PTFE (Polytetrafluoroethylene) Sheet & Rod – Technical Material Specification

1.0 Material Overview & Common Uses

PTFE (Polytetrafluoroethylene), commonly known by the brand name Teflon, is a high-performance fluoropolymer with exceptional chemical resistance, low friction coefficient, and a wide operating temperature range. It is a semi-crystalline thermoplastic that does not melt into a free-flowing liquid but rather transitions into a gel-like state at high temperatures, making it suitable for compression molding, sintering, and skiving processes.

- Primary applications include chemical processing equipment (gaskets, seals, linings), electrical insulation (high-frequency components, wire wraps), non-stick surfaces (food processing, molds), mechanical bearings and bushings (low-load, high-speed), and laboratory apparatus (beakers, tubing).
- Commonly supplied in sheet (1/32" to 2" thickness) and rod (1/8" to 12" diameter) forms, with both virgin (unfilled) and filled grades (e.g., glass, carbon, bronze) available for enhanced wear resistance or dimensional stability.

2.0 Core Technical Properties & Sizing

- Density: 2.15 – 2.20 g/cm³ (virgin grade); filled grades may vary (e.g., 25% glass-filled: 2.25 g/cm³).
- Melting point: 327°C (621°F) – PTFE does not flow; it transitions to a high-viscosity gel. Continuous service temperature: -200°C to +260°C (-328°F to +500°F).
- Tensile strength: 20–35 MPa (virgin sheet/rod) per ASTM D4894. Elongation at break: 200–400%. Flexural modulus: 400–600 MPa.
- Coefficient of friction: 0.05–0.10 (static), among the lowest of any solid material. Water absorption: <0.01% (24-hour immersion).
- Standard sheet dimensions: 48" x 48", 48" x 96", 60" x 60" (tolerance: ±1/8" on length/width). Thickness tolerance: ±0.005" for <1/4", ±0.010" for 1/4" to 1/2", ±0.015" for >1/2". Rod diameter tolerance: ±0.002" for <1", ±0.005" for 1" to 3", ±0.010" for >3". Length tolerance: +1/4" / -0" on standard 4' or 6' lengths.
- Hardness: Shore D 50–65 (virgin); filled grades may reach Shore D 70–75. Dielectric strength: 500–1000 V/mil (0.125" thickness).

3.0 Processing, Machinability & Application

PTFE is considered easy to machine but requires sharp tooling and careful chip control due to its soft, gummy nature. It does not produce a continuous chip; instead, it forms a powdery or short, stringy swarf. Coolant is generally not required, but air blast or vacuum is recommended for chip evacuation. The material is not weldable by conventional fusion methods; joining is achieved via mechanical fastening, adhesive bonding (after surface etching), or heat staking.

- Turning: Use high-speed steel (HSS) or carbide tooling with a 0° to 5° rake angle. Spindle speed: 500–1500 SFM (surface feet per minute). Feed rate: 0.002–0.010 IPR (inches per revolution). Depth of cut: 0.010–0.100". Avoid dwell marks; use a sharp tool to prevent tearing.
- Milling: Use sharp, polished carbide end mills with a 30° helix. Climb milling preferred. Spindle speed: 800–2000 RPM. Feed rate: 0.003–0.015 IPT (inches per tooth). Depth of cut: 0.020–0.080". Use air blast to clear chips; do not use coolant as it may cause swelling.

- Drilling: Use a 118° or 135° split-point drill bit. Peck drilling (0.010–0.020" per peck) is recommended to clear chips. Spindle speed: 500–1500 RPM. Feed rate: 0.002–0.008 IPR. For deep holes (>3x diameter), use a slow helix drill and frequent retraction.
- Sawing: Use a fine-tooth bandsaw (10–14 TPI) or a carbide-tipped circular saw. Blade speed: 200–500 SFM. For thin sheets (<1/8"), use a shear or die cutting method to avoid edge fraying.
- Adhesive bonding: Only possible after surface etching (e.g., sodium naphthalene etch) to increase surface energy. Use cyanoacrylate, epoxy, or acrylic adhesives. Bond strength is typically 50–70% of the base material. Mechanical fastening (e.g., countersunk screws with washers) is preferred for load-bearing applications.
- Heat staking: For rod-to-sheet joints, heat the rod end to 300–320°C (572–608°F) and press into a pre-drilled hole. Allow to cool under pressure for 30 seconds. Joint strength is approximately 60% of parent material.

4.0 Common Defects & Quality Control

- Reject if surface exhibits visible cracks, crazing, or stress whitening under 5x magnification. PTFE is notch-sensitive; any surface defect deeper than 0.005" is cause for rejection.
- Reject if internal voids or porosity are detected via ultrasonic testing (ASTM E2375) exceeding 0.010" diameter in critical sealing areas. For non-critical areas, voids up to 0.020" are acceptable if less than 5% of cross-section.
- Reject if thickness variation exceeds ±0.010" for sheets under 1/4", ±0.015" for 1/4" to 1/2", and ±0.020" for thicker sheets. Rod out-of-roundness must be within 0.005" TIR (total indicator reading).
- Reject if color is non-uniform (virgin PTFE is translucent white; filled grades should be consistent). Yellowing or dark spots indicate thermal degradation or contamination.
- Reject if surface has embedded foreign particles, scratches deeper than 0.003", or die lines (for extruded rod) that exceed 0.002" depth. For skived sheet, reject if there are visible knife marks or chatter patterns.
- Warpage limit: For sheets, maximum bow or twist is 0.010" per linear foot. For rods, maximum straightness deviation is 0.005" per foot.

5.0 Storage, Handling & WHMIS Guidelines

- Store in a clean, dry environment at 15–30°C (59–86°F) and relative humidity below 60%. PTFE is non-hygroscopic, but moisture can cause surface staining or dimensional changes in filled grades. Shelf life is indefinite under proper conditions; however, FIFO (first-in, first-out) rotation is recommended for filled grades to avoid filler settling.
- Avoid prolonged exposure to direct sunlight or UV sources; UV degradation can cause surface discoloration and embrittlement over time. Store away from ozone-generating equipment (e.g., motors, welders).
- WHMIS Classification: PTFE is not classified as a hazardous material under WHMIS 2015 (GHS). However, machining dust and fumes from thermal decomposition (above 300°C) may be harmful. SDS (Safety Data Sheet) must be available on-site per WHMIS regulations.
- Mandatory PPE during machining: Safety glasses with side shields, cut-resistant gloves (e.g., Kevlar or nitrile-coated), and hearing protection if noise exceeds 85 dBA. For operations generating airborne dust, use a NIOSH-approved N95 respirator. Avoid skin contact with machining swarf; wash with soap and water if contact occurs.
- Fire safety: PTFE is non-flammable but will decompose at temperatures above 400°C (752°F), releasing toxic fumes (including carbonyl fluoride and hydrogen fluoride). In case of fire, use water fog, dry chemical, or CO2 extinguishers. Evacuate area and ventilate. Do not use on electrical equipment unless extinguisher is rated for Class C fires.
- Disposal: PTFE is not biodegradable. Recycle through specialized plastic recyclers if possible. Do not incinerate without proper scrubbers. Dispose of in accordance with local, provincial, and federal regulations (e.g., Ontario Regulation 347, BC Hazardous Waste Regulation).

Regulatory Disclaimer: This document is a generic technical material specification provided for educational purposes. The end-user assumes all liability for reviewing, adapting, and validating all tolerances, properties, and safety protocols against specific OEM data sheets and local regulations before deployment.