



1. Identification

Product Identifier

Carbon Nanotube FDM 3D Printing Filament — PCTG copolyester with 0.2% multi-walled carbon nanotubes (MWCNT, CAS#: 308068-56-6)

Note: The closest CAS number for the carbon-nanotube component of this formulation is CAS#: 308068-56-6, but our carbon nanotubes are different, primarily in their length, in ways that make them more suitable for certain applications and potentially safer to work with since they are too long to be inhaled. The PCTG carrier is a PET-based, glycol-modified copolyester; as a polymer mixture, the finished filament does not carry a single CAS number.

Manufacturer

Company: Industrial CNT LLC (maker of Troll Hair)

Description: Industrial CNT LLC (Troll Hair) manufactures carbon nanotubes and carbon-nanotube-enhanced materials in the United States and ships anywhere in the United States and internationally.

Main Contact: Lee Nolan

Phone: (917) 601-9449

Email: lee@trollhair.com

Recommended Use

Fused deposition modeling (FDM / FFF) 3D printing; research and development of carbon-nanotube-enhanced printed parts.

Emergency Contact

Contact: Dr. Bradley Edwards

Phone number: (206) 661-5008

2. Hazard(s) identification

OSHA Hazards: Not classified as hazardous under 29 CFR 1910.1200 (HazCom 2012).

GHS Classification

Not classified. The finished filament does not meet GHS classification criteria for any hazard class: The carbon nanotubes (0.2% by weight) are bound within the solid polymer matrix and are present far below every GHS mixture-classification cut-off, and PCTG copolyester itself is not a classified substance.

Label elements: None required.

Signal Word: None.

Hazard Statements: None required.

Precautionary Statements

- Danger of thermal burns on contact with molten polymer (printing temperatures 240–270 °C).
- Vapors generated during printing at high temperatures may irritate the eyes and respiratory tract. Print in a well-ventilated area.
- Machining, sanding, grinding, or cutting printed parts generates polymer dust that may contain embedded carbon nanotubes — avoid breathing dust; use ventilation and respiratory protection during post-processing.
- Hazardous vapors in case of burning.

HMIS Classification

- Health hazard: 1
- Flammability: 1
- Physical hazards: 0

NFPA Rating

- Health hazard: 1
- Fire: 1
- Reactivity Hazard: 0

Potential Health Effects

- Inhalation: The solid filament presents no inhalation hazard in normal use. Vapors and ultrafine particles emitted during printing may cause respiratory irritation at high temperatures or in poorly ventilated spaces. Dust from machining or sanding printed parts may be harmful if inhaled and should be treated as containing carbon nanotubes.
- Skin: Molten polymer causes thermal burns. The solid filament is not expected to cause skin irritation.
- Eyes: Splashes of molten polymer cause burns. Vapors from overheated material may cause irritation. Dust from post-processing may cause mechanical irritation.

- Ingestion: Not an expected route of exposure. May be harmful if swallowed.

3. Composition/Information On Ingredients

Component	CAS #	% By Weight
PCTG copolyester (PET-based, glycol-modified poly(cyclohexylenedimethylene terephthalate))	Not assigned (polymer mixture)	> 99%
Multi-walled carbon nanotubes (graphitic carbon), > 1 mm length	308068-56-6 (closest match — see Section 1 note)	0.2% (nominal)
Polymer stabilizers and processing additives	Proprietary	< 1%

Note: The carbon nanotubes are dispersed in, and immobilized by, the solid polymer matrix. They are not released as free nanotubes during normal handling or printing. Minor stabilizers and processing additives are likewise immobilized by the polymer and are not released with normal use. No component is present above GHS classification cut-offs.

4. First-aid measures

After skin contact (molten polymer): Cool the affected skin rapidly with plenty of cold water. Do NOT attempt to peel solidified polymer from the skin. Cover with a sterile dressing and obtain medical attention.

After skin contact (solid filament): No first aid normally required. Wash with soap and water if irritation occurs.

After inhalation (printing fumes or post-processing dust): Remove to fresh air and keep comfortable for breathing. If symptoms such as coughing or irritation persist, seek medical advice.

After eye contact: In case of contact with molten polymer, do not attempt to remove solidified material; cover the eye with a sterile dressing and contact an ophthalmologist immediately. For dust or vapor irritation, rinse the opened eye for several minutes under running water; if irritation persists, consult a doctor.

After swallowing: Not an expected route of exposure. Rinse mouth with water and drink water. Do not induce vomiting. Seek medical advice if symptoms occur.

Most important symptoms/effects, acute and delayed

- Skin contact: Contact with molten polymer causes severe thermal burns.
- Eye exposure: Vapors generated during printing may cause irritation, redness, and tearing; molten splashes cause burns.
- Inhalation: Vapors at printing temperatures, or dust from machining printed parts, may cause respiratory tract irritation and coughing.
- Ingestion: May cause gastrointestinal discomfort.

Note: The health effects of carbon nanotubes are not fully studied or understood. In this product the nanotubes are bound in a solid polymer matrix, which substantially reduces the potential for exposure compared to loose powder; precautions should nonetheless be taken to prevent inhalation of processing fumes and post-processing dust.

Indication of immediate medical attention and special treatment needed: Treat molten-polymer burns as thermal burns. Otherwise, no data available.

5. Fire-fighting measures

Suitable extinguishing media: Water spray, alcohol-resistant foam, dry chemical, or carbon dioxide.

Unsuitable extinguishing media: High-pressure water jet (risk of spreading burning material).

Specific hazards arising from the chemical: Hazardous decomposition products formed under fire conditions. Molten polymer flows and can cause severe burns.

Hazardous combustion products: Carbon oxides (CO and CO₂), acetaldehyde and other aldehydes, and dense smoke. Soot and combustion residue may contain carbon nanotubes and should be handled with the same precautions as nanotube-containing dust.

Special protective equipment: Wear self-contained breathing apparatus and protective clothing for firefighting if necessary.

Further information: The product is not self-igniting and is not classified as flammable; it will burn in a sustained fire (auto-ignition of the copolyester ≈ 454 °C, ASTM E659).

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures: The product is a solid spooled filament — accidental release is essentially a mechanical spill. Loose filament

and fragments are a slipping hazard. If material has been shredded or ground, avoid dust formation, ensure adequate ventilation, and avoid breathing dust.

Environmental precautions: Do not let product enter drains, surface water, or soil. The polymer and the carbon nanotubes it contains are persistent in the environment.

Methods and materials for containment and cleaning up: Collect mechanically (pick up, sweep up) and place in a suitable container for reuse or disposal. Avoid creating dust when handling fragments or shavings.

7. Handling and storage

Precautions for safe handling:

- Avoid contact with molten polymer — the hot end, nozzle, and freshly extruded material reach 240–270 °C.
- Print in a well-ventilated area. Avoid breathing vapors generated during printing; do not lean over the printer for extended periods while it runs. For enclosed print farms or continuous operation, provide local exhaust ventilation or filtered enclosures.
- Avoid generating dust when post-processing printed parts (sanding, grinding, drilling, cutting). Where dust is generated, use local exhaust ventilation and respiratory protection (see Section 8).
- Rubbing and friction can build electrostatic charge on the filament; avoid electrostatic discharge near flammable materials.
- Do not exceed recommended processing temperatures; thermal decomposition accelerates above the recommended printing range.
- No eating or drinking while working. Wash hands after handling and before breaks.

Conditions for safe storage, including any incompatibilities

Store cool and dry, protected from moisture, direct sunlight, and UV radiation. Keep the packaging (and desiccant, where supplied) closed when not in use. Keep away from sources of ignition and from incompatible materials (see Section 10).

Exposure Controls & Individual Protection (PPE)

Occupational exposure limit values

No occupational exposure limits have been established for the finished filament. Relevant reference values for operations that may generate dust or fumes:

- Carbon nanotubes and nanofibers: NIOSH recommended exposure limit (REL) of 1 µg/m³ elemental carbon (respirable fraction, 8-hour TWA). This applies to any operation that liberates nanotube-containing dust (e.g., machining or sanding printed parts). In this product the nanotubes are matrix-bound: published release studies of

CNT-polymer composites find that machining releases predominantly polymer particles with embedded or protruding nanotubes rather than free nanotubes, and that exposures from bound material are far lower than from powder handling. Treat post-processing dust conservatively regardless.

- Particulates not otherwise regulated (nuisance dust): OSHA PEL 15 mg/m³ total / 5 mg/m³ respirable (8-hour TWA).

Appropriate engineering controls

Ventilate printing areas (general dilution ventilation for occasional desktop use; local exhaust ventilation or filtered enclosures for enclosed spaces, print farms, or continuous operation). Provide local exhaust ventilation at any workstation where printed parts are machined, sanded, ground, or cut.

Individual protection measures (Personal protective equipment - PPE)

Respiratory protection: Not required for normal handling of the solid filament or for occasional printing in a ventilated space. For post-processing operations that generate dust (sanding, grinding, machining printed parts), or sustained printing in poorly ventilated spaces, use a NIOSH-approved particulate respirator (N95 minimum; P100 recommended where dust generation is significant, consistent with the conservative handling guidance for carbon-nanotube-containing materials). Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Hand protection: Heat-resistant gloves (e.g., conforming to EN 407) when working near the hot end, nozzle, heated bed, or freshly extruded material. Protective gloves are not otherwise required for handling the solid filament; for prolonged handling of post-processing dust, use gloves and wash hands afterwards.

Eye protection: Safety glasses with side-shields conforming to EN 166 (or equivalent NIOSH/ANSI standard) during printing, maintenance near the hot end, and all post-processing operations.

Skin and body protection: Normal work clothing. Long sleeves recommended when working near hot printer components.

Hygiene measures: Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of the workday. Clean dust deposits with a HEPA vacuum or wet methods — do not dry-sweep or use compressed air.

9. Physical and chemical properties

Appearance

- **Form:** Solid filament, 1.75 mm diameter, wound on 1 kg spools.

- **Color:** Black (carbon nanotube filled).

Odor: Odorless. Slight characteristic odor may be noticeable during printing.

Odor threshold: Not applicable.

pH: Not applicable (insoluble solid).

Melting point/freezing point: Not applicable — amorphous copolyester; glass transition temperature 80–85 °C (ASTM D3418); Vicat softening temperature $\approx$ 79 °C (ISO 306/A50).

Processing (printing) temperature range: 240–270 °C nozzle; 70–100 °C bed.

Initial boiling point and boiling range: Not applicable.

Flash point: Not applicable (solid).

Evaporation rate: Not applicable (solid).

Flammability (solid, gas): Not self-igniting; not classified as flammable. Burns in a sustained fire.

Upper/lower flammability or explosive limits: Not applicable.

Vapor pressure: Not applicable at normal conditions.

Vapor density: Not applicable.

Relative density: $\approx$ 1.27 g/cm³ at 25 °C (ASTM D792, for the PCTG copolyester; the 0.2% nanotube loading does not measurably change bulk density).

Solubility: Insoluble in water. Attacked by certain organic solvents and strong acids/bases (see Section 10).

Partition coefficient (n-octanol/water): Not applicable.

Auto-ignition temperature: $\approx$ 454 °C (ASTM E659, copolyester).

Decomposition temperature: Thermal decomposition onset above approximately 250 °C with prolonged residence; decomposition accelerates well above the recommended processing range. The carbon-nanotube component begins to oxidize in air above approximately 450 °C.

Viscosity: Not applicable (solid).

Explosive properties: Not explosive.

Oxidizing properties: None.

Specific properties

- Carbon nanotube content: 0.2% by weight, multi-walled, length > 1 mm, diameter 50–120 nm, fully dispersed in the polymer matrix.
- Glass transition temperature: 80–85 °C. Heat deflection temperature: 71 °C @ 0.45 MPa; 61 °C @ 1.80 MPa (ISO 75-1/-2).

10. Stability and reactivity

Reactivity: Generally unreactive under normal conditions. The polyester matrix is resistant to most aqueous media but is attacked by certain solvents and strong acids/bases.

Chemical stability: Stable under recommended storage and handling conditions.

Possibility of hazardous reactions: None known. No hazardous polymerization.

Conditions to avoid: Prolonged exposure to temperatures above the recommended processing range; open flames and ignition sources; extended UV exposure and moisture during storage; accumulation of electrostatic charge near flammables.

Incompatible materials: Strong oxidizing agents, strong acids, and strong bases (will degrade the polyester). The polyester is also attacked or dissolved by: acetic anhydride, acetone, aniline, benzene, chloroform, chromic acid, cyclohexanone, dimethylformamide, dioxane, ethyl acetate, phenol, and tetrahydrofuran.

Hazardous decomposition products: On overheating or burning: carbon monoxide, carbon dioxide, acetaldehyde and other aldehydes, and dense smoke. Combustion residue and soot may contain carbon nanotubes.

Note: The reactivity and decomposition properties of carbon-nanotube-filled polymers have not been exhaustively investigated. This information represents the best available knowledge at the time of preparation and should be treated with appropriate caution.

11. Toxicological information

Acute toxicity

- Oral LD50: No data available for the finished filament. Based on the components, classification criteria are not met.
- Inhalation LC50: No data available.
- Dermal LD50: No data available.

Skin corrosion/irritation: Based on available data, classification criteria are not met. Contact with the molten product causes thermal burns.

Serious eye damage/eye irritation: Based on available data, classification criteria are not met. Vapors generated at printing temperatures may cause transient irritation.

Respiratory or skin sensitization: Based on available data, classification criteria are not met.

Germ cell mutagenicity: No data available.

Carcinogenicity: Not classified. Carbon nanotubes other than MWCNT-7 (Mitsui-7) are classified by IARC as Group 3 (not classifiable as to carcinogenicity to humans); in this product the nanotubes are additionally bound within the polymer matrix at 0.2% by weight. PCTG copolyester is not listed as a carcinogen by IARC, NTP, or OSHA.

Reproductive toxicity: No data available.

Specific target organ toxicity - single exposure (STOT-SE): Classification criteria are not met. Printing fumes may cause transient respiratory irritation at high temperatures.

Specific target organ toxicity - repeated exposure (STOT-RE): No data available.

Aspiration hazard: Not applicable (solid).

Additional Information: The toxicological properties of carbon nanotubes have not been thoroughly investigated; however, exposure to nanotubes from this product is not expected during normal use because they are immobilized in the solid polymer. The principal foreseeable exposures are to thermal-processing emissions (vapors and ultrafine particles common to FDM printing of any thermoplastic) and to dust generated by machining printed parts. Control both with ventilation and the PPE described in Section 8.

12. Ecological information

Ecotoxicity: The product is not classified as hazardous to the environment. No specific data available for the finished filament.

Persistence and degradability: The copolyester is not readily biodegradable, and carbon nanotubes are expected to be persistent in the environment.

Bioaccumulative potential: No bioaccumulative potential expected for the solid polymer; no specific data for the bound nanotube fraction.

Mobility in soil: Low mobility expected (insoluble solid).

Other adverse effects: As with any plastic, uncontrolled release contributes to persistent plastic pollution. Prevent release to the environment; collect and dispose of scrap, failed prints, and shavings properly.

13. Disposal considerations

Waste disposal recommendations: Minimize waste generation and check possibilities for mechanical recycling of clean scrap first. Dispose of contents/container in accordance with local/regional/national/international regulations — typically acceptable for disposal as non-hazardous industrial/domestic solid waste or authorized incineration where local rules allow. Consult an environmental professional for assistance with appropriate disposal methods.

Special precautions: Do not dump into sewers, onto the ground, or into any body of water. Do not burn in open air. Quantities remaining after R&D activities are complete may only be disposed of as waste in accordance with applicable regulations, or used for the limited purposes permitted by 40 CFR 720.36(e).

Contaminated packaging: Spools and packaging may be recycled or disposed of at an approved waste-handling site.

14. Transport information

DOT (US): Not dangerous goods

IMDG: Not dangerous goods

IATA: Not dangerous goods

15. Regulatory information

OSHA Hazards: Not classified as hazardous under 29 CFR 1910.1200.

TSCA: The multi-walled carbon-nanotube component of this product is supplied under the research and development exemption at TSCA § 5(h)(3) and 40 CFR 720.36, and this product is limited to research and development use by the accompanying R&D-Only Material Supply and Use Agreement. The PCTG copolyester carrier is a conventional commercial polymer.

SARA 302 Components: No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components: This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

SARA 311/312 Hazards: Not classified.

Massachusetts Right To Know Components: No components are subject to the Massachusetts Right to Know Act.

Proposition 65 (California): This product does not contain any chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm. PCTG is manufactured without bisphenols or phthalate plasticizers.

PFAS: Does not contain PFAS (per- and polyfluoroalkyl substances).

16. Other information

Disclaimer: All information herein is accurate to the best of our knowledge at the time of publication. Industrial CNT provides the information contained herein in good faith and makes no representation as to its comprehensiveness, accuracy, or completeness. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. Industrial CNT makes no representations or warranties, either express or implied, regarding the suitability of the material for any purpose or the accuracy of the information contained within this document. Accordingly, Industrial CNT will not be responsible for damages resulting from use of or reliance upon this information.