

# Automotive Plastics Guide

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

## Based on article:

<https://nylonplastic.com/automotive-plastic-parts-manufacturing-guide/>

## Quick Overview

The automotive industry demands plastics that can withstand extreme temperatures, chemical exposure, UV radiation, and mechanical stress — all while meeting stringent cost and weight targets. From under-hood components facing 150°C+ engine bay temperatures to interior trim requiring Class-A surface finishes, selecting the right automotive-grade plastic is a multi-variable engineering decision that directly impacts vehicle performance, safety certification, and total program cost. With the global automotive plastics market projected to reach \$58.4 billion by 2028, understanding the material landscape has never been more critical for OEM engineers and Tier-1/2 suppliers alike.

This guide provides a comprehensive reference for automotive plastic part manufacturing, covering material selection by vehicle zone, processing considerations, regulatory compliance, and cost optimization strategies. Whether you're developing EV battery housings, under-hood fluid management systems, or premium interior components, the data and design rules below will help you make informed material and manufacturing decisions that balance performance, manufacturability, and program budget.

Plastics in modern vehicles serve distinct functions depending on their location. Each zone imposes unique material requirements that drive polymer selection.

## Engineering Notes

### Material Selection by Vehicle Zone

Plastics in modern vehicles serve distinct functions depending on their location. Each zone imposes unique material requirements that drive polymer selection. Under-Hood Components (PA66, PPA, PPS): Engine bay temperatures routinely reach 120-150°C, with hot spots near turbochargers and exhaust manifolds exceeding 200°C for short durations. Glass-fiber-reinforced PA66 (GF30-GF50) remains the workhorse material for most under-hood applications, offering 250 MPa tensile strength and continuous use temperatures of 120-140°C. For applications above 140°C — such as charge air ducts, EGR valve bodies, and thermostat housings — PPA (polyphthalamide) with its 180°C HDT and PPS with its remarkable 260°C continuous use rating become necessary upgrades. Key under-hood applications include engine covers (PA66-GF30), intake manifolds (PA66-GF35), radiator end tanks (PA66-GF30), oil filter housings (PPA-GF40), and high-temperature connectors (PPS-GF40). Interior Components (PC/ABS, PP, ABS): Interior plastics must balance aesthetics, tactile quality, low VOC emissions, UV stability, and flammability compliance (FMVSS 302). PC/ABS blends dominate

### EV Battery Component Material Requirements

Electric vehicles introduce entirely new plastic applications centered around the battery pack. Battery housings, module frames, cell holders, busbar mounts, and coolant manifolds each present unique material challenges. The dominant requirements are flame retardancy (UL94 V-0 at 1.5-3.0mm thickness), electrical insulation (CTI > 600V for high-voltage isolation), thermal management capability, and dimensional stability across -40°C to 85°C thermal cycling. Flame-retardant PC/ABS blends (UL94 V-0 at 1.5mm) are widely used for module housings and cell holders, with halogen-free FR systems preferred to meet evolving EU and Chinese regulations on halogen content. For thermal management components — coolant distribution manifolds and end plates — glass-filled PP with hydrolysis-resistant stabilization provides chemical compatibility with glycol-based coolants at 85°C continuous exposure. PPS and PPA remain the materials of choice for high-voltage connectors and busbar insulation, where CTI (Comparative Tracking Index) values above 400V are mandatory per IEC 60112. A critical emerging requirement is thermal runaway containment: materials



## Automotive Regulatory Standards and Testing

Automotive plastic parts must comply with a complex matrix of international, regional, and OEM-specific standards. The foundational regulatory framework includes: Horizontal burn test, 38mm specimen Odor grade "d 3; VOC < 50 µg/g Headspace GC-MS; thermal desorption Thermal cycling, humidity, chemical resistance Application-specific cycling profiles Thermal runaway containment "e 5 min Cell thermal runaway propagation test Permanent marking for recycling Molded-in or laser-marked codes Beyond these baseline standards, each OEM maintains proprietary material specifications (e.g., Ford WSS-M4D, GM GMW, VW TL) that define approved material grades, permitted regrind percentages (typically 0-25% depending on application criticality), and PPAP (Production Part Approval Process) documentation requirements. First-time qualification of a new material variant typically requires 6-12 months and \$50,000-150,000 in testing costs.

## Design Rules for Automotive Plastic Parts

Maintain uniform wall thickness of 2.0-3.5mm: Wall thickness variation should not exceed 25% across any single part. Transition zones require a minimum 3:1 taper ratio (3mm length per 1mm thickness change) to prevent sink marks, warpage, and flow hesitation. For glass-filled materials, minimum wall thickness should be 1.5mm to avoid fiber breakage and surface defects. Apply 0.5°-1.5° draft angle on all vertical surfaces: Exterior Class-A surfaces require minimum 0.5° draft; textured surfaces need 1° per 0.025mm texture depth plus 1° base draft. Deep ribs and bosses should use 0.5°-1° draft per side. Inadequate draft increases ejection force, risks part damage, and accelerates tool wear — adding 15-30% to mold maintenance costs over production life. Radius all internal corners at minimum 0.5x wall thickness: Sharp internal corners create stress concentrations up to 3-5x nominal stress levels. The inside corner radius should be at least 0.5x nominal wall thickness, with 0.75x preferred for glass-filled materials where fiber orientation exacerbates notch sensitivity. Outside corners should use inside radius + wall thickness.

## Industry Application Matrix

Engine Air Intake Manifold HDT > 220°C, burst pressure > 12 bar UL94 V-0 @1.5mm, CTI > 400V Flex modulus > 4500 MPa, > 40 kJ/m<sup>2</sup> impact UV stable 10+ years, impact at -30°C

## Cost Decision Framework

How to choose the right material grade for cost-optimized production: Start with the minimum performance requirement and work upward — not the reverse. A PA66-GF30 part costs \$3.80-4.50/kg in raw material, while PPS-GF40 runs \$12-18/kg. The key question: does your application actually need PPS-level performance? Run thermal mapping on prototype vehicles before locking in material specifications. For EV applications, balance flame retardancy requirements against cost: PC/ABS FR V-0 adds \$1.50-2.00/kg over standard PC/ABS. Consider post-processing cost in your total part cost calculation — painting adds \$0.80-1.50 per part, while molded-in-color ASA saves this entirely. Finally, evaluate tooling life: highly abrasive glass-filled PPS reduces tool life to 200,000-300,000 shots vs. 500,000+ for unfilled materials — factor \$15,000-40,000 in additional tool maintenance into your 5-year cost model.

## Common Troubleshooting for Automotive Plastic Parts

Warpage exceeding 0.5% of part length Differential shrinkage from fiber orientation or non-uniform cooling Adjust gate location; increase cooling time by 20-30%; use conformal cooling channels Moldflow warp analysis pre-production; balanced cooling circuit design Surface blistering after paint bake (120°C/30min) Moisture trapped in material; inadequate drying before molding Verify dryer dew point < -30°C; dry PA66 4h at 80°C minimum Moisture analyzer inline check every 2h; < 0.15% moisture content Brittle failure at sub-zero temperatures Material grade without low-temperature impact modifier Switch to impact-modified grade (e.g., PA66-I); verify notched Izod > 10 kJ/m<sup>2</sup> at -30°C Specify cold-impact grade in material callout; test at -40°C for safety margin Creaking/rattle in snap-fit assemblies Stick-slip between PC/ABS surfaces; inadequate lubrication Apply felt tape at contact points; use silicone-based anti-squeak coating Ziegler stick-slip test during DV phase; specify compatible material pairs



## 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](mailto:nova@nylonplastic.com) | <https://nylonplastic.com/contact/>**

