

Occupational Health Guideline for Natural Graphite

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: C
- Synonyms: Plumbago; potelot; carbo mineralis; black lead; carburet of iron; silver lead; crayon noir
- Appearance and odor: Black, greasy, odorless solid.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for natural graphite is 15 million particles of natural graphite per cubic foot of air (mppcf) averaged over an eight-hour work shift.

HEALTH HAZARD INFORMATION

• Routes of exposure

Natural graphite can affect the body if it is inhaled or if it comes in contact with the eyes.

• Effects of overexposure

Repeated inhalation of natural graphite over a number of years may cause scarring of the lungs with such symptoms as chest tightness, shortness of breath, cough, black sputum, and pain.

• Reporting signs and symptoms

A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to natural graphite.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to natural graphite at potentially hazardous levels:

1. Initial Medical Examination:

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Examination of the respiratory system and the cardiovascular system should be stressed.

—14" x 17" chest roentgenogram: Natural graphite may cause human lung damage. Surveillance of the lungs is indicated.

—FVC and FEV (1 sec): Natural graphite is reported to cause decreased pulmonary function. Periodic surveillance is indicated.

2. Periodic Medical Examination: The aforementioned medical examinations should be repeated on an annual basis.

• Summary of toxicology

Natural graphite dust causes graphite pneumoconiosis. The earliest roentgenologic changes may be the disappearance of normal vascular markings, with the appearance later of pinpoint and macronodular densities in all lung fields. Massive lesions, when present, are caused by large cysts filled with black fluid. The pleura is often involved: hydrothorax, pneumothorax, and pleural thickening may occur. At autopsy, the lungs are gray-black to black; histologically there are widely scattered particles, spicules, and plates of graphite, often within intra-alveolar phagocytes amidst diffuse interstitial fibrosis and occasionally pneumonitis. There are also interwoven bands of collagen, similar to those found in silicosis, which frequently are the most prominent feature of the fibrotic lesions occupying the lung and the bronchial lymph nodes. Symptoms include expectoration of black sputum, dyspnea, and cough. It has been generally believed that the capacity of inhaled natural graphite dust to cause disease is largely the result of its crystalline silica component. However, there is a recent report of a worker who, after exposure to "nearly pure" carbon for 17 years as a grinder of synthetic graphite bars, developed cough, dyspnea, and reduced pulmonary function, and died. At autopsy, both ventricles of

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

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the heart were hypertrophied, and the lungs revealed the typical findings of graphite pneumoconiosis including fibrous tissue; the ashed material from the lung showed little or no birefringent particles, indicating the absence of silicious material.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 12
2. Boiling point (760 mm Hg): Not applicable
3. Specific gravity (water = 1): 2.25
4. Vapor density (air = 1 at boiling point of natural graphite): Not applicable
5. Melting point: 3350 C (6040 F) (sublimes)
6. Vapor pressure at 20 C (68 F): Essentially zero
7. Solubility in water, g/100 g water at 20 C (68 F): Insoluble
8. Evaporation rate (butyl acetate = 1): Not applicable

• Reactivity

1. Conditions contributing to instability: None
2. Incompatibilities: Contact with very strong oxidizers such as fluorine, chlorine trifluoride, and potassium peroxide may cause fires and explosions.
3. Hazardous decomposition products: None
4. Special precautions: None

• Flammability

1. Flash point: Not applicable
2. Minimum ignition temperature: 730 C (1346 F) (cloud); 580 C (1076 F) (layer)
3. Minimum explosive concentration: Data not available
4. Extinguishant: Water

• Warning properties

Grant states that "carbon, when pure, has no toxic effect on the eye. As superficial foreign bodies, carbon black and graphite may be slightly irritating mechanically and may cause discoloration of lids and conjunctivae, but they are chemically inert."

MONITORING AND MEASUREMENT PROCEDURES

• General

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

• Method

At the time of publication of this guideline, no measurement method for graphite had been published by NIOSH.

RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.

• In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to natural graphite may occur and control methods which may be effective in each case:

Operation	Controls
Liberation during mining, purification, packaging, blasting, and drilling	Local exhaust ventilation; personal protective equipment
Use in foundry facings; steelmaking as carbon raiser; manufacture of refractories in crucibles and retorts; use in manufacture of lubricants and adhesives in bearings, slides, gears, engines, and mold release agents	Process enclosure; local exhaust ventilation; personal protective equipment
Manufacture of writing and drafting agents; manufacture of industrial paints, inks, and polishes; manufacture of motor and generator brushes, batteries, carbon resistors, and electrodes	Process enclosure; local exhaust ventilation; personal protective equipment

Use in manufacture of tungsten carbide cutting tools, friction materials and clutch facings; use in electroplating; use in manufacture of ammunition; miscellaneous uses in hard rubber, engine packing, cord, rope, twine, floor coverings, and coatings for fertilizer

Process enclosure; local exhaust ventilation; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• Eye Exposure

If natural graphite gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention immediately. Contact lenses should not be worn when working with this chemical.

• Breathing

If a person breathes in large amounts of natural graphite, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

• Rescue

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL AND DISPOSAL PROCEDURES

• Persons not wearing protective equipment and clothing should be restricted from areas of spills until cleanup has been completed.

• If natural graphite is spilled, the following steps should be taken:

1. Ventilate area of spill.
2. Collect spilled material in the most convenient and safe manner for reclamation, burning in a suitable combustion chamber or for disposal in a secured sanitary landfill.

• Waste disposal methods:

Natural graphite may be disposed of:

1. In a sanitary landfill.
2. By burning in a suitable combustion chamber.

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RESPIRATORY PROTECTION FOR NATURAL GRAPHITE

Condition	Minimum Respiratory Protection* Required Above 15 mppcf
Particulate Concentration	
75 mppcf or less	Any dust respirator.
150 mppcf or less	Any dust respirator, except single-use or quarter-mask respirator. Any fume respirator or high efficiency particulate filter respirator. Any supplied-air respirator. Any self-contained breathing apparatus.
750 mppcf or less	A high efficiency particulate filter respirator with a full facepiece. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
7500 mppcf or less	A powered air-purifying respirator with a high efficiency filter. A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode.
Greater than 7500 mppcf or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.

*Only NIOSH-approved or MSHA-approved equipment should be used.