
T-Slot Aluminum Extrusion Profiles – Technical Material Specification

1.0 Material Overview & Common Uses

T-slot aluminum extrusion profiles are structural framing components made from 6063-T5 aluminum alloy, extruded into profiles with continuous longitudinal slots that accept standard T-nuts and fasteners. The 6063 alloy is heat-treated to a T5 temper, providing a good balance of strength, corrosion resistance, and extrudability. These profiles are widely used for modular machine frames, workstations, conveyor systems, guarding enclosures, and industrial automation structures due to their reconfigurability and ease of assembly without welding.

Common applications include: machine bases and safety guarding, material handling racks, cleanroom framing, solar panel mounting structures, and custom jigs and fixtures. The T-slot design allows for infinite adjustability and rapid prototyping of structural assemblies.

2.0 Core Technical Properties & Sizing

- Alloy: 6063-T5 per ASTM B221 / CSA HA.3
- Tensile Strength: 150 MPa (minimum) – 190 MPa (typical)
- Yield Strength: 110 MPa (minimum) – 145 MPa (typical)
- Elongation: 8% minimum in 50 mm gauge length
- Hardness: 60 HB (Brinell) typical
- Density: 2.70 g/cm³
- Melting Range: 615°C – 655°C
- Modulus of Elasticity: 68.9 GPa
- Thermal Conductivity: 200 W/m·K
- Coefficient of Thermal Expansion: 23.5 µm/m·°C (20°C – 100°C)
- Electrical Resistivity: 0.033 µΩ·m at 20°C
- Standard Profile Lengths: 3.0 m, 6.0 m (custom lengths available up to 7.3 m)
- Cross-Section Tolerances: ±0.2 mm on overall width and height for profiles up to 100 mm; ±0.3 mm for profiles 100–200 mm
- Slot Width Tolerance: ±0.1 mm (critical for T-nut fit)
- Straightness Tolerance: 0.5 mm per 1.0 m length (maximum deviation)
- Twist Tolerance: 1.0° per 1.0 m length (maximum)
- Cut Length Tolerance: ±0.5 mm for standard saw cuts; ±0.2 mm for CNC-machined ends
- Surface Finish: Mill finish (as-extruded) or clear anodized (AA10 – AA15 per ASTM B580)

3.0 Processing, Machinability & Application

6063-T5 aluminum extrusion is highly machinable with excellent chip formation and low tool wear. The material is suitable for sawing, milling, drilling, tapping, and routing. Carbide-tipped tooling is recommended for production runs; high-speed steel

(HSS) may be used for low-volume work. Flood coolant or mist lubrication is recommended to prevent chip welding and improve surface finish.

- Sawing: Use a carbide-tipped blade with 80–100 teeth for 6 m profiles; feed rate 0.05–0.10 mm/tooth; blade speed 3000–4000 SFM. For miter cuts, use a blade with triple-chip grind geometry.
- Milling: Use 2-flute or 3-flute carbide end mills; spindle speed 8000–12000 RPM; feed rate 0.10–0.20 mm/rev; depth of cut up to 3 mm per pass. Climb milling preferred to reduce burr formation.
- Drilling: Use high-speed steel or carbide twist drills with a 118° point angle; spindle speed 3000–6000 RPM; peck drilling recommended for holes deeper than 3× diameter. Use cutting fluid to prevent galling.
- Tapping: Use spiral-point or spiral-flute taps; cutting speed 10–15 m/min; use water-soluble cutting oil. For M6 threads in 6 mm wall, pre-drill 5.0 mm hole.
- Welding: 6063-T5 is weldable using 4043 or 5356 filler wire (GMAW or GTAW). Preheat not required for sections under 12 mm. Post-weld aging (T5 temper) may be partially lost in the HAZ; consider mechanical fastening for critical load paths.
- Adhesive Bonding: Use structural acrylic or epoxy adhesives (e.g., 3M DP420 or Lord 406). Surface preparation: degrease with isopropyl alcohol, abrade with 80-grit abrasive pad, and clean again. Cure at 20°C for 24 hours or 60°C for 2 hours.
- Fastening: Standard T-nuts (M4, M5, M6, M8) and socket head cap screws. Torque values: M6 – 8 N·m, M8 – 18 N·m (lubricated threads). Use anti-seize compound on stainless steel fasteners to prevent galvanic corrosion.
- Anodizing: Clear or black anodizing per MIL-A-8625 Type II (0.0002–0.0007 inch thickness). Rack marks may be visible; specify if cosmetic appearance is critical.

4.0 Common Defects & Quality Control

- Reject if any visible cracks, tears, or seams are present on the surface or in the slot walls under 5× magnification.
- Reject if surface pits exceed 0.3 mm depth or 1.0 mm diameter in any 100 mm × 100 mm area.
- Reject if die lines (longitudinal striations) are deeper than 0.05 mm or visible to the naked eye after anodizing.
- Reject if slot width deviates more than ±0.15 mm from nominal; a T-nut must slide freely without binding.
- Reject if profile is out-of-square by more than 0.5 mm over 100 mm width (measured with a machinist square).
- Reject if twist exceeds 1.5° per 1.0 m length (measured on a surface plate with a height gauge).
- Reject if cut ends have burrs exceeding 0.2 mm height; all cut ends must be deburred with a chamfer tool or file.
- Reject if anodized coating thickness is below 0.0002 inch (5 µm) or exhibits bare spots, scratches, or color variation beyond acceptable sample.
- Reject if hardness is below 55 HB (Brinell) on any cross-section.
- Reject if chemical composition deviates from ASTM B221 limits for 6063 alloy (e.g., Mg < 0.45%, Si < 0.20%).

5.0 Storage, Handling & WHMIS Guidelines

- Store indoors in a dry, well-ventilated area. Relative humidity below 60% recommended to minimize surface oxidation.
- Temperature range: 10°C to 40°C. Avoid direct contact with concrete floors; use wooden dunnage or plastic pallets to prevent moisture wicking.
- Shelf life: Indefinite under proper storage conditions. No FIFO rotation required unless profiles are anodized or painted (coating may degrade after 2 years in uncontrolled environments).
- Handling: Use lifting straps or vacuum lifters for profiles over 3 m. Do not drag profiles across each other to avoid surface abrasion. Wear clean gloves to prevent oil transfer.
- WHMIS Classification: Not classified as a hazardous material under WHMIS 2015 (solid aluminum alloy). No SDS required for the solid state. However, machining operations generate aluminum dust and chips.

- Aluminum dust is combustible. Avoid accumulation of fine dust. Use local exhaust ventilation (LEV) during machining. Ground all equipment to prevent static discharge.
- PPE for machining: Safety glasses with side shields, hearing protection (if noise > 85 dBA), cut-resistant gloves (ANSI A2 or higher) when handling sharp edges. Use respirator (N95 or P100) if dust levels exceed OEL (OSHA PEL: 15 mg/m³ total dust, 5 mg/m³ respirable).
- First aid: For skin contact with sharp edges, clean wound and apply antiseptic. For eye contact with chips, flush with water for 15 minutes. Seek medical attention if irritation persists.
- Disposal: Aluminum scrap is non-hazardous and fully recyclable. Segregate from steel and other metals. Recycle through approved metal recyclers.

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