
	<p align="center"><b>Safe Handling Guide</b></p> <p align="center"><b>GRAPHISTRENGTH™</b></p> <p align="center"><b>Carbon Nanotube Powders</b></p>	
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March 2007

This document is a guide to safe handling of GRAPHISTRENGTH™ carbon nanotube powders and is provided as a supplement to the Material Safety Data Sheets (MSDS).

### GRAPHISTRENGTH™ Carbon Nanotube Products

GRAPHISTRENGTH™ products comprise multi-walled carbon nanotubes. Typical GRAPHISTRENGTH™ carbon nanotube diameter is 10 to 15 nanometers; typical length is approximately a few microns, roughly between 1 to 10 µm. Due to their process of production, GRAPHISTRENGTH™ multi walled carbon nanotubes exist in agglomerated bundles with average dimensions of about 400 microns with range of approximately 50 to 900 microns. Using GRAPHISTRENGTH™ powders likely poses a potential risk of exposure. This guide identifies good practices for handling GRAPHISTRENGTH™ powders to minimize human and environmental exposure.

### Safe Handling

**BEFORE HANDLING THE MATERIAL, READ AND UNDERSTAND THE MSDS (MATERIAL SAFETY DATA SHEET) FOR ADDITIONAL INFORMATION ON PERSONAL PROTECTIVE EQUIPMENT AND FOR SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION.**

GRAPHISTRENGTH™ multi walled carbon nanotubes are chemically consistent with graphite, however, due to dimension, shape and physical characteristic differences, toxicological properties of GRAPHISTRENGTH™ powders are not completely understood and are the subject of ongoing studies. The goal in safely handling GRAPHISTRENGTH™ powders is to eliminate, to the extent possible, contact with people and the environment via any exposure route.

Access to work areas where GRAPHISTRENGTH™ powders are present should be restricted to reduce worker exposure. The best way to avoid worker exposure is to use GRAPHISTRENGTH™ powders in closed, negative pressure processes equipped with high efficient particulate air filtration (>99.9% efficiency at sub-micron particle size).

In cases where the use cannot be conducted in a closed process, appropriate local exhaust systems and personal protective equipment (PPE) must be used. Local exhaust must be equipped with high efficiency filtration as defined above.

Recommended PPE for these applications is as follows:

- High efficiency dust mask or half face respirator, with an appropriate fit test. The most efficient dust masks available on the market must be used. For instance, FFP3 rating in Europe, or N100 rating in North America.
- Suitable impervious gloves;
- Laminated coverall and foot coverings (equivalent to TYCHEM® non-porous protective clothing products).

When managing spills or releases, a hood-type powered air-purifying respirator (PAPR) equipped with a high efficiency filter must be used with the other specified PPE. Work areas must be cleaned with a high efficiency filtration vacuum cleaner (>99.9% efficiency at sub micron particle size) and wet wiping methods.

In addition, after handling carbon nanotube powders, all the used materials must be discarded according to state and local regulations.

Periodic personnel exposure monitoring should be performed to assure particle concentrations do not exceed established background levels.

#### First Aid

- If in eyes, immediately flush with water. Obtain medical attention for persistent irritation.
- If on skin, immediately wash with soap and water. Remove contaminated articles. Obtain medical attention for any symptom.
- If swallowed, do not induce vomiting. Administer water. Obtain medical attention.
- If inhaled, remove to fresh air. If not breathing, administer artificial respiration. If breathing is difficult, administer oxygen. Obtain medical attention.

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# GRAPHISTRENGTH™ C100

## 1. PRODUCT AND COMPANY IDENTIFICATION

### Company

Arkema Inc.  
2000 Market Street  
Philadelphia, Pennsylvania 19103

Arkema Nano-scale Materials

Customer Service Telephone Number: (215) 419-7000  
(Monday through Friday, 8:30 AM to 5:30 PM EST)

### Emergency Information

Transportation: CHEMTREC: (800) 424-9300  
(24 hrs., 7 days a week)

Medical: Rocky Mountain Poison Center: (303) 623-5716  
(24 hrs., 7 days a week)

### Product Information

Product name: GRAPHISTRENGTH™ C100  
Synonyms: None  
Molecular formula: Not available  
Chemical family: Graphite in the form of carbon nanotubes  
Product use: Additive in coatings, composites, and thermoplastic polymers.

## 2. HAZARDS IDENTIFICATION

### Emergency Overview

Color: black  
Physical state: solid  
Form: powder  
Odor: none

**WARNING!**  
**MAY FORM COMBUSTIBLE DUST AIR MIXTURES.**  
**MAY CAUSE EYE, SKIN AND RESPIRATORY TRACT IRRITATION.**

### Potential Health Effects

Primary routes of exposure:  
Inhalation and skin contact.

Signs and symptoms of acute exposure:  
Dust: May cause eye irritation. May cause irritation of respiratory tract. Prolonged or repeated contact may dry skin and cause irritation.

**GRAPHISTRENGTH™ C100****3. COMPOSITION/INFORMATION ON INGREDIENTS**

Chemical Name	CAS-No.	Wt/Wt	OSHA Hazardous
Graphite	7782-42-5	> 90 %	Y
Aluminum oxide (Al <sub>2</sub> O <sub>3</sub> )	1344-28-1	<= 7 %	Y
Iron oxide (Fe <sub>2</sub> O <sub>3</sub> )	1309-37-1	<= 5 %	Y

The substance(s) marked with a "Y" in the Hazard column above, are those identified as hazardous chemicals under the criteria of the OSHA Hazard Communication Standard (29 CFR 1910.1200).

This material is classified as hazardous under Federal OSHA regulation.

**4. FIRST AID MEASURES****Inhalation:**

If inhaled, remove victim to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

**Skin:**

In case of contact, immediately flush skin with plenty of water. Remove contaminated clothing and shoes. Get medical attention if irritation persists. Wash clothing before reuse. Thoroughly clean shoes before reuse.

**Eyes:**

Immediately flush eye(s) with plenty of water. Get medical attention if irritation persists.

**Ingestion:**

If swallowed, DO NOT induce vomiting. Get medical attention. Never give anything by mouth to an unconscious person.

**5. FIRE-FIGHTING MEASURES**

**Flash point:** Not determined

**Auto-ignition temperature:** > 752 °F (> 400 °C) (Method: Standard NF EN 50281-2-1)

**Lower flammable limit (LFL):** Not determined

**Upper flammable limit (UFL):** Not determined

**Extinguishing media (suitable):**

Water spray, Carbon dioxide (CO<sub>2</sub>), Dry powder

**Protective equipment:**

Fire fighters and others who may be exposed to products of combustion should wear full fire fighting turn out gear (full Bunker Gear) and self-contained breathing apparatus (pressure demand / NIOSH approved or equivalent). Fire fighting equipment should be thoroughly decontaminated after use.



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### Further firefighting advice:

Do not use a solid stream of water.

A solid stream of water can cause a dust explosion.

### Fire and explosion hazards:

Dust clouds generated during handling and/or storage can form explosive mixtures with air. Dust explosion characteristics vary with the particle size, particle shape, moisture content, contaminants, and other variables.

Note: Check that all equipment is properly grounded and installed to satisfy electrical classification requirements. As with any dry material, pouring this material or allowing it to free-fall or to be conveyed through chutes or pipes can accumulate and generate electrostatic sparks, potentially causing ignition of the material itself, or of any flammable materials which may come into contact with the material or its container.

## 6. ACCIDENTAL RELEASE MEASURES

### In case of spill or leak:

Sweep up and shovel into suitable containers for disposal. Use only non-sparking tools. Wet down dust with water spray jet. Spills should be contained and placed in suitable containers for disposal. Consult a regulatory specialist to determine appropriate state or local reporting requirements, for assistance in waste characterization and/or hazardous waste disposal and other requirements listed in pertinent environmental permits.

## 7. HANDLING AND STORAGE

### Handling

#### **General information on handling:**

Keep away from heat, sparks and flames.

Avoid contact with the skin, eyes and clothing.

Avoid breathing dust.

Keep container closed.

Avoid creating dust in handling, transfer or clean up.

Prevent dust accumulation.

Check that all equipment is properly grounded and installed to satisfy electrical classification requirements.

Use only with adequate ventilation.

Wash thoroughly after handling.

Container hazardous when empty.

Emptied container retains product residue.

Follow label warnings even after container is emptied.

**RESIDUAL DUSTS MAY EXPLODE ON IGNITION.**

**DO NOT CUT, DRILL, GRIND, OR WELD ON OR NEAR THIS CONTAINER.**

Improper disposal or reuse of this container may be dangerous and/or illegal.

### Storage

#### **General information on storage conditions:**

Store in cool, dry, well ventilated area away from sources of ignition such as flame, sparks and static electricity.

Ensure that all storage and handling equipment is properly grounded and installed to satisfy electrical classification requirements. Static electricity may accumulate when transferring material. All storage containers, including drums, cylinders and IBCs, must be bonded and grounded during filling and emptying operations.



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**Storage incompatibility – General:**

Store separate from oxidizers.

**Storage incompatibility – Segregation (specific):**

Strong oxidizing agents

**8. EXPOSURE CONTROLS/PERSONAL PROTECTION**

**Airborne Exposure Guidelines:**

**Graphite (7782-42-5)**

**US. ACGIH Threshold Limit Values**

Form: Respirable fraction.  
Time Weighted Average (TWA): 2 mg/m<sup>3</sup>

**US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000)**

Form: Respirable fraction.  
PEL: 5 mg/m<sup>3</sup>

Form: Total dust.  
PEL: 15 mg/m<sup>3</sup>

**Aluminum oxide (Al<sub>2</sub>O<sub>3</sub>) (1344-28-1)**

**US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000)**

Form: Respirable fraction.  
PEL: 5 mg/m<sup>3</sup>

Form: Total dust.  
PEL: 15 mg/m<sup>3</sup>

**Iron oxide (Fe<sub>2</sub>O<sub>3</sub>) (1309-37-1)**

**US. ACGIH Threshold Limit Values**

Form: Respirable fraction.  
Time Weighted Average (TWA): 5 mg/m<sup>3</sup>

**US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000)**

Form: Fume.  
PEL: 10 mg/m<sup>3</sup>



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Only those components with exposure limits are printed in this section. Limits with skin contact designation above have skin contact effect. Air sampling alone is insufficient to accurately quantitate exposure. Measures to prevent significant cutaneous absorption may be required. Limits with a sensitizer designation above mean that exposure to this material may cause allergic reactions.

**Engineering controls:**

Investigate engineering techniques to reduce exposures below airborne exposure limits. Provide ventilation if necessary to control exposure levels below airborne exposure limits (see above). If practical, use local mechanical exhaust ventilation at sources of air contamination such as open process equipment. Consult ACGIH ventilation manual or NFPA Standard 91 for design of exhaust systems.

**Respiratory protection:**

Avoid breathing dust. Where airborne exposure is likely or airborne exposure limits are exceeded (if applicable, see above), use NIOSH approved respiratory protection equipment appropriate to the material and/or its components (full facepiece recommended). Consult respirator manufacturer to determine appropriate type equipment for a given application. Observe respirator use limitations specified by NIOSH or the manufacturer. For emergency and other conditions where there may be a potential for significant exposure or where exposure limit may be significantly exceeded, use an approved full face positive-pressure, self-contained breathing apparatus or positive-pressure airline with auxiliary self-contained air supply. Respiratory protection programs must comply with 29 CFR § 1910.134.

**Skin protection:**

Wear appropriate chemical resistant protective clothing and chemical resistant gloves to prevent skin contact. Consult glove manufacturer to determine appropriate type glove material for given application. Rinse immediately if skin is contaminated. Wash contaminated clothing and clean protective equipment before reuse. Wash thoroughly after handling.

**Eye protection:**

Where eye contact may be likely, wear chemical goggles and have eye flushing equipment available.

**9. PHYSICAL AND CHEMICAL PROPERTIES**

<b>Color:</b>	black
<b>Physical state:</b>	solid
<b>Form:</b>	powder
<b>Odor:</b>	none
<b>pH:</b>	no data available
<b>Density:</b>	no data available
<b>Specific Gravity (Relative density):</b>	no data available
<b>Bulk density:</b>	100 - 400 kg/m3
<b>Vapor pressure:</b>	no data available
<b>Vapor density:</b>	no data available



**Boiling point/boiling range:** no data available

**Freezing point:** no data available

**Melting point/range:** no data available

**Solubility in water:** insoluble

## 10. STABILITY AND REACTIVITY

**Stability:**

This material is chemically stable under normal and anticipated storage, handling and processing conditions.

**Materials to avoid:**

Strong oxidizing agents

**Conditions / hazards to avoid:**

To avoid thermal decomposition, do not overheat.

**Hazardous decomposition products:**

Thermal decomposition giving toxic products :  
Carbon oxides

## 11. TOXICOLOGICAL INFORMATION

### Data for Aluminum oxide (Al<sub>2</sub>O<sub>3</sub>) (1344-28-1)

**Acute toxicity**

**Oral:**

Practically nontoxic. (rat) LD<sub>50</sub> > 5,000 mg/kg.

**Skin Irritation:**

Non-irritating. (rabbit)

**Eye Irritation:**

Non-irritating. (rabbit)

### Data for Iron oxide (Fe<sub>2</sub>O<sub>3</sub>) (1309-37-1)

**Acute toxicity**

**Oral:**

Slightly toxic. (rat) LD<sub>50</sub> = 1,600 mg/kg.

**Dermal:**

No more than slightly toxic. (rabbit) LD<sub>50</sub> > 1,000 mg/kg.

**Carcinogenicity**



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Chronic inhalation, intratracheal injection administration to rat, mouse, hamster, guinea pig / No increase in tumor incidence was reported.

**Data for Graphite (7782-42-5)****Carcinogenicity**

Repeated inhalation, intratracheal injection administration to rat / affected organ(s): lung / signs: fibrosis

**Human experience****Inhalation:**

Respiratory tract: Epidemiology studies of workers indicate pulmonary function is not affected; no significant increases in cancer.

**Data for Carbon nanotubes****Acute toxicity****Oral:**

No more than slightly toxic. (rat) LD50 > 2,000 mg/kg.

**Dermal:**

No more than slightly toxic. (rat) LD50 > 2,000 mg/kg.

**Skin Irritation:**

Slightly irritating. (rabbit)

**Eye Irritation:**

Moderately irritating. (rabbit)

**Other routes:**

(In rats and mice, intratracheal injection of single-walled carbon nanotubes was reported to produce an inflammatory reaction in the lungs with a fibrogenic response.)

**Skin Sensitization:**

Not a skin sensitizer. (mouse)

**Genotoxicity****Assessment in Vitro:**

No genetic changes were observed in laboratory tests using: bacteria, human cells

**12. ECOLOGICAL INFORMATION****Chemical Fate and Pathway**

No data are available.

**Ecotoxicology****Data for Iron oxide (Fe<sub>2</sub>O<sub>3</sub>) (1309-37-1)****Aquatic toxicity data:**



Practically nontoxic. *Leuciscus idus* (Golden orfe) 48 h LC0 = 1,000 mg/l

**Microorganisms:**

Practically nontoxic. Bacteria EC0 = 5,000 mg/l

**13. DISPOSAL CONSIDERATIONS****Waste disposal:**

Where possible recycling is preferred to disposal or incineration. If recycling is not an option, incinerate or dispose of in accordance with federal, state, and local regulations. Consult a regulatory specialist to determine appropriate state or local reporting requirements, for assistance in waste characterization and/or hazardous waste disposal and other requirements listed in pertinent environmental permits. Note: Chemical additions to, processing of, or otherwise altering this material may make this waste management information incomplete, inaccurate, or otherwise inappropriate. Furthermore, state and local waste disposal requirements may be more restrictive or otherwise different from federal laws and regulations.

**14. TRANSPORT INFORMATION**

US Department of Transportation (DOT): not regulated

International Maritime Dangerous Goods Code (IMDG): not regulated

**15. REGULATORY INFORMATION****Chemical Inventory Status**

EU. EINECS	EINECS	Conforms to
US. Toxic Substances Control Act	TSCA	The components of this product are all on the TSCA Inventory.
Australia. Industrial Chemical (Notification and Assessment) Act	AICS	Conforms to
Canada. Canadian Environmental Protection Act (CEPA). Domestic Substances List (DSL). (Can. Gaz. Part II, Vol. 133)	DSL	All components of this product are on the Canadian DSL list.
Japan. Kashin-Hou Law List	ENCS (JP)	Conforms to
Korea. Toxic Chemical Control Law (TCCL) List	KECI (KR)	Conforms to
Philippines. The Toxic Substances and Hazardous and Nuclear Waste Control Act	PICCS (PH)	Conforms to
China. Inventory of Existing Chemical Substances	INV (CN)	Conforms to
New Zealand. Inventory of Chemicals (NZIoC), as published by ERMA New Zealand	NZIOC	Conforms to

**GRAPHISTRENGTH™ C100****United States – Federal Regulations****SARA Title III – Section 302 Extremely Hazardous Chemicals:**

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

**SARA Title III - Section 311/312 Hazard Categories:**

Acute Health Hazard

**SARA Title III – Section 313 Toxic Chemicals:**

<u>Chemical Name</u>	<u>CAS-No.</u>	<u>De minimis concentration</u>	<u>Reportable threshold:</u>
Aluminum oxide (Al <sub>2</sub> O <sub>3</sub> )	1344-28-1	1.0 %	10000 lbs (Otherwise used (non-manufacturing/processing)) 25000 lbs (Manufacturing and processing)

**Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) - Reportable Quantity (RQ):**

The components in this product are either not CERCLA regulated, regulated but present in negligible concentrations, or regulated with no assigned reportable quantity.

**OSHA Regulated Carcinogens (NTP, IARC, OSHA Listed):****NTP:**

No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

**IARC:**

No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

**OSHA:**

No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

**United States – State Regulations****Massachusetts Right to Know**

<u>Chemical Name</u>	<u>CAS-No.</u>
Iron oxide (Fe <sub>2</sub> O <sub>3</sub> )	1309-37-1
Aluminum oxide (Al <sub>2</sub> O <sub>3</sub> )	1344-28-1
Graphite	7782-42-5

**GRAPHISTRENGTH™ C100****New Jersey Right to Know**

<u>Chemical Name</u>	<u>CAS-No.</u>
Iron oxide (Fe <sub>2</sub> O <sub>3</sub> )	1309-37-1
Aluminum oxide (Al <sub>2</sub> O <sub>3</sub> )	1344-28-1

**Pennsylvania Right to Know**

<u>Chemical Name</u>	<u>CAS-No.</u>
Iron oxide (Fe <sub>2</sub> O <sub>3</sub> )	1309-37-1
Aluminum oxide (Al <sub>2</sub> O <sub>3</sub> )	1344-28-1
Graphite	7782-42-5

**Pennsylvania Right to Know -- Environmentally Hazardous Substance(s)**

<u>Chemical Name</u>	<u>CAS-No.</u>
Aluminum oxide (Al <sub>2</sub> O <sub>3</sub> )	1344-28-1

**California Prop. 65**

This product does not contain any chemicals known to the State of California to cause cancer, birth defects, or any other reproductive effects.

**16. OTHER INFORMATION****Latest Revision(s):**

Reference number: 000000047038  
Date of Revision: 07/25/2008  
Date Printed: 09/18/2008

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