

Tri Mix Shielding Gas (Helium/Argon/CO2) Technical Material Specification

1.0 Material Overview & Common Uses

Tri Mix shielding gas is a ternary blend of helium (He), argon (Ar), and carbon dioxide (CO₂), typically formulated in ratios such as 90% He / 7.5% Ar / 2.5% CO₂ or 65% Ar / 26.5% He / 8.5% CO₂. It is a non-flammable, compressed gas mixture used exclusively as a shielding atmosphere in gas metal arc welding (GMAW) and gas tungsten arc welding (GTAW) processes.

Primary industrial applications include welding of carbon steel, stainless steel, and aluminum alloys in automotive fabrication, structural steel erection, pressure vessel manufacturing, and heavy equipment repair. The helium component increases arc temperature and heat input, improving weld pool fluidity and travel speeds, while argon provides stable arc characteristics and CO₂ enhances penetration and reduces surface tension.

2.0 Core Technical Properties & Sizing

- Typical composition (common blend): 90% Helium $\pm 1\%$, 7.5% Argon $\pm 1\%$, 2.5% Carbon Dioxide $\pm 0.5\%$ by volume.
- Density at 15°C and 101.325 kPa: approximately 0.166 kg/m³ (varies with exact blend; lighter than air due to high helium content).
- Boiling point of components: Helium -268.9°C, Argon -185.8°C, CO₂ -78.5°C (sublimes). Mixture remains gaseous at all ambient temperatures.
- Standard cylinder sizes: 20 ft³ (0.57 m³), 40 ft³ (1.13 m³), 80 ft³ (2.27 m³), 125 ft³ (3.54 m³), and 150 ft³ (4.25 m³) water capacity, filled to 2000–2600 psi (13.8–17.9 MPa) at 21°C.
- Cylinder valve outlet: CGA 580 (standard for inert gas mixtures) or CGA 590 (for high-pressure blends).
- Purity specification: Total impurities < 50 ppm (water < 5 ppm, oxygen < 10 ppm, hydrocarbons < 5 ppm).
- Maximum allowable composition tolerance per batch: $\pm 0.5\%$ absolute for each component as per ISO 6142 or equivalent.

3.0 Processing, Machinability & Application

Tri Mix gas is applied through a welding torch with a gas diffuser and nozzle. Flow rate must be precisely regulated using a two-stage gas regulator with a flowmeter calibrated for the specific blend. Typical flow rates range from 15 to 35 CFH (cubic feet per hour) depending on joint geometry, material thickness, and welding position.

- For GMAW of carbon steel (1/8 to 1/2 inch thickness): set flow rate 20–25 CFH, voltage 24–28 V, wire feed speed 250–400 ipm using 0.035-inch ER70S-6 wire.
- For GMAW of stainless steel (304/316): use flow rate 25–30 CFH, voltage 22–26 V, wire feed speed 200–350 ipm with 0.035-inch ER308L wire.
- For GTAW of aluminum (1/8 inch): use flow rate 15–20 CFH, AC balance 70% EN, 150–200 A with 2% thoriated tungsten electrode.
- Pre-purge time: 0.5–1 second before arc initiation; post-flow time: 2–3 seconds per 1/16 inch of electrode diameter to prevent oxidation.
- Do not use with flux-cored wires (FCAW) unless specifically formulated for gas-shielded flux-cored; consult wire manufacturer.

- Regulator must be rated for maximum cylinder pressure (3000 psi) and have a CGA 580 or 590 inlet connection.

4.0 Common Defects & Quality Control

- Reject cylinder if gas composition analysis (performed via gas chromatography) shows any component outside $\pm 0.5\%$ absolute of specified blend.
- Reject if moisture content exceeds 5 ppm by volume; moisture causes hydrogen cracking and porosity in welds.
- Reject if oxygen content exceeds 10 ppm; oxygen causes excessive spatter and oxidation of weld bead.
- Reject if hydrocarbon content exceeds 5 ppm; hydrocarbons cause soot and porosity.
- Reject cylinder if valve is damaged, leaking, or missing safety cap; perform leak test with soap solution at valve stem and threads.
- Reject if cylinder hydrostatic test date is older than 5 years (per Transport Canada TDG regulations) or if cylinder shows visible corrosion, dents, or bulges.
- Acceptable weld quality criteria: no visible porosity, spatter index $< 2\%$ of weld area, penetration depth within ± 0.5 mm of specification.

5.0 Storage, Handling & WHMIS Guidelines

- Store cylinders upright in a well-ventilated, dry area away from heat sources, open flames, and temperatures exceeding 52°C (125°F).
- Secure cylinders with chains or straps to prevent tipping; store away from combustible materials and oxidizers.
- WHMIS 2015 classification: Gases under pressure (compressed gas) – Class 2.2 (non-flammable, non-toxic). CO₂ component may cause asphyxiation in confined spaces.
- Hazard statements: H280 – Contains gas under pressure; may explode if heated. H281 – May cause frostbite upon rapid expansion. H302 – Harmful if inhaled in high concentrations (asphyxiant).
- Precautionary statements: P202 – Do not handle until all safety precautions have been read and understood. P271 – Use only outdoors or in a well-ventilated area. P403 – Store in a well-ventilated place.
- Mandatory PPE: Safety glasses with side shields, leather welding gloves, flame-resistant clothing, and steel-toed boots. Use a supplied-air respirator if welding in confined spaces.
- First aid: If inhaled, move to fresh air and administer oxygen if breathing is difficult. If frostbite occurs from liquid gas contact, immerse affected area in lukewarm water (not hot) and seek medical attention.
- FIFO protocol: Use oldest cylinders first based on fill date; do not store for more than 12 months without retesting composition.
- Transport Canada TDG: Proper shipping name 'Compressed gas, n.o.s. (Helium, Argon, Carbon Dioxide)', UN1956, Class 2.2, PG III.

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