Glass Filled Nylon Guide

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

Based on article:

https://nylonplastic.com/glass-filled-nylon-complete-guide/

Quick Overview

Adding glass fiber to nylon transforms a tough, wear-resistant engineering plastic into a structural material that competes with die-cast metals. At 30% glass loading, PA66-GF30 doubles tensile strength (80 to 165-185 MPa), triples flexural modulus (2.8 to 8-9 GPa), and pushes the heat deflection temperature from 75 degree C to over 240 degree C. These numbers explain why glass-filled nylon has replaced aluminum in automotive intake manifolds, power tool housings, and structural brackets across every industry where weight reduction meets structural demand.

But glass fibers are a double-edged sword: they make nylon anisotropic (strength varies with flow direction), abrasive to molds and tooling, and more brittle at low temperatures. This guide covers the grades, design rules, and processing considerations that separate a reliable GF nylon part from one that fails at the knit line.

PA66-GF15: Tensile 120-130 MPa, flex modulus 5-6 GPa. Best balance of toughness and stiffness. Used for clips, fasteners, and snap-fit components that need strength improvement without becoming too brittle. PA66-GF30: The industry workhorse. Tensile 165-185 MPa, flex modulus 8-9 GPa, HDT (1.82 MPa) 240-250 degree C. Used for intake manifolds, engine covers, structural brackets. PA66-GF50: Tensile 210-230 MPa, flex modulus 14-16 GPa. Approaching die-cast aluminum stiffness at one-third the weight. Used for structural mounts and high-load bearing applications. Trade-off: impact strength drops 40-50% versus GF30, and flowability decreases significantly.

Engineering Notes

Glass Fiber Loading: What Each Percentage Delivers

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Fiber Orientation: The Hidden Design Variable

Glass fibers align with the melt flow direction during injection, creating anisotropic mechanical properties. A PA66-GF30 tensile bar tested parallel to flow direction shows 180 MPa; the same material tested perpendicular to flow shows 80-100 MPa - a 45-55% reduction. This anisotropy must be accounted for in part design and FEA analysis. Design implication: orient the part in the mold so that the primary load path aligns with the flow direction. Use multiple gates to control fiber orientation when loads are multi-axial, but be aware that knit lines (where flow fronts meet) contain no fiber bridging and have only 50-60% of the base strength.

Design Rules for Glass-Filled Nylon

Account for anisotropic shrinkage: GF nylon shrinks 2-4x more in the transverse direction than along flow. A 100 mm feature parallel to flow may shrink 0.3 mm; the same feature perpendicular may shrink 1.0 mm. Apply different shrinkage factors for flow and transverse directions in mold design, or use mold flow simulation to predict differential shrinkage. Avoid sharp corners at knit lines: Knit lines in GF nylon contain no fiber bridging - the two flow fronts meet with only matrix polymer at the interface. A radius of 0.5 mm minimum at knit line locations reduces stress concentration from Kt=3-4 down to Kt=1.5-2. Move knit lines away from high-stress areas by repositioning gates. Specify hardened mold steel: GF30 and above is abrasive. P20 steel (HRC 28-32) wears measurably after 50,000-100,000 shots. Use H13 (HRC 48-52) or D2 (HRC 58-62) for cavities expected to exceed 100,000 cycles. For GF50, even H13 shows wear at 50,000 cycles - consider stainless steel with nitriding or hard chrome plating on wear surfaces.

Industry Application Matrix

Intake manifolds, engine covers, radiator end tanks, mirror housings 250 deg C HDT, glycol resistance, weld-line strength Housings, gear cases, handle frames Impact at -20 deg C, vibration damping, UL 94 HB Pump housings, structural brackets, conveyor components Creep resistance under sustained load, chemical exposure Appliance structural frames, furniture mechanisms Cost-to-strength ratio, colorability, tactile feel

Cost Decision Framework

Material cost: PA66-GF30: $4.50-7.00/kg (vs $3.00-4.50 for unfilled PA66). PA66-GF50: $6.00-9.00/kg. The glass fiber premium is 50-100% over unfilled, but the strength improvement is 100-150% - the strength-per-dollar ratio actually improves with GF content for load-bearing parts. Processing cost: GF grades require 10-20 deg C higher melt temperatures, slightly longer cycle times, and more frequent screw/barrel replacement (every 500-1,000 tons of material vs 2,000-3,000 for unfilled). The mold steel upgrade (P20 to H13) adds $2,000-8,000 to mold cost but is essential for volumes above 100,000. Decision rule: Start with GF15 if the part needs better stiffness than unfilled but must retain toughness (snap-fits, clips). Use GF30 as the default structural grade - it is the most widely available and best-characterized. Reserve GF50 for parts where stiffness is the primary design driver and impact requirements are secondary. Consider that GF50 poor flow may require larger gates and thicker walls, partially offsetting the stiffness advantage.

Common Defects and Solutions

Anisotropic shrinkage: flow vs transverse Gate centrally for symmetrical fill; use mold flow analysis; uniform cooling Part cracks at flow-front meeting line No fiber bridging; stress concentration Move gate to relocate knit line; add radius over 0.5mm; increase melt temp 10-15 deg C Surface glass fiber appearance Visible fibers on part surface; roughness Low mold temperature; high fiber content at surface Increase mold temp to 120-140 deg C; use fast fill speed; GF15 max for cosmetic surfaces Cavity dimensions growing; flashing increasing Glass fiber abrasion on P20 steel Upgrade to H13 or D2 steel; hard chrome plate gate area; inspect after 50K shots

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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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