

Material Safety Data Sheet

acc. to OSHA and ANSI

1 - Identification of substance:

Chemical Name: Carbon Nanotubes

Formula: Carbon

Chemical Family: Carbon Nanotubes

Synonyms: Single Walled, Double Walled, Thin Walled, Multi Walled Carbon Nanotubes, CNTs, SWNTs, DWNTs, TWNTs, MWNTs

CAS Number:

- **Manufacturer/Supplier:**

Cheap Tubes Inc.

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All Materials Sold by Cheap Tubes Inc are for Research & Development Only.

2 - Composition/Data on components:

- **Chemical characterization:**

Description: (CAS#)

<u>Component</u>	<u>%</u>	<u>OSHA/PEL</u>	<u>ACGIH/TLV</u>
Synthetic graphite	Up to 100%	15 mg/m ³ (total dust) 5 mg/m ³ (respirable fraction)	2 mg/m ³ TWA
Metallic impurity	Balance		

*Exposure limits based on synthetic graphite

3 - Hazards identification

Potential Health Effects

Eye Contact: May cause eye irritation

Skin Contact: At this time, it is not fully known whether skin penetration of nanoparticles would result in adverse effects in animal models. However, topical application of raw SWCNT to nude mice has been shown to cause dermal irritation [Murray et al. 2007]. Studies conducted in vitro using primary or cultured human skin cells have shown that both SWCNT and multi-walled carbon nanotubes (MWCNT) can enter cells and cause release of pro-inflammatory cytokines, oxidative stress, and decreased viability [Monteiro-Riviere et al. 2005; Shvedova et al. 2003]. It remains unclear, however, how these findings may be extrapolated to a potential occupational risk, given that additional data are not yet available for comparing the cell model studies with actual conditions of occupational exposure. Research on the dermal exposure of nanomaterials is ongoing (www.unileipzig.de/~nanoderm/). Ingestion can occur from

Inhalation: Inhalation is the most common route of exposure to airborne particles in the workplace. Inhalation may lead to the formation of lung Granulomas or possibly Mesothelioma. Use NIOSH Approved respirators (N100 or P100) with a full face shield to prevent Inhalation.

Ingestion: No known hazards, but may irritate gastrointestinal tract
Acute and Chronic High concentration of dusts may be irritating to eyes, skin, Health Effects: mucus membranes and respiratory tract. Ingestion can occur from Unintentional hand to mouth transfer of materials; this has been found to happen with Traditional materials, and it is scientifically reasonable to assume that it also could happen During handling of nanomaterials. Ingestion may also accompany inhalation exposure because particles that are cleared from the respiratory tract via the mucociliary escalator may be swallowed [ICRP 1994]. Little is known about possible adverse effects from the ingestion of nanomaterials.

- **Information pertaining to particular dangers for man and environment**
R 36/37 Irritating to eyes and respiratory system.

4 - First aid measures

- **After inhalation**
Remove to fresh air. If required, provide artificial respiration. Keep patient warm. Seek immediate medical advice.
- **After skin contact**
Immediately wash with water and soap and rinse thoroughly. Seek immediate medical advice.
- **After eye contact**
Rinse opened eye for several minutes under running water. Then consult a doctor.
- **After swallowing** Seek immediate medical advice.

5 - Fire fighting measures

Flash Point: Not applicable.

Explosion Limits: Unknown

Extinguisher Medium: Water, Carbon Dioxide, Dry Chemical, or Foam

Special Procedures: None

Decomposition Products: Carbon Monoxide, Carbon Dioxide

Unusual Hazards: Thermal decomposition or combustion may produce dense smoke.

- **Suitable extinguishing agents**
CO₂, extinguishing powder or water spray. Fight larger fires with water spray.
- **Special hazards caused by the material, its products of combustion or resulting gases:**
In case of fire, the following can be released:
Carbon monoxide (CO)
- **Protective equipment:**
Wear self-contained respirator.
Wear fully protective impervious suit.

6 - Accidental release measures

- **Person-related safety precautions:**
Wear protective equipment. Keep unprotected persons away.
Ensure adequate ventilation
- **Measures for environmental protection:**
Do not allow material to be released to the environment.
- **Measures for cleaning/collecting:** Ensure adequate ventilation.
- **Additional information:**
See Section 7 for information on safe handling
See Section 8 for information on personal protection equipment.
See Section 13 for disposal information.

7 - Handling and storage

- **Handling:** Use PERSONAL PROTECTIVE EQUIPMENT and exposure controls given in Section 8.
Detailed information on handling carbon nanotubes may be found at the ASTM Standard E 2535 - 07, Standard Guide for Handling Unbound Engineered Nanoscale Particles in Occupational Settings,” ASTM International, West Conshohocken, PA, www.astm.org.
- **Storage:** Keep in closed container for storage
- **Information for safe handling:**
Keep container tightly sealed.

Store in cool, dry place in tightly closed containers.
Ensure good ventilation at the workplace.

- **Information about protection against explosions and fires:**
No Special Requirements
- **Requirements to be met by storerooms and receptacles:**
No special requirements.
- **Information about storage in one common storage facility:**
Store away from oxidizing agents.
Store away from halogens.
Do not store together with acids.
- **Further information about storage conditions:**
Keep container tightly sealed.
Store in cool, dry conditions in well sealed containers.

8 - Exposure controls and personal protection

- **Additional information about design of technical systems:**
Properly operating chemical fume hood designed for hazardous chemicals and having an average face velocity of at least 100 feet per minute.

Components with limit values that require monitoring at the workplace:

Graphite	mg/m ³
ACGIH TLV	2
Belgium TWA	2.5
Finland TWA	5
France VME	2
Germany MAK	6
Ireland TWA	5
Korea TLV	2
Netherlands MAC-TGG	2
Poland TWA	2
Sweden NGV	5 (dust)
Switzerland MAK-W	2.5
United Kingdom	5-LTEL
USA PEL	15 mppcf

- **Additional information:** No data
- **Personal protective equipment**
 1. Eye Protection: ANSI 787 rated safety glasses with side-shields
 2. Respiratory Protection: NIOSH N-100 or P-100 rated particulate respirator with full face mask.
 3. Skin Protection: Nitrile gloves (see below) or equivalent and protective clothing to prevent skin contact, such as cotton fiber lab coat or uniform or Tyvek coveralls.

Glove specifications for nanomaterials:

- For any handling steps where the nanomaterial is in particulate form (e.g., powders, crystals, granules, etc.), or in a suspension with pure water and insoluble in water, gloves must be comprised of material that successfully passes ASTM F-1671. (Note: EPA may consider ASTM F-1671 testing to be adequate for some dilute aqueous suspensions on a case-by-case basis.)
- For any handling steps where the nanomaterial is part of a carrier liquid/solvent other than the aqueous suspension noted in the previous paragraph, gloves must be comprised of material that successfully passes ASTM F-739 (continuous liquid contact method). Gloves must be changed before the breakthrough time for the carrier liquid (as determined by the ASTM F-739 testing or by the manufacturer).
- Also applicable are general best practices for worker glove use (that would apply to all PMN cases with glove restrictions):
 - Gloves must be discarded and replaced with such frequency as to ensure that they will reliably provide an impervious barrier to the chemical substances under normal and expected conditions of exposure within the work area.
 - Damaged or defective gloves must not be used.
 - The glove manufacturer's care and maintenance instructions for the gloves must be followed.

4. Ventilation: A local or general exhaust system is recommended.
 - **General protective and hygienic measures**
 The usual precautionary measures for handling chemicals should be followed.
 Keep away from foodstuffs, beverages and feed.
 Remove all soiled and contaminated clothing immediately.
 Wash hands before breaks and at the end of work.
 Avoid contact with the eyes.
 Avoid contact with the eyes and skin.

9 - Physical and chemical properties:

- **General Information**

- **Form:** Powders
- **Color:** Black
- **Odor:** Odorless

Value/Range Unit Method

- **Change in condition**
- **Melting point/Melting range:** Estimated 3652-3697 °C (subl/vac)

- **Boiling point/Boiling range:** Not determined
- **Sublimation temperature / start:** Not determined
- **Flash point:** Not applicable
- **Ignition temperature:** Not determined
- **Decomposition temperature:** Not determined
- **Danger of explosion:**
Product does not present an explosion hazard.

Explosion limits:

- **Lower:** Not determined
- **Upper:** Not determined
- **Vapor pressure:** Not determined
- **Density:** at 20 ° C ~ 2.1 g/cm³
- **Solubility in / Miscibility with**
- **Water:** Insoluble

10 - Stability and reactivity

- **Thermal decomposition / conditions to be avoided:**
Decomposition will not occur if used and stored according to specifications.
- **Materials to be avoided:**
Oxidizing agents
Acids
Halogens
Interhalogens Alkali metals
- **Dangerous reactions** No dangerous reactions known
- **Dangerous products of decomposition:** Carbon monoxide and carbon dioxide

11 - Toxicological information

- **Acute toxicity:**
- **Primary irritant effect:**
- **On the skin:** Irritant to skin and mucous membranes.
- **On the eye:** Irritating effect.
- **Sensitization:** No sensitizing effects known.
- **Subacute to chronic toxicity:**
The inhalation of graphite, both natural and synthetic, has caused pneumoconiosis in exposed workers. The pneumoconiosis found is similar to coal worker's pneumoconiosis.
- **Additional toxicological information:**
To the best of our knowledge the acute and chronic toxicity of this substance is not fully known. No classification data on carcinogenic properties of this material is available from the EPA, IARC, NTP, OSHA or ACGIH.

Toxicological information on carbon nanotubes may be found at the website of the International Council on Nanotechnology at <http://icon.rice.edu/>

12 - Ecological information:

- **General notes:**

Do not allow this material to be released to the environment!

Ecological information on carbon nanotubes may be found at the website of the International Council on Nanotechnology at <http://icon.rice.edu/>. Cheap Tubes recommends the use of Hazardous Materials Remediation companies for dealing with CNT Waste. Companies such as Safety Kleen are good companies to dispose of your CNT waste with.

13 - Disposal considerations

- **Product:** Carbon Nanotubes
- **Recommendation**
Consult state, local or national regulations to ensure proper disposal. Specific care should be taken to insure that no carbon nanotubes or carbon nanotube packaging is released into the environment.
- **Uncleaned packagings:**
Consult all state, local or national regulations to ensure proper disposal. Specific care should be taken to insure that no carbon nanotubes or carbon nanotube packaging is released into the environment.
- **Recommendation:**

Disposal must be made according to official regulations. Contact a hazardous materials removal company. Keep all carbon nanotube waste, packaging, and contaminated items segregated from other waste and dispose of with a materials removal company such as Saftey Kleen or others.

14 - Transport information

Not a hazardous material for transportation.

- **DOT regulations:**
- **Hazard class:** None
- **Land transport ADR/RID (cross-border)**
- **ADR/RID class:** None
- **Maritime transport IMDG:**
- **IMDG Class:** None
- **Air transport ICAO-TI and IATA-DGR:**
- **ICAO/IATA Class:** None
- **Transport/Additional information:**
Not dangerous according to the above specifications.

15 - Regulations

- **Product related hazard informations:**

This material is listed on the US Toxic Substances Control Act (TSCA) Inventory and the following chemical inventories: Canadian Domestic Substances List (DSL), European Inventory of Existing Commercial Chemical Substances (EINECS), Korean Existing Chemicals List (ECL), Australian Inventory of Chemical Substances (AICS), the Philippines Inventory of Chemicals and Chemical Substances (PICCS), and the Swiss Giftlist 1 Inventory of Notified New Substances. In addition, this substance is not regulated in Japan and excluded from the Japanese Chemical Substances Control Law according to the Japanese Ministry of Economy, Trade and Industry, formerly the Ministry of International Trade and Industry (MITI).

- **Hazard symbols:** Eye Irritant

- **Risk phrases:** 36/37 Irritating to eyes and respiratory system.
- **Safety phrases:**
26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
- **National regulations**
All components of this product are listed in the U.S. Environmental Protection Agency Toxic Substances Control Act Chemical Substance Inventory.
- **Information about limitation of use:**
For use only by technically qualified individuals.

16 - Other information:

Employers should use this information only as a supplement to other information gathered by them, and should make independent judgement of suitability of this information to ensure proper use and protect the health and safety of employees. This information is furnished without warranty, and any use of the product not in conformance with this Material Safety Data Sheet, or in combination with any other product or process, is the responsibility of the user.

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM (HMIS)

Health Flammability Reactivity BASIS

1 0 0 Synthetic graphite powder

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

Health Flammability Reactivity BASIS

1 0 0 Synthetic graphite powder

Label Precautions:

Do not get in eyes, on skin or on clothing.

Do not breathe dust.

Wash thoroughly after handling.

Keep container closed.

Use with adequate ventilation.

Label First Aid:

If inhaled, remove to fresh air. If breathing difficulties persist, get medical attention. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. If irritation develops or persists, get medical attention.

Disclaimer: Cheap Tubes Inc. provides the information contained herein in good faith and makes no representation as to its comprehensiveness or accuracy. 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. Cheap Tubes Inc. 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, Cheap Tubes Inc. will not be responsible for damages resulting from use of or reliance upon this information.