



## MATERIAL SAFETY DATA SHEET

### SILICON CARBIDE WHISKERS, EPOXY FUNCTIONALIZED

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Issued: 01/12/12

#### I. GENERAL

**Trade Name:** SI-TUFF™ Silicon Carbide Whiskers: SC-210

**Other Name:** Silicon Carbide Whiskers

**Generic Name:** Silicon Carbide

**Chemical Family:** Metal Carbide

**CAS No.:** See Section II

**DOT Hazardous Material Proper Shipping Name:** Not regulated

**DOT Hazard Class:** Not regulated

**UN/NA ID NO.:** N/AP

**NFPA Rating:** Health 1 Flammability 0 Reactivity 0

#### II. COMPONENTS AND HAZARD INFORMATION

<u>NAME</u>	<u>CAS #</u>	<u>%</u>	<u>CARCINOGEN<sup>b</sup></u>	<u>EXPOSURE LIMIT</u>
Silicon Carbide Whiskers	None <sup>a</sup>	97-100%	2,3	OSHA PEL : Not listed ACGIH <sup>®</sup> TLV <sup>®</sup> : 0.1 fibers/cc TWA, respirable fibers <sup>c</sup> OTHER: None
Coupling agent <sup>d</sup>	Listed	0-3%		

a. No CAS # is assigned to silicon carbide whiskers. The CAS # for silicon carbide particulate is 409-21-2.

b. Listing Agencies: 1 = NTP, National Toxicology Program  
2 = IARC, International Agency for Research on Cancer  
3 = ACGIH<sup>®</sup>, American Conference of Governmental Industrial Hygienists  
4 = OSHA, Occupational Safety and Health Administration  
5 = Other

c. 0.1 fibers/cc 8-hour time weighted average (TWA); fibers greater than 5 micrometers in length, with an aspect ratio greater than or equal to 3:1 as determined by the membrane filter method at 400 to 450 times magnification (4-mm objective), using phase-contrast illumination.

d. Ingredients are non-hazardous (according to supplier's MSDS) as compounded, when product is used as directed.

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**II. COMPONENTS AND HAZARD INFORMATION – Continued**


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Silicon carbide whiskers are a fibrous form of single-crystal silicon carbide having an aspect ratio of 3:1 or greater. Hazardous whiskers are those in the respirable size range. Silicon carbide whiskers are not classified by OSHA or NTP as a carcinogen. IARC classifies the family of ceramic fibers, which includes Silicon Carbide Whiskers, as group 2B: possibly carcinogenic to humans (group 2B: “There is sufficient evidence for the carcinogenicity of ceramic fibers in experimental animals; no data were available on the carcinogenicity of ceramic fibers to humans”). ACGIH® has classified fibrous forms of silicon carbide as A2: Suspected Human Carcinogen in “Silicon Carbide: TLV® Chemical Substances 7th Edition Documentation, ACGIH® Publication #7 DOC-530, 2003.” (“The carcinogen designation of A2, Suspected Human Carcinogen, is recommended for fibrous forms, based on inhalation experiments in several species showing lung and pleural carcinogenicity, and limited human data for lung cancer...”).

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**III. PHYSICAL / CHEMICAL CHARACTERISTICS**


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<b>Boiling Point:</b> N/AP	<b>Specific Gravity (Water = 1):</b> 3.2
<b>Vapor Pressure (mm Hg):</b> N/AP	<b>Melting Point:</b> Decomposes above 2500°C
<b>Vapor Density (Air = 1):</b> N/AP	<b>pH:</b> N/AP
<b>Solubility in Water:</b> Insoluble	<b>Evaporation Rate (Butyl Acetate = 1):</b> N/AP
<b>Appearance and Odor:</b> Variable, typically gray-green powder with no odor.	

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**IV. FIRE AND EXPLOSION HAZARD DATA**


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**NOTE:** This section is applicable for fire and explosion hazards only and is not to be used for occupational exposures.

**Flash Point (Method):** Non-flammable by conventional test methods.

**Auto Ignition Temp. (Method):** N/AP

**Flammable Limits:** Non-flammable      **Lower (LEL):** N/AP      **Upper (UEL):** N/AP

**Fire and Explosion Hazards:** Negligible fire and explosion hazard when whiskers alone are exposed to heat and flame. Will not support combustion. Can be hazardous under fire conditions if, as a result of contact with water (or other media), causes steam explosions, spreading other combustibles and widening the fire area. Above 700°C, reaction between silicon carbide whiskers and oxidizing agents may produce carbon monoxide.

**Extinguishing Media:** Use extinguishing media appropriate for surrounding materials.

**Special Firefighting Procedures:** Avoid actions that would cause materials to become airborne. Wear pressure-demand, self-contained breathing apparatus and full firefighting protective clothing.

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**V. REACTIVITY DATA**


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**Hazardous Reactions:** No dangerous reactions known.

**Conditions to Avoid:** None typically, although temperatures greater than 700°C may produce carbon monoxide when silicon carbide whiskers are in contact with oxidizing agents.

**Incompatibility (Materials to Avoid):** None typically, although temperatures greater than 700°C may produce carbon monoxide when silicon carbide whiskers are in contact with oxidizing agents.

**Hazardous Polymerization:** Will not occur.

**Conditions to Avoid:** N/AP

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**VI. HEALTH HAZARDS**

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**SUMMARY OF ACUTE HAZARDS**

Excessive exposure to respirable silicon carbide whiskers may cause cough, mucus production, shortness of breath, irritation of the breathing passages, and/or may result in lung damage.

**Inhalation (Primary Route):** Excessive respirable exposure may cause cough, mucus production, shortness of breath, irritation of the breathing passages, and/or may result in lung damage.

**Eye Contact:** No appropriate human or animal health effects data are known. This material may be an eye irritant.

**Ingestion:** There is insufficient information on this material to predict the harmful effects by ingestion.

**Skin Absorption:** No appropriate human or animal health effects data are known to exist.

**Skin Irritation:** No appropriate human or animal health effects data are known to exist. This material may be a skin irritant.

**SUMMARY OF CHRONIC HAZARDS AND SPECIAL HEALTH EFFECTS**

**Chronic (Long Term) Overexposure:** Prolonged overexposure to respirable silicon carbide whiskers may result in progressive and irreversible lung disease. Inhalation of respirable silicon carbide whiskers has been known to cause pathological changes in the pulmonary systems of laboratory rats. Inhalation of materials with similar physical dimensions has been linked to chronic lung disease, including lung cancer and mesothelioma. See Supplement, Section IX.

**Carcinogenicity:** IARC classifies the family of ceramic fibers, which contains silicon carbide whiskers, as group 2B: possibly carcinogenic to humans (group 2B: "There is sufficient evidence for the carcinogenicity of ceramic fibers in experimental animals; no data were available on the carcinogenicity of ceramic fibers to humans"). ACGIH® has classified fibrous forms of silicon carbide as A2: Suspected Human Carcinogen. ("The carcinogen designation of A2, Suspected Human Carcinogen, is recommended for fibrous forms, based on inhalation experiments in several species showing lung and pleural carcinogenicity, and limited human data for lung cancer...").

**Medical Conditions Generally Aggravated by Exposure:** Chronic respiratory diseases such as bronchial hyper-reactivity and chronic bronchial or lung disease may be aggravated by exposure. Smoking has been shown to increase the risk of lung cancer in conjunction with inhalation of naturally occurring mineral fibers of similar dimension to silicon carbide whiskers.

**EMERGENCY FIRST AID PROCEDURES**

**Inhalation:** If symptoms of pulmonary involvement develop (coughing, wheezing, or shortness of breath), remove immediately from the exposure area to fresh air. If symptoms persist, seek medical attention.

**Eye Contact:** In case of eye irritation due to contact with this solid material, immediately rinse with copious quantities of clean water, occasionally lifting upper and lower eyelids, until no evidence of material remains (approximately 15-20 minutes). If symptoms persist, such as pain, blinking, tears, or redness, seek medical attention.

**Skin Contact:** Not expected to present a significant skin hazard under anticipated conditions of normal use, but, if irritation or rash occurs, seek medical attention for symptomatic treatment.

**Ingestion:** Not expected to present a significant ingestion hazard under anticipated conditions of normal use.

**Emergency Medical Treatment Procedures:** No additional medical information found.

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**VII. PRECAUTIONS FOR SAFE HANDLING AND USE**

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**Steps to be Taken in Case Material is Released or Spilled:** Use respirator during cleanup. Do not sweep. Use HEPA filter equipped central or portable vacuum cleaner if vacuuming. To minimize dust generation, wet down spillage with low velocity fine mist water spray.

**Waste Disposal Method:** Spillage, emission control dust, or unused materials should be disposed in accordance with federal, state, county and local solid waste regulations. Disposal containers should be sealed to prevent airborne emissions during transportation and at the disposal site. It is recommended that disposal containers be externally labeled to indicate an airborne fiber inhalation hazard.

**Precautions to be Taken in Handling and Storing:** Handle whiskers in a fashion whereby they do not become airborne during any stage of processing. Appropriate respirators are required where possibility exists for airborne whiskers until it has been determined that exposures are below the limits of Section II, Hazardous Ingredients. Take special precautions to avoid contamination of clothing. Ensure that personnel who handle or are exposed to silicon carbide whiskers have been trained in safe handling of silicon carbide whiskers. Store whiskers in tightly sealed containers in a clean, secure area. Identify the contents of all containers.

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**VIII. CONTROL MEASURES**

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**Respiratory Protection:** It is recommended that engineering controls rather than administrative controls be used to minimize employee exposure. If airborne concentrations exceed the recommended limits of Section II, Hazardous Ingredients, a suitable respirator should be worn in accordance with OSHA's Respiratory Protection Standard (29 CFR §1910).

**Eye Protection:** Yes, or as appropriate to exposure.

**Skin Protection:** Not normally considered a skin hazard. Where use can result in skin contact, practice good personal hygiene, and wash hands and other exposed areas with mild soap and water before eating, drinking, smoking, using toilet facilities, or leaving work.

**Ventilation:** The ventilation system should be designed and applied in a manner that maintains exposure to respirable silicon carbide whiskers below that of Section II, Hazardous Ingredients. Exhaust of power tools and equipment should be controlled to prevent airborne silicon carbide whiskers.

**Other Protective Clothing or Equipment:** As required to minimize exposure and contamination of personal equipment or clothing.

**Other Hygienic and Work Practices:** No eating, drinking, smoking, or chewing is permissible in the whisker processing area. Use good hygiene practices when entering or exiting the control zone.

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**IX. SUPPLEMENT**

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**SUMMARY OF CHRONIC HAZARDS**

The ACGIH® TLV® report states that the notation of A2, Suspected Human Carcinogen, is recommended based on the animal data for lung and pleural carcinogenicity, corroborating human data from a small number of clinical case reports, and findings from the only mortality study of silicon carbide workers to date which showed lung cancer was associated with silicon carbide exposures.

ACGIH® also reviewed potentially relevant animal studies of the effects of whiskers, including a 90-day inhalation study of rats exposed to silicon carbide whiskers in which dose-related pathological lung changes were seen. Additionally, dose related increased thickness (hyperplasia) and scarring (fibrosis) of the pleural lining around the lungs and the chest wall were found in some exposed rats immediately after and six months following the cessation of the 90-day exposure period. These changes were associated with all three

concentrations of whiskers employed in this study, including the lowest of 3.9 mg/m<sup>3</sup> (630 fibers/cc). The significance of these results with respect to the long-term exposure of workers has yet to be determined.

Prolonged overexposure to respirable silicon carbide whiskers may result in progressive and irreversible lung disease. Inhalation of respirable silicon carbide whiskers has been known to cause pathological changes in the pulmonary system of laboratory rats. Inhalation of materials with similar physical dimensions has been linked to chronic lung disease, including lung cancer and mesothelioma.

### **OCCUPATIONAL EXPOSURE LIMITS**

The ACGIH<sup>®</sup> TLV<sup>®</sup> is 0.1 fibers/cc, 8-hour time weighted average, for fibers greater than 5 micrometers in length, with an aspect ratio of greater than or equal to 3:1, as determined by membrane filter method at 400 to 450 times magnification (4-mm objective), using phase-contrast illumination.

It is recommended that appropriate ventilation, respiratory protection, and protective clothing and equipment be used when handling silicon carbide whiskers might result in airborne exposure to respirable silicon carbide whiskers. For additional guidance on handling fibrogenic materials, refer to OSHA regulations (29 CFR §1910.1001).

### **MEDICAL SURVEILLANCE PROGRAM**

Employees who handle or are exposed to silicon carbide whiskers above the recommended exposure limits should be included in a medical surveillance program.

- - - NOTE - - - QUALIFICATIONS	EQ = Equal	AP = Approximately	N/P = No Applicable Information Found
	LT = Less Than	UK = Unknown	N/AP = Not Applicable
	GT = Greater Than	TR = Trace	N/DA = No Data Available

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