
Two Part Epoxy Resin Structural Adhesive – Technical Material Specification

1.0 Material Overview & Common Uses

Two-part epoxy resin structural adhesive is a high-strength thermosetting polymer system consisting of a resin (Part A) and a hardener (Part B). When mixed in the specified ratio, a chemical cross-linking reaction occurs, forming a rigid, durable bond with excellent mechanical strength, chemical resistance, and thermal stability. This material is widely used in aerospace, automotive, marine, construction, and electronics industries for bonding metals, composites, ceramics, and rigid plastics where mechanical fasteners are impractical or undesirable.

- Common applications include structural panel bonding, composite repair, metal-to-metal joining, potting of electronic components, and concrete anchoring systems.
- Available in various viscosities (from thin-penetrating to non-sag paste) and cure speeds (fast-set to slow-cure for extended working time).
- Typical service temperature range: -40°C to +120°C, with some formulations rated up to 200°C.

2.0 Core Technical Properties & Sizing

- Mix ratio by volume: 1:1 or 2:1 (resin to hardener), depending on formulation; verify per manufacturer datasheet.
- Mixed viscosity at 25°C: 500–50,000 cP (paste grades may be thixotropic).
- Pot life at 25°C: 5 minutes (fast-set) to 120 minutes (slow-cure).
- Cure schedule: Tack-free in 30–60 minutes; full structural cure in 24–72 hours at 25°C; accelerated cure possible at 60–80°C for 1–4 hours.
- Lap shear strength (ASTM D1002): 15–35 MPa on aluminum, depending on surface preparation.
- Tensile strength (ASTM D638): 30–60 MPa.
- Elongation at break: 1–5% (rigid formulations).
- Glass transition temperature (T_g): 60–150°C, depending on formulation and post-cure.
- Density (cured): 1.1–1.6 g/cm³.
- Hardness (Shore D): 75–90.
- Standard packaging: 50 mL dual-cartridge, 400 mL dual-cartridge, 1 L kits, 5 L pails, 20 L pails.

3.0 Processing, Machinability & Application

Two-part epoxy adhesives require precise mixing and surface preparation to achieve maximum bond strength. Application methods include manual mixing, pneumatic dispensing from dual-cartridge systems, or meter-mix-dispense equipment for high-volume production. Cured epoxy can be machined using conventional metalworking tools, though it is abrasive and will dull cutting edges quickly.

- Surface preparation: Degrease with solvent (e.g., acetone, isopropyl alcohol), abrade with 80–120 grit abrasive, and solvent-wipe again. For aluminum, use a chromate conversion coating or phosphoric acid anodize for maximum durability.

- **Mixing:** Dispense equal volumes (or specified ratio) onto a clean surface; mix thoroughly for 2–3 minutes until uniform colour is achieved. Avoid entrapping air.
- **Application:** Apply a uniform 0.1–0.5 mm bondline thickness; use shims or spacers to control thickness. Clamp with moderate pressure (10–50 psi) to ensure intimate contact.
- **Cure:** Maintain at 20–30°C for 24 hours for handling strength; 7 days for full cure. For accelerated cure, ramp to 60–80°C at 2°C/min, hold for 1–4 hours, then cool slowly to avoid thermal shock.
- **Machining cured epoxy:** Use carbide or diamond-tipped tooling. Recommended cutting speed: 150–300 SFM (45–90 m/min). Feed rate: 0.002–0.005 inch/rev (0.05–0.13 mm/rev). Use coolant to prevent heat buildup and resin softening.
- **Drilling:** Use 118° point angle, high helix drill, peck cycle to clear chips. Avoid pecking deeper than 2× diameter.
- **Tapping:** Use roll-form taps for threads; cutting taps may cause chipping. Lubricate with cutting oil or alcohol.
- **Sanding/finishing:** Use wet sanding with 400–1200 grit paper to avoid dust inhalation. Cured epoxy dust is a respiratory irritant.

4.0 Common Defects & Quality Control

- Reject if mixed material shows streaks, colour variation, or unmixed resin/hardener (incomplete mixing).
- Reject if bondline thickness exceeds 1.0 mm without specific engineering approval (reduced shear strength).
- Reject if cured adhesive exhibits visible cracks, bubbles, or porosity > 0.5 mm diameter per 25 mm² area.
- Reject if lap shear strength (ASTM D1002) is below 80% of manufacturer's minimum specified value.
- Reject if adhesive shows tackiness or incomplete cure after specified cure schedule (check T_g via DSC).
- Reject if bond fails cohesively (within adhesive) or adhesively (at interface) during peel or shear testing per applicable standard.
- Reject if material has exceeded manufacturer's stated shelf life (typically 12–24 months from date of manufacture when stored unopened at 18–25°C).
- Reject if Part A shows crystallization (cloudy, grainy appearance) that does not fully dissolve when warmed to 50°C and stirred.

5.0 Storage, Handling & WHMIS Guidelines

- Store in original sealed containers at 15–25°C in a dry, well-ventilated area away from direct sunlight, heat sources, and oxidizers.
- Relative humidity during storage: < 60% to prevent moisture contamination of hardener (Part B).
- Shelf life: 12–24 months from date of manufacture; follow FIFO (First In, First Out) inventory rotation.
- Do not freeze; if frozen, thaw slowly at 20–25°C and remix before use. Do not use if separation or crystallization is visible.
- WHMIS classification: Part A (Resin) – Class D-2B (Toxic), Class B-3 (Combustible liquid). Part B (Hardener) – Class D-2B (Toxic), Class E (Corrosive), Class B-3 (Combustible liquid).
- Hazard statements: H315 (Causes skin irritation), H317 (May cause allergic skin reaction), H318 (Causes serious eye damage), H335 (May cause respiratory irritation), H411 (Toxic to aquatic life with long-lasting effects).
- Precautionary statements: P261 (Avoid breathing dust/fume/gas/mist/vapours/spray), P280 (Wear protective gloves/protective clothing/eye protection/face protection), P302+P352 (IF ON SKIN: Wash with plenty of soap and water), P305+P351+P338 (IF IN EYES: Rinse cautiously with water for several minutes; remove contact lenses if present and easy to do; continue rinsing).
- Mandatory PPE: Safety glasses with side shields or chemical splash goggles; nitrile or neoprene gloves (minimum 0.4 mm thickness); chemical-resistant apron or lab coat; in confined spaces, use NIOSH-approved organic vapour respirator.
- Spill procedure: Contain with inert absorbent (vermiculite, sand); collect in sealed container for disposal per local regulations. Do not flush to drains.
- First aid: Skin contact – remove contaminated clothing, wash with soap and water for 15 minutes. Eye contact – flush with

water for 15 minutes, seek medical attention. Inhalation – move to fresh air, administer oxygen if breathing is difficult. Ingestion – do not induce vomiting; seek immediate medical attention.

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