Orthotic Materials Reference

Properties, Characteristics and Clinical Applications

Material selection is fundamental to orthotic function and patient outcomes. The same prescription on different materials produces markedly different mechanical behaviour. This reference covers the key material groups — their physical properties, mechanical characteristics, durability, and clinical applications — to support evidence-informed material selection.

1 Shell / Structural Materials

Material	Shore Hardness	Profile / Weight	Heat For mable	Key Properties	Best Clinical Use
Polypropylene (Rigid)	80-95A (rigid)	Low flex / Moderate wt	Yes (>150°C)	Firm, stable, controls motion effectively; may require grinding for modifications	PTTD, severe flat foot, spastic conditions, high-demand sport
Polypropylene (Semi-rigid)	65-80A	Low-mod flex / Moderate wt	Yes	Thinner gauge allows mild flex; good balance of control and comfort	General MSK, moderate pronation, everyday use
Carbon Fibre	N/A (com posite)	Very low flex / Very light	No (pre-preg)	Exceptional rigidity at low weight; cannot be heat modified; expensive	High-performance sport, running — weight and rigidity priority
Co-polymer / Subortholen	55-75A	Moderate flex / Light-mod wt	Yes (lower temp)	More forgiving than polypropylene; slightly more flexible; easier to modify	Paediatric orthotics, moderate control, comfort priority
Thermoplastic (low-temp)	40-60A	High flex / Light wt	Yes (<80°C)	Quick, chairside fabrication; less durable; suitable for temporary or offloading devices	Diabetic offloading, ulcer management, temporary devices, wound care

Material	Shore Hardness	Profile / Weight	Heat Formable	Key Properties	Best Clinical Use
TPU (FDM 3D-printed)	Variable (infill-dependent)	Variable / Very light	No (printed)	Stiffness entirely determined by infill density and pattern — low infill = flexible/cushioning, high infill = rigid/controlling; zonal variation possible in single shell; excellent resilience and fatigue resistance	Bespoke 3D-printed orthotic shells; variable-stiffness devices; high-performance sport; complex geometry indications

2 Cushioning & Top Cover Materials

Material	Density / Hardness	Shock Absorption	Durability	Key Properties	Best Clinical Use
Poron Pink (Standard)	4–8 lb/ft³	Excellent	High	Moderate density open-cell urethane; excellent memory; low compression set; low-profile; widely available	General cushioning top covers, heel and met pads, everyday use; preferred where standard cushioning is sufficient
Poron Fusion	Composite (Poron + EVA/Plastazote laminate)	Excellent + shape retention	High	Dual-layer: Poron cushioning bonded to EVA or Plastazote substrate; combines shock absorption with structural shape retention	Diabetic/neuropathic orthotics; presentations requiring both cushioning and conforming shape retention; reduces material migration
Poron Vive	6–10 lb/ft³ (higher resilience)	Excellent	Very high	Higher resilience than standard Poron; thinner profile for equivalent performance; better energy return; maintains properties over time	Sports/active use where bulk is a constraint; high-mileage patients; performance applications where longevity is a priority

Material	Density / Hardness	Shock Absorption	Durability	Key Properties	Best Clinical Use
Poron XRD	Rate-dependent (soft at rest, stiffens on impact)	Exceptional (rate-dependent protection)	Very high	Unique viscoelastic behaviour — soft and flexible normally, stiffens on high-rate impact. Exceptional protection against impact forces. Certified for impact protection.	High-impact sport; metatarsal stress fracture protection; bone stress injury management; patients requiring maximum impact attenuation
Plastazote (Closed-cell PE foam)	30A–60A (grades 1–3)	Good	Moderate	Heat moulds to foot shape; accommodating; conforming	Diabetic orthotics, pressure relief, bony prominences, total contact; Grade 1 (softest) for neuropathy
PPT (Polyurethane foam)	10–30 lb/ft³	Good	Moderate-high	Good energy return; slightly firmer than Poron; widely available	General cushioning, sport orthotics, heel and met pads, good cost-performance balance
EVA (Ethylene Vinyl Acetate)	30A–60A	Moderate	Moderate	Widely available; heat mouldable; easy to grind/modify; cost-effective; compresses over time	Shell material for prefab orthotics; wedging; posting; general-purpose — lower cost applications
Leather (top cover)	N/A	Minimal	High	Breathable; durable; moulds to foot over time; aesthetic; traditional; reduces friction	Dress shoe orthotics; patients requiring aesthetics; formal footwear; reduces shear

Material	Density / Hardness	Shock Absorption	Durability	Key Properties	Best Clinical Use
Neoprene	30A–50A	Moderate	Moderate	Flexible; accommodating; cushioning; provides warmth	Cold sensitivity; mild compression support; accom modative orthotics
Microfibre / Fabric covers	N/A	Minimal	Moderate	Moisture wicking; breathable; patient comfort; reduces friction	General top cover; athletic applications; patients with hyperhidrosis

3 Material Selection by Clinical Presentation

Presentation	Recommended Shell	Recommended Top Cover / Additions	Key Rationale
Diabetic neuropathy	Low-temp thermoplastic or Plastazote total contact	Plastazote Grade 1 + Poron	Pressure redistribution; minimal shear; accommodating to deformity
Plantar fasciitis	Semi-rigid polypropylene	Poron heel cushion + full-length EVA/PPT	Control + cushioning; reduce tensile and compressive heel load
PTTD / adult flat foot	Rigid polypropylene with medial flange	PPT or Poron full length	Maximum medial control; durability for long-term use
Pes cavus / rigid foot	Semi-rigid to soft EVA	Poron full length + Plastazote top	Cushioning priority; shock absorption; accommodate rigid structure
Paediatric flat foot	Co-polymer / Subortholen	PPT or EVA full length	Lighter; less aggressive; accommodates growth
High-performance running	Carbon fibre or rigid polypropylene	Poron or PPT sulcus length	Maximum energy return and control at minimum weight
Metatarsalgia / offloading	Semi-rigid shell with met dome	Poron met pad + PPT forefoot	Targeted pressure redistribution; cushioning under met heads
3D-printed / bespoke	TPU (variable infill density)	TPU or EVA	Customisable stiffness; zonal variation in single shell possible

4 Shore Hardness Quick Reference

Shore A Value	Perceived Feel	Common Materials at This Range
20–35A	Very soft, cushioning	Plastazote Grade 1, soft foam
35–50A	Soft-medium	EVA 35-45A, Neoprene, PPT soft grades
50–65A	Medium	EVA 55A, co-polymer thin gauge, Plastazote Grade 3
65–80A	Semi-rigid	Polypropylene thin, co-polymer thick, EVA 65-70A
80–95A+	Rigid	Polypropylene thick, carbon fibre composite, hard TPU

Material selection should always consider the patient's body weight, activity level, footwear, pathology severity, and budget. No single material is universally superior - the optimal prescription matches the material properties to the patient's specific biomechanical and clinical requirements.