish spec right isn't just about aesthetics — it directly impacts part cost, mold life, and demolding performance. An SPI A-1 diamond polish adds $800-1,500 per cavity to tooling cost and requires re-polishing every 50,000-100,000 shots to maintain the spec. Meanwhile, an SPI D-2 blast finish costs essentially nothing extra and stays consistent for millions of cycles. The spec you call out on the drawing determines whether y

SPI Grade A: Diamond Polish Finishes

SPI Grade A finishes are achieved through progressive diamond polishing, starting with coarse diamond paste and working down to ultra-fine grades. A-1, the highest possible polish, requires a #3 diamond compound producing an Ra of 0.012-0.025 ;ÆÒ r W76VçF– ÆÇ’ Ö—'&÷"× V Æ—G•. Achieving this requires the mold steel to be hardened to at least 48 HRC and demands 8-16 hours of skilled hand polishing per cavity for a typical consumer product mold. A-2 uses #6 diamond compound for Ra 0.025-0.05 ;ÆÒÂ v†–ÆR Ó2 6 2 B 3 R F– ÖöæB 6ö× ÷VæB FVÆ—`ering Ra 0.05-0.10 ;ÆÒà These finishes are specified for optical lenses, transparent medical components, reflective automotive lighting, and any part where surface clarity is non-negotiable. The cost of A-grade finishes cascades beyond the initial polishing. Because even minor tool wear or material residue dulls the mirror finish, molds with A-1 or A-2 surfaces require inspection every 10,000-15,000 cycles and re-polishing every 50,000-100,000 shots. Each re-polish removes 0.002-0.005mm of steel, gradually changing cavity dimensions — a concern for parts with tight tolerances. For clear polycarbonate le

SPI Grade B: Fine Semi-Gloss Finishes

Grade B finishes use grit paper rather than diamond compound, producing semi-gloss surfaces suitable for most consumer-facing parts. B-1 uses 600-grit paper for Ra 0.05-0.10 ;ÆÒÂ "Ó" W6W2 C Öprit for Ra 0.10-0.15 ;ÆÒÂ æB "Ó2 uses 320-grit for Ra 0.15-0.28 ;ÆÒà These are the workhorse finishes of injection molding — roughly 60% of all consumer product cavities ship with B-1 or B-2 finish. The semi-gloss appearance hides minor flow lines, blush marks, and sink that would be glaring on an A-grade finish while still delivering a premium look that satisfies most consumer expectations. B-grade finishes offer the best cost-to-appearance ratio in the SPI system. A B-1 finish adds roughly $300-500 per cavity versus a raw machined surface, and the polish holds up for 200,000-300,000 shots before needing touch-up on standard P20 steel. For medical device housings, consumer electronics enclosures, and automotive interior trim (non-Class-A surfaces), B-2 is the default specification. An often-overlooked advantage: B-grade surfaces are more forgiving of minor tool wear because the paper-grit texture is inherently less directional than diamond poli

SPI Grade C and D: Textured and Matte Finishes

Grade C finishes use grit stone for matte-to-satin results: C-1 (600 stone, Ra 0.35-0.40 ;ÆÒ’Â 2Ó" ƒC 7FöæP, Ra 0.45-0.50 ;ÆÒ’Â æB 2Ó2 ƒ3# 7FöæP, Ra 0.60-0.70 ;ÆÒ’à These are specified for functional surfaces where appearance matters less than grip, paint adhesion, or light diffusion. Grade D finishes use dry blasting with glass bead or aluminum oxide: D-1 (glass bead at low pressure, Ra 0.80-1.00 ;ÆÒ’Â BÓ" †vÆ 72 &V B B ÖVF—VÒ &W77W&P, Ra 1.25-1.50 ;ÆÒ’Â æB BÓ2 † ÇVÖ–àum oxide, Ra 2.00-3.50 ;ÆÒ’à D-grade finishes excel at hiding parting lines, weld lines, and flow marks, which is why they're ubiquitous on power tool housings, under-hood automotive components, and industrial equipment covers. The key specification trap with C and D grades: these are the finishes most likely to cause ejection problems if draft angles aren't adjusted accordingly. A D-2 blasted texture creates microscopic peaks and valleys that mechanically interlock with the cooling plastic — this is intentional for paint adhesion but disastrous for demolding without adequate draft. Per the SPI texture depth rule, D-2 requires roughly 4-5° of additional draft beyond

Material-Finish Matching: Which Finish for Which Resin

Not every material can achieve every finish — the resin itself imposes a ceiling on surface quality. Amorphous materials (polycarbonate, ABS, acrylic) take polish better than semi-crystalline ones because their random molecular structure doesn't scatter light the way crystalline regions do. Clear polycarbonate can achieve A-1 clarity, while even the most painstakingly polished mold running polypropylene will top out at a slightly hazy B-2 appearance due to PP's inherent crystallinity. Glass-filled materials present the most severe limitation: the exposed glass fibers at the surface create a naturally matte appearance regardless of mold polish level, effectively capping the achievable finish at B-3 even with A-2 tooling. The material-finish matching matrix also works in reverse: some materials need a specific minimum finish to function properly. Silicone and TPE adhere so aggressively to polished surfaces that B-1 or better is essentially mandatory for demolding without tearing. POM's low friction coefficient means it releases well from any finish, but a B-2 or better cavity surface is recommended to minimize squeaking in moving part

Industry Application Matrix

Premium feel + scratch resistance Low gloss for glare reduction Durability + defect hiding Cost Decision Framework: SPI Finish Grade Economics Surface finish directly impacts three cost drivers — initial tooling, cycle time, and maintenance. Here's how finish grade affects your total cost of ownership across production volumes: Prototype / Bridge Tooling (1-5K parts): Use B-3 or as-machined finish. The $200-500 savings per cavity doesn't justify premium polishing for low-volume validation. Expect visible tool marks but functional parts. Low-Volume Production (5K-50K parts): B-2 is the sweet spot. One polish cycle lasts the entire production run on P20 steel, and the semi-gloss finish satisfies 90% of consumer product requirements. Total finish cost: $200-400 per cavity, zero re-polish expense. Mid-Volume Production (50K-250K parts): A-3 for cosmetic surfaces, B-2 for everything else. Budget for one re-polish at 150K shots ($400-600). If optical clarity is required, A-1 on the critical surface only — not the entire cavity.

Common Surface Finish Defects and Solutions

Over-polishing with wrong technique — excessive pressure causes surface waviness instead of smoothness Re-polish using progressive grit steps without skipping grades (400!'600!'800!'1200, never 400!'1200). Reduce polishing pressure to 5-10 N and verify with profilometer between steps. Sink Marks Visible Through Polish High-gloss finish amplifies even 0.005mm of sink (vs 0.02mm threshold on C-grade) Reduce rib thickness to 50% of wall. Increase packing pressure 15-25% and extend hold time 2-3 seconds. If persistent, downgrade to A-3 or B-1 — semi-gloss hides sink 4× better than mirror polish. Scratch Marks After Short Runs Soft mold steel (below 40 HRC) paired with abrasive material like glass-filled resin Upgrade to hardened steel (48-52 HRC) or stainless (S136 at 50-54 HRC). Apply TiN or CrN coating (0.003-0.005mm) for added abrasion resistance on GF materials. Expect coating to add $300-600 per cavity. Inconsistent Gloss Across Part Uneven polishing pressure in contoured areas or differential mold temperature during molding

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.

Contact: nova@nylonplastic.com | https://nylonplastic.com/contact/