
2% Thoriated Tungsten TIG Electrodes (Red) – Technical Material Specification

1.0 Material Overview & Common Uses

2% thoriated tungsten electrodes (red band) are a non-consumable tungsten alloy containing 1.7–2.2% thorium dioxide (ThO_2) by weight, with the balance being pure tungsten. The thorium addition enhances electron emission, arc stability, and current-carrying capacity, making these electrodes ideal for DC welding of carbon steel, stainless steel, nickel alloys, titanium, and copper alloys. They are widely used in manual and automated TIG (GTAW) welding applications requiring high arc initiation reliability and long electrode life.

Common industrial applications include pressure vessel fabrication, pipe welding, aerospace component assembly, and structural steel work. The red colour code distinguishes them from pure tungsten (green), 1% thoriated (yellow), 2% ceriated (grey), and 1.5% lanthanated (gold) electrodes.

2.0 Core Technical Properties & Sizing

- Thorium dioxide content: 1.7% – 2.2% by weight (per AWS A5.12 / ASME SFA-5.12).
- Tungsten balance: 97.8% – 98.3% by weight.
- Density: 19.3 g/cm³ (nominal, at 20°C).
- Melting point: 3422°C (6192°F).
- Electrical conductivity: ~30% IACS (International Annealed Copper Standard).
- Thermal conductivity: 173 W/m·K at 20°C.
- Standard diameters: 1/16 in (1.6 mm), 3/32 in (2.4 mm), 1/8 in (3.2 mm), 5/32 in (4.0 mm), 3/16 in (4.8 mm).
- Standard lengths: 7 in (175 mm) and 12 in (300 mm).
- Diameter tolerance: ± 0.002 in (± 0.05 mm) for diameters up to 1/8 in; ± 0.003 in (± 0.08 mm) for larger diameters.
- Straightness tolerance: Maximum bow of 0.010 in per 12 in length (0.25 mm per 300 mm).
- Surface finish: Smooth, free of cracks, pits, and foreign inclusions. Surface roughness $R_a \leq 1.6$ μm .
- Hardness: 250–350 HV (Vickers) depending on processing history.

3.0 Processing, Machinability & Application

2% thoriated tungsten electrodes are ground to a point or truncated cone shape using a dedicated tungsten grinder or a fine-grit diamond wheel (120–200 grit). Grinding must be performed longitudinally (parallel to the electrode axis) to avoid transverse scratches that can cause arc wandering. Use a grinding angle of 20–30° for DC welding of steel and stainless steel; a blunter angle (30–45°) is used for AC welding of aluminium. The tip should be flat (truncated) to a diameter of 0.010–0.030 in (0.25–0.76 mm) for optimal arc stability.

- Grinding wheel: Diamond or silicon carbide, 120–200 grit, dedicated to tungsten only to avoid contamination.
- Grinding speed: 6,000–10,000 surface feet per minute (SFPM).
- Feed rate: Light passes, no more than 0.001 in (0.025 mm) per pass to prevent thermal cracking.

- Coolant: Use water or water-soluble coolant to prevent overheating and micro-cracking.
- Welding current range (DCEN, 1/8 in diameter): 250–400 A.
- Gas nozzle size: #6 to #8 for most applications; use larger nozzles for high-current welding.
- Shielding gas: 100% argon or argon/helium mixes; flow rate 15–25 CFH (cubic feet per hour).
- Pre-grind cleaning: Wipe electrode with acetone or isopropyl alcohol to remove oils and contaminants.
- Do not use for AC welding of aluminium unless specifically required; ceriated or lanthanated electrodes are preferred for AC.

4.0 Common Defects & Quality Control

- Reject if thorium dioxide content is outside 1.7–2.2% by weight (verify via XRF or chemical analysis per ASTM E539).
- Reject if diameter is out of tolerance: ± 0.002 in for $\leq 1/8$ in, ± 0.003 in for $> 1/8$ in.
- Reject if straightness exceeds 0.010 in bow per 12 in length.
- Reject if surface has visible cracks, pits deeper than 0.001 in (0.025 mm), or inclusions under 10x magnification.
- Reject if colour band is missing, smudged, or incorrect (must be red).
- Reject if electrode is bent or kinked; do not attempt to straighten.
- Reject if packaging is damaged or moisture barrier broken (electrodes are hygroscopic).
- Acceptable surface finish: $R_a \leq 1.6 \mu\text{m}$; reject if rougher.
- Sampling plan: Per ANSI/ASQ Z1.4, Level II, AQL 1.0 for dimensional and visual defects.

5.0 Storage, Handling & WHMIS Guidelines

- Store in original sealed packaging in a dry, climate-controlled environment at 15–25°C and <50% relative humidity.
- Shelf life: 5 years from date of manufacture when stored properly.
- FIFO (First-In, First-Out) protocol: Rotate stock by manufacturing date; use oldest stock first.
- Do not store near acids, oxidizers, or moisture sources.
- WHMIS 2015 classification: Not classified as a hazardous product under GHS for solid form. Grinding dust is hazardous.
- WHMIS hazard statement (grinding dust): H302 (Harmful if swallowed), H332 (Harmful if inhaled), H315 (Causes skin irritation), H319 (Causes serious eye irritation), H335 (May cause respiratory irritation), H360 (May damage fertility or the unborn child – thorium is radioactive).
- PPE during grinding: N95 or P100 respirator, safety glasses with side shields, leather gloves, and long sleeves. Use local exhaust ventilation (LEV) to capture dust.
- PPE during handling: Cut-resistant gloves (ANSI A2 or higher) and safety glasses.
- Radioactive content: Thorium is a low-level alpha emitter. Do not ingest or inhale dust. Wash hands after handling. Dispose of grinding dust as low-level radioactive waste per provincial regulations.
- First aid (dust exposure): Eye contact – flush with water for 15 minutes. Skin contact – wash with soap and water. Inhalation – move to fresh air. Ingestion – do not induce vomiting; seek medical attention.
- Spill procedure: Sweep or vacuum dust (HEPA vacuum) – do not use compressed air. Place in sealed container labelled for radioactive waste.

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