

Nylon 6 vs Nylon 66

Selection Guide

Engineering Reference for Injection Molding Material Selection

Prepared by Nylon Plastic | nylonplastic.com
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This guide provides engineering teams with a structured framework for choosing between Nylon 6 (PA6) and Nylon 66 (PA66) in injection molding applications. All data is based on published material standards and practical manufacturing experience.

1. Material Overview

Nylon 6 (PA6) and Nylon 66 (PA66) are the two most widely used polyamides in injection molding. While chemically similar—both are polyamides with repeating amide linkages—the difference of one carbon atom in the monomer structure creates a cascade of divergent properties. PA66, derived from hexamethylene diamine and adipic acid, achieves tighter crystalline packing, yielding higher strength and heat resistance. PA6, polymerized from caprolactam, offers a broader processing window and superior impact toughness.

Quick Facts:

- PA66 melting point: 255–265°C vs PA6: 220°C
- PA66 tensile strength: 80–95 MPa vs PA6: 70–85 MPa (dry)
- PA6 notched Izod impact: 5–8 kJ/m² vs PA66: 3–5 kJ/m²
- PA6 absorbs ~0.5% more moisture at equilibrium
- PA66 supply historically more volatile (adiponitrile shortages)

2. Mechanical & Thermal Properties Comparison

Property	Nylon 6 (PA6)	Nylon 66 (PA66)	Practical Impact
Melting Point	220°C	255–265°C	PA6: lower barrel temps, less degradation
Tensile Strength (dry)	70–85 MPa	80–95 MPa	PA66 ~12% stronger dry
Flexural Modulus (dry)	2.6–3.0 GPa	2.8–3.3 GPa	PA66 stiffer for structural parts
Notched Izod Impact	5–8 kJ/m ²	3–5 kJ/m ²	PA6 2–3x better for snap-fits
HDT @ 1.8 MPa	65–80°C	80–100°C	PA66 handles 15–20°C higher heat
Mold Shrinkage	0.5–1.5%	1.0–2.0%	PA6 tighter tolerances, less draft
Moisture (equilibrium, 50% RH)	2.5–3.0%	2.0–2.5%	PA66 more dimensionally stable
Melt Temp Range	230–270°C	260–300°C	PA6 15–30°C lower energy cost
Density	1.13–1.15 g/cm ³	1.13–1.15 g/cm ³	Equivalent part weight

Key Takeaway: When conditioned to equilibrium moisture (50% RH), the strength gap narrows significantly. PA6 conditioned tensile drops to 35–45 MPa with dramatically improved impact. PA66 conditioned reaches 55–65 MPa with only modest impact gains. Always factor in the service environment—dry-as-molded parts behave very differently from humidity-equilibrated parts.

3. Injection Molding Processing Guidelines

Drying Requirements

Both nylons are hygroscopic and must be dried to <0.15% moisture before processing. Insufficient drying causes splay marks, hydrolytic degradation, and 15–30% strength loss. Recommended: 80°C for 4–6 hours with desiccant dryer (dew point <−30°C). A properly maintained dryer is the single most important processing variable for nylon molding.

Processing Parameters

Parameter	Nylon 6 (PA6)	Nylon 66 (PA66)	Notes
Barrel Temp (Rear)	230–240°C	260–270°C	PA66 needs ~30°C more
Barrel Temp (Front)	250–270°C	280–300°C	Higher front helps flow
Mold Temperature	60–90°C	80–120°C	Hotter mold = better crystallinity
Injection Pressure	50–100 MPa	60–120 MPa	Varies with part geometry
Back Pressure	0.5–1.5 MPa	0.5–2.0 MPa	Helps melt homogeneity
Screw Speed	50–150 rpm	40–120 rpm	Limit shear heating in PA66
Cycle Time (vs PA6)	Baseline	+5–15%	Higher mold temp extends cooling

Moisture Conditioning

Dry-as-molded PA6 parts are dangerously brittle—conditioning in ambient humidity takes 40–90 days for full toughening (depending on wall thickness). For accelerated conditioning, immerse parts in 80°C water for 30 minutes. PA66 dry-as-molded has a wider safety margin and requires less aggressive conditioning. For parts that ship immediately, PA66 is the safer choice in the dry state; for snap-fit designs, PA6 conditioned toughness is superior.

4. Design Rules Checklist

Rule 1: Wall Thickness

PA6: 0.8–3.0 mm / PA66: 1.0–3.5 mm. Maximum variation: 25%. Uniform walls prevent differential shrinkage warpage.

Rule 2: Draft Angle

0.5–1° minimum. PA66 requires more draft due to higher shrinkage. Add 1° per 0.025 mm of texture depth.

Rule 3: Corner Radius

Minimum 0.5 mm internal; 1.0 mm for PA66. Sharp corners create stress concentrations exceeding 3x nominal bending stress.

Rule 4: Gate Location

Position at the thickest section. PA66 demands shorter fill times (<2 seconds for parts under 100g). Avoid gating at snap-fit roots.

Rule 5: Hole Spacing

Edge distance $\geq 1.5x$ hole diameter. Closer spacing risks mold parting line cracking, especially with PA66's higher shrinkage.

Rule 6: Weld/Knit Lines

PA66's fast crystallization can freeze melt fronts before knitting, reducing strength 30–50%. Increase mold temp to 80–100°C to mitigate.

Rule 7: Rib Design

Rib thickness $\leq 60\%$ of wall thickness. Rib height $\leq 3x$ wall thickness. PA66 ribs need 0.5–1° draft per side.

5. Decision Framework: When to Choose Which Grade

Choose Nylon 6 (PA6) When:

- Impact resistance and toughness are primary requirements (snap-fits, clips, enclosures)
- Maximum continuous service temperature is below 80°C
- Tight tolerances are needed (lower mold shrinkage: 0.5–1.5%)
- Cost optimization is a priority (20–30% lower raw material cost)
- Fast cycle times matter (5–15% shorter cooling due to lower mold temp)
- You need FDA-compliant grades (better availability)
- Surface finish is important (PA6 flows better, less visible knit lines)

Choose Nylon 66 (PA66) When:

- Sustained service temperature exceeds 80°C (under-hood automotive, industrial)
- Maximum stiffness and creep resistance are required (structural brackets)
- Dimensional stability in varying humidity is critical
- UL RTI (Relative Thermal Index) ratings are required for electrical applications
- Parts must ship immediately without conditioning (PA66 dry-as-molded safer)
- Chemical resistance matters—PA66 slightly better vs oils and solvents
- Long-term static loads require minimal creep (gears, bearings under constant load)

6. Industry Applications Matrix

Industry	Typical Parts	Grade	Rationale
Automotive	Engine covers, intake manifolds, radiator tanks	PA66 GF30	HDT 240°C handles under-hood; glass adds stiffness
Consumer Products	Power tool housings, appliance gears, cable ties	PA6	Better surface finish, lower cost, superior impact
Electrical	Connectors, breakers, terminal blocks	PA66 V-0	Higher RTI rating meets UL requirements
Industrial	Gears, bearings, wear pads, conveyors	PA6 + MoS ₂	Moly-filled PA6: excellent wear, lower cost
Food & Medical	Processing components, pharma trays	PA6	Better FDA availability, lower extractables

7. Cost Analysis Framework

Raw Material: PA6 baseline \$2.80–3.50/kg vs PA66 \$3.50–4.50/kg. The 20–30% raw material premium for PA66 is the starting point, but the full cost picture includes processing energy, cycle time, and supply chain factors.

Volume	PA6 Advantage	Annual Savings (200g part, 50K/yr)
Low (<1,000 pcs)	Negligible—mold amortization dominates	<\$500
Mid (1,000–50,000)	Material + cycle time savings compound	\$1,500–\$4,000
High (>50,000)	8–12% lower total part cost	\$6,000–\$12,000+

Supply Chain Risk: PA66 supply is sensitive to adiponitrile (ADN) availability—a key precursor historically subject to shortages. PA6 caprolactam supply is more diversified globally, providing better long-term price stability. For multi-year production programs, double-source your PA66 specification and maintain a qualified PA6 alternative on file.

8. Troubleshooting: Common Molding Defects

Defect	Root Cause	Solution
Splay marks (silver streaks)	Moisture >0.15% in resin	Verify dryer dew point <–30°C; dry 6h at 80°C
Warpage / distortion	Differential shrinkage	Uniform wall thickness; raise mold temp 10–15°C
Brittle fracture	Dry-as-molded PA6, no conditioning	Water bath 80°C, 30 min; or 40–90 day ambient
Knit line weakness	PA66 fast crystallization	Mold temp to 80–100°C; relocate gates
Burn marks / dieseling	Trapped gas at end of fill	Add venting 0.02–0.05 mm; reduce injection speed
Dimensional variation	Moisture content fluctuation	Closed-loop dryer with dew point monitoring

About Nylon Plastic

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Services	CNC Machining Injection Molding 3D Printing Insert Molding Overmolding
Materials	PA6, PA66, POM, PEEK, ABS, PC, PP, PBT, TPE, and 50+ engineering grades
Quality	ISO 9001:2015 Full dimensional inspection reports PPAP Level 3 available
Contact	www.nylonplastic.com Get a quote in 24–48 hours

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