



Safety Data Sheet

Rev. E – April 1, 2017

Section 1 - Identification

Product Identifier and Trade Names: Badger Coated™ Atlas CRC-C, Atlas CRC-E, Atlas CRC-One, Atlas CRC-LT

Product Type: Oil and Gas Well Resin Coated Proppant – Sand Substrate

Application: Hydraulic Fracturing

Restriction on Use: **This product is not to be used for abrasive blasting. This Safety Data Sheet (SDS) and the information contained herein were not developed for abrasive blasting. Do not pneumatically unload at a pressure exceeding 5 psi so as to avoid abrading the product.**

Manufacturer's Name: Badger Mining Corporation

Manufacturer's Address: 409 South Church Street
Berlin, WI 54923

Manufacturer's Telephone: 24-Hour Telephone (715) 662-2400

Distributors: Canada: BMC-NRI
#45 61027 Hwy 672, Emerson Trail Industrial Park
Sexsmith, AB, T0H 3C0
Phone: (780) 568-2096

Mexico: GARMI del Norte, SA de CV
Estanislao Martinez Lara No. 110
Parque Industrial Milimex
Santa Catarina, N.L. C.P. 66350
Mexico
Phone: 52-818-335-5191

Section 2 - Hazards Identification

GHS Classification:

Health:

Category 1A Carcinogen
Category 1 Specific Target Organ Toxicity (STOT) following repeated exposures
Category 2B Eye Irritation

Signal Word: DANGER



Hazard Statements:

May cause cancer by inhalation.
Causes damage to lungs, kidneys and autoimmune system through prolonged or repeated exposure by inhalation.
Causes eye irritation.

Section 2 - Hazards Identification

Precautionary Statements:

Do not handle this product until the safety information presented in this SDS has been read and understood.

DO NOT BREATHE DUST. Do not eat, drink or smoke while handling this product. Wash skin thoroughly after handling.

If in eyes: Rinse continuously with water for several minutes. Remove contact lenses, if present and easy to do, and continue rinsing. If exposed, concerned, unwell or irritation of the eyes persist: Get medical attention.

Avoid creating dust when handling, using or storing. Use with adequate ventilation to keep exposure below recommended exposure limits. Wear eye protection and respiratory protection following this SDS, NIOSH guidelines and other applicable regulations.

Dispose of contents/container in accordance with local, regional, national or international regulations. Please refer to Section 11 for details of specific health effects of crystalline silica and phenolic resin dust.

Section 3 - Composition/Information on Ingredients

Hazardous Ingredients:

	<u>CAS #</u>	<u>Percent</u>
Quartz (SiO ₂) (Crystalline Silica)	14808-60-7	95% to 98%
Phenolic Resin	9003-35-4, 37337-65-8	2% to 5%

Section 4 - First Aid Measures

Inhalation - If excessive inhalation of product occurs, remove the person to fresh air. Dust in throat and nasal passages should clear spontaneously. Perform artificial respiration as needed and contact a physician if irritation persists or develops later.

Eye - Immediately wash the eye with plenty of water for at least 15 minutes, while holding eyelid(s) open. Occasionally lift the eyelid(s) to ensure thorough rinsing. Remove contact lenses, if present and easy to do, and continue rinsing. Beyond flushing, do not attempt to remove material from the eye(s). Contact a physician if irritation persists or develops later.

Skin - If abrasion occurs, wash with soap and water, and seek medical attention if irritation persists or develops later.

Ingestion - If gastrointestinal discomfort occurs, give a large quantity of water. Never attempt to make an unconscious person drink or vomit. Seek medical attention.

Signs and Symptoms of Exposure - There are generally no signs or symptoms of exposure to crystalline silica (quartz). Often, chronic silicosis has no symptoms. The symptoms of chronic silicosis, if present, are shortness of breath, wheezing, cough and sputum production. The symptoms of acute silicosis which can occur with exposures to very high concentrations of respirable crystalline silica over a very short time period, sometimes as short as 6 months, are the same as those associated with chronic silicosis; additionally, weight loss and fever may also occur. The symptoms of scleroderma, an autoimmune disease, include thickening and stiffness of the skin, particularly in the fingers, shortness of breath, difficulty swallowing and joint problems.

Phenolic resin dust can be generated from abusive handling of this product including, but not limited to, excessive mixing, handling at a pressure greater than 5 psi, etc. and the dust may cause eye, nose, and throat and lung irritation if allowed to become airborne.

Direct skin and eye contact with dust may cause irritation by mechanical abrasion. Inhalation of dust may irritate nose, throat, mucous membranes and respiratory tract by mechanical abrasion. Coughing, sneezing, chest pain, shortness of breath, inflammation of mucous membrane, and flu-like fever may occur following exposures in excess of

appropriate exposure limits. Repeated excessive exposure may cause pneumoconiosis, such as silicosis and other respiratory effects.

Section 5 - Fire Fighting Measures

Extinguishing Media:	Use water spray, alcohol foam, CO ₂ or dry chemical.
Unusual Fire and Explosion Habits:	This product is coated with phenolic resin which may abrade during handling or mechanical conveyance generating organic dust. Abraded phenolic resin dust can be combustible and may present a fire or explosive hazard when dispersed and ignited in air. Handle or convey as instructed in NFPA Pamphlet 654, UK HSE Guidance HSG 103. 100% Phenolic resin dust lower explosive limit (LEL) – 25,000 mg/m ³ (0.025 oz/ft ³). Contact with powerful oxidizing agents may cause fire and/or explosions (see Section 10 of this SDS).

Section 6 - Accidental Release Measures

Special Fire Fighting Procedures:	Fire fighters should wear self-contained breathing apparatus.
Hazardous Combustion Products:	See Hazardous Decomposition Products in Section 10.

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Persons involved in cleaning should first follow the precautions defined in Section 7 of the SDS. Spilled materials, where dust can be generated, may overexpose cleanup personnel to respirable crystalline silica-containing dust that may pose inhalation hazards. Do not dry sweep spilled material. Collect the material using a method that does not produce dust such as a High-Efficiency Particulate Air (HEPA) vacuum or thoroughly wetting down the dust before cleaning up.

Wear appropriate personal protective equipment as specified in Section 8. Ensure appropriate respirators are worn during and following clean up or whenever airborne dust is present, to ensure worker exposures remain below occupational exposure limits (OELs - Refer to Section 8). Follow respiratory protection selection guidelines as described in Section 8 of this document.

Surface may be slippery due to roundness of the material. Place the silica-containing dust in a covered container appropriate for disposal. Dispose of the silica-containing dust according to federal, state and local regulations.

This product is not subject to the reporting requirements of SARA Title III Section 313, and 40 CFR 372.

Section 7 - Handling and Storage

This product is **not** to be used for abrasive blasting. Do not abrade or crush this material. Follow protective controls set forth in Section 8 of this SDS when handling this product. Dust containing respirable crystalline silica that may be an irritant may be generated during processing, handling and storage. Do not breathe dust, which may be created during the handling of this product. Do not rely on vision to determine whether respirable silica is present in the air, as it may be present without a visible cloud. Use good housekeeping procedures to prevent the accumulation of silica dust in the workplace. Avoid the creation of respirable dust. Avoid contact with skin and eyes. Do not store near food or beverages or smoking materials. Avoid standing on piles of materials as they may be unstable.

Use adequate ventilation and dust collection equipment. Ensure that the dust collection system is adequate to reduce airborne dust levels to below the appropriate OELs. If the airborne dust levels are above the appropriate OELs, use respiratory protection during the establishment of engineering controls. Refer to Section 8 - Exposure Controls/Personal Protection for further information. Avoid conditions that will generate dust when handling this product.

Store in a cool dry place. Do not cut, grind, weld, or drill on or near this product. See Section 5. Fire Fighting Measures as it relates to handling and storage of this material.

Section 7 - Handling and Storage, continued

In accordance with OSHA's Hazard Communication Standards (29 CFR 1910.1200, 1915.99, 1917.28, 1918.90, 1926.59, 1928.21), state and/or local right to know laws and regulations, familiarize your employees with this SDS and the information herein. Warn employees, your customers and other third parties (in the case of resale or distribution to others), of the potential health risks associated with the use of this product and train them in the appropriate use of PPE and engineering controls which will reduce their risks of exposure. It is a requirement of law that training, testing and appropriate handling is used.

See also ASTM standard practice E 1132-06, "Standard Practice for Health Requirements Relating to Occupational Exposure to Respirable Crystalline Silica."

For safe handling and use of this product for Hydraulic Fracturing, please see the OSHA/NIOSH Hazard Alert Worker Exposure to Silica during Hydraulic Fracturing DHHS (NIOSH) Publication No. 2012-166 (2012): http://www.osha.gov/dts/hazardalerts/hydraulic_frac_hazard_alert.pdf

Section 8 - Exposure Controls/Personal Protection

OELs (respirable fraction) in air for dust containing crystalline silica (quartz):

Standard	Exposure Limits
MSHA/OSHA PEL* (8-Hour Time-Weighted Average)	$\frac{10 \text{ mg/m}^3}{\% \text{ SiO}_2 + 2}$
ACGIH TLV** (8-Hour Time-Weighted Average)	0.025 mg/m ³
NIOSH REL** (10-Hour Time-Weighted Average, 40-hour work week)	0.05 mg/m ³

* Crystalline silica is normally measured as respirable dust. The OSHA/MSHA standard also presents a formula for calculation of the PEL based on total dust: $30 \text{ mg/m}^3 / (\% \text{ SiO}_2 + 2)$. The OSHA/MSHA PEL for dust containing crystalline silica (quartz) is based on the silica content of the respirable dust sample. The OSHA/MSHA PEL for crystalline silica as tridymite and cristobalite is one-half the PEL for crystalline silica (quartz). The current OSHA PEL is effective through June 22, 2017 and June 22, 2018 for construction and general industry, respectively.

** The ACGIH and NIOSH limits are for crystalline silica (quartz), independent of % silica content of the respirable dust sample. The ACGIH TLV for crystalline silica as cristobalite is equal to the TLV for crystalline silica as quartz. In 2005, ACGIH withdrew the TLV for crystalline silica as tridymite. Refer to Section 10 for thermal stability information for crystalline silica (quartz).

OSHA PEL effective June 23, 2017 for Construction; June 23, 2018 for General Industry/Maritime/Hydraulic Fracturing

OSHA has issued a new final rule on June 23, 2016 for Occupational Exposure to Respirable Crystalline Silica as codified in 29 CFR 1910.1053 for general industry, and 29 CFR 19126.1153 for construction work. This final rule establishes a permissible exposure limit (PEL) for respirable crystalline silica of 0.050 mg/m³ as an 8-hour time-weighted average (TWA) in industries covered by the rule. In addition to the PEL, the rule includes provisions to protect employees such as requirements for exposure assessment, methods for controlling exposure, respiratory protection, medical surveillance, hazard communication, and recordkeeping. OSHA has issued two separate standards—one for general industry and maritime, and the other for construction—in order to tailor requirements to the circumstances found in these sectors. OSHA has also established a silica Action Level (AL). If a worker's exposure exceeds the AL, a concentration of airborne respirable crystalline silica of 0.025 mg/m³ as an 8-hour TWA, the employer must implement exposure monitoring, engineering controls and other requirements as codified in the new Occupational Exposure to Respirable Crystalline Silica OSHA standard. It is likely MSHA will follow OSHA's rulemaking and implement this PEL, as well as state OSHA plans. See <https://www.osha.gov/silica/> for more information.

OELs in air for inert/nuisance dust:

Standard	Respirable Dust	Total Dust
MSHA/OSHA PEL (as Inert or Nuisance Dust)	5 mg/m ³	15 mg/m ³
ACGIH TLV (as Particles Not Otherwise Specified)	3 mg/m ³	*10 mg/m ³

The limits for Inert Dust are provided as guidelines. Nuisance dust is limited to particulates not known to cause systemic injury or illness. * The TLV provided is for inhalable particles not otherwise specified.

Section 8 - Exposure Controls/Personal Protection, continued

California Inhalation Reference Exposure Limit (REL): The California chronic REL for respirable crystalline silica is $3 \mu\text{g}/\text{m}^3$ (As of June 2014). A chronic REL is an airborne level of a chemical at or below which no adverse health effects are anticipated in individuals indefinitely exposed to that level. [Adoption of chronic REL for Silica dated 2/10/05].

Canadian OEL for crystalline silica:

Canada Labor Code: $0.025 \text{ mg}/\text{m}^3$ (respirable).

Alberta, British Columbia: $0.025 \text{ mg}/\text{m}^3$ (respirable quartz and cristobalite).

Saskatchewan: $0.05 \text{ mg}/\text{m}^3$ (respirable, cristobalite); $0.05 \text{ mg}/\text{m}^3$ (respirable, quartz); $0.1 \text{ mg}/\text{m}^3$ (respirable, Tripoli, as quartz).

Manitoba, Newfoundland, Prince Edward Island: $0.025 \text{ mg}/\text{m}^3$ (respirable, crystalline silica).

Ontario: $0.05 \text{ mg}/\text{m}^3$ (respirable cristobalite); $0.1 \text{ mg}/\text{m}^3$ (quartz, tripoli)

Quebec: $0.05 \text{ mg}/\text{m}^3$ (respirable, cristobalite, tridymite); $0.1 \text{ mg}/\text{m}^3$ (quartz, tripoli)

New Brunswick: $0.1 \text{ mg}/\text{m}^3$ (quartz); $0.05 \text{ mg}/\text{m}^3$ (cristobalite).

Nova Scotia: $0.025 \text{ mg}/\text{m}^3$ (quartz, cristobalite).

Yukon: 300 particles/ml measured with a konometer (quartz, and tripoli); 150 particles/ml measured with a konometer (cristobalite and tridymite).

Northwest Territories, Nunavut: $0.05 \text{ mg}/\text{m}^3$ (respirable, cristobalite, tridymite); $0.1 \text{ mg}/\text{m}^3$ (respirable, quartz, tripoli).

OEL for crystalline silica (Mexico):

$0.1 \text{ mg}/\text{m}^3$ (quartz, tripoli containing respirable quartz powder, inhalable)

$0.05 \text{ mg}/\text{m}^3$ (cristobalite, tridymite inhalable)

(Also refer to ACGIH)

OEL for crystalline silica (Argentina):

$0.05 \text{ mg}/\text{m}^3$ (quartz, cristobalite, tridymite respirable)

$0.1 \text{ mg}/\text{m}^3$ (tripoli, respirable)

Exposure limits for Phenolic Resin are not listed.

Engineering Controls:

Ventilation: Use local exhaust, general ventilation or natural ventilation adequate to maintain exposures below appropriate exposure limits.

Other control measures: Respirable dust and quartz levels should be monitored regularly. Dust and quartz levels in excess of appropriate exposure limits should be reduced by implementing feasible engineering controls, including (but not limited to) dust suppression (wetting), ventilation, process enclosure, and enclosed employee work stations.

Minimize creation of dust. Do not abrade or crush this material. It is not to be used for abrasive blasting.

Respiratory Protection:

Consult with OSHA regulations, Canadian CCOHS, NIOSH recommendations and other applicable regulatory agencies to determine the appropriate respiratory protection to be worn during use of this product, and use only such recommended respiratory protection equipment. Avoid breathing dust produced during the use and handling of this product. If the workplace airborne crystalline silica concentration is unknown for a given task, conduct air monitoring to determine the appropriate level of respiratory protection to be worn. Consult with a certified industrial hygienist, your insurance risk manager or the OSHA Consultative Services group for detailed information. Ensure appropriate respirators are worn during and following the task, including clean up or whenever airborne dust

is present, to ensure worker exposures remain below occupational exposure 29 CFR 1910.134 – Respiratory Protection for minimum program

Section 8 - Exposure Controls/Personal Protection, continued

limits. Provisions should be made for a respiratory protection training program (see requirements). See also ANSI standard Z88.2 (latest revision) "American National Standard for Respiratory Protection," 29 CFR 1910.134 and 1926.103, and 42 CFR 84.

Respirator Recommendations:

For respirable quartz levels that exceed, or are likely to exceed appropriate exposure limits, a NIOSH-approved particulate filter respirator must be worn.

NIOSH recommendations for respiratory protection include:

Up to 0.5 mg/m³:

(APF = 10) Any particulate respirator equipped with an N95, R95, or P95 filter (including N95, R95, and P95 filtering facepieces) except quarter-mask respirators. The following filters may also be used: N99, R99, P99, N100, R100, P100.

Up to 1.25 mg/m³:

(APF = 25) Any powered, air-purifying respirator with a high-efficiency particulate filter (100 series).

(APF = 25) Any supplied-air respirator operated in a continuous-flow mode

Up to 2.5 mg/m³:

(APF = 50) Any air-purifying, full-facepiece respirator with an N100, R100, or P100 filter.

(APF = 50) Any powered, air-purifying respirator with a tight-fitting facepiece and a high-efficiency particulate filter

Up to 25 mg/m³:

(APF = 1000) Any supplied-air respirator operated in a pressure-demand or other positive-pressure mode

Respirator use must comply with applicable standards, which include provisions for a user training program, respirator maintenance and cleaning, respirator fit testing, and other requirements. For additional information contact NIOSH at 1-800-35-NIOSH or visit website: <http://www.cdc.gov/niosh/npg> (search for crystalline silica).

Emergency or planned entry into unknown concentrations or IDLH conditions (50 mg/m³ for crystalline silica-quartz): Any self-contained breathing apparatus that has a full-face piece and is operated in a pressure-demand or other positive-pressure mode or any supplied-air respirator that has a full-face piece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus.

Escape from unknown or IDLH conditions: Any air-purifying, full-face piece respirator with a high-efficiency particulate filter or any appropriate escape-type, self-contained breathing apparatus.

Protective Clothing:

Long-sleeved shirt, full length pants and safety shoes.

Gloves:

Recommended in situations where abrasion from sand may occur.

Eye/Face:

Safety glasses with side shields should be worn as minimum protection. Dust goggles should be worn when excessively (visible) dusty conditions are present or are anticipated. There is a potential for severe eye irritation if exposed to excessive concentrations of dust for those wearing contact lenses.

Section 8 - Exposure Controls/Personal Protection, continued

General Hygiene Considerations: There are no known hazards associated with this material when used as recommended. Following the guidelines in this SDS is recognized as good industrial hygiene practice. Avoid breathing dust. Avoid skin and eye contact. Wash dust-exposed skin with soap and water before eating, drinking, smoking and using toilet facilities. Wash work clothes after each use.

Section 9 - Physical and Chemical Properties

Appearance:	Light tan/yellow to amber, free flowing granules
Odor:	Mild phenolic resin odor
Odor threshold:	Varies
pH (slurry in Distilled Water):	6.5 - 7.5
Boiling Point:	N/A
Melting point:	N/A
Flash Point:	Not readily combustible (Fire Train Test, 49 CFR 173, Appendix E)
Evaporation Rate:	Not applicable
Flammable Limits in Air:	None, except dusty conditions
Upper/Lower Explosive Limit:	See Section 5
Vapor Pressure	Not applicable
Vapor Density:	Not applicable
Specific Gravity:	2.43 - 2.60
Solubility in Water:	Insoluble
Partition coefficient: n-octanol/water	Not applicable
Auto ignition Temperature:	None
Viscosity	Not applicable

Section 10 - Stability and Reactivity

Chemical Stability:	Stable
Conditions to Avoid:	Contact with incompatible materials (see below).
Thermal Stability:	If crystalline silica (quartz) is heated to more than 870° C (1598° F), it can change to a form of crystalline silica known as tridymite, and if crystalline silica (quartz) is heated to more than 1470° C (2678° F), it can change to a form of crystalline silica known as cristobalite.
Incompatibility:	Contact with strong oxidizing agents, such as fluorine, boron trifluoride, chlorine trifluoride, manganese trifluoride, hydrogen fluoride, oxygen difluoride, hydrogen peroxide, etc.; acetylene and ammonia may cause fire and/or explosions.
Hazardous Decomposition Products:	Small amounts of phenol, formaldehyde, carbon monoxide, carbon dioxide and water vapor may be evolved if the product polymerizes or decomposes. Silica will dissolve in hydrofluoric acid and produce a corrosive gas – silicon tetrafluoride.

Hazardous Polymerization: Not expected to occur. (NFPA 704-12 (4-3.1)).

Section 11 - Toxicological Information

CAUTION: Crystalline silica exists in several forms, the most common of which is quartz. Crystalline silica as tridymite and cristobalite are more fibrogenic than crystalline silica as quartz.

Potential Health Effects

Primary routes(s) of exposure: Inhalation Skin Ingestion

Inhalation: Dust may irritate nose, throat, mucous membranes and respiratory tract by mechanical abrasion. Coughing, sneezing, chest pain, shortness of breath, inflammation of mucous membrane, and flu-like fever may occur following exposures in excess of appropriate exposure limits.

Eye Contact: Direct contact with dust may cause irritation by mechanical abrasion. Conjunctivitis may occur. Crystalline silica (quartz) may cause abrasion of the cornea.

Skin Contact: May cause abrasion to skin.

Ingestion: No adverse effects expected for incidental ingestion. Ingestion of large amounts may cause gastrointestinal tract irritation and blockage.

Medical Conditions Generally Aggravated by Exposure: The condition of individuals with existing respiratory system disease(s) (e.g., bronchitis, emphysema, chronic obstructive pulmonary disease) and/or dysfunctions can be aggravated by exposure. Exposure to dust may aggravate existing skin and/or eye conditions. Smoking and obstructive/restrictive lung diseases may also exacerbate the effects of excessive exposure to this product.

ACGIH, MSHA, and OSHA have determined that adverse effects are not likely to occur in the workplace provided exposure levels do not exceed the appropriate exposure limits. Lower exposure limits may be appropriate for some individuals including persons with pre-existing medical conditions as described under medical conditions aggravated by exposure.

A. SILICOSIS

The major concern is silicosis (lung disease), caused by the inhalation and retention of respirable crystalline silica dust. Silicosis leads to conditions such as lung fibrosis and reduced pulmonary function. The form and severity in which silicosis manifests itself, depends in part on the type and extent of exposure to silica dusts: chronic, accelerated and acute forms are recognized. In later stages the critical condition may become disabling and potentially fatal. Restrictive and/or obstructive changes in lung function may occur due to exposure. A risk associated with silicosis is development of pulmonary tuberculosis (silico-tuberculosis). Respiratory insufficiencies due to massive fibrosis and reduced pulmonary function, possibly with accompanying heart failure, are other potential causes of death due to silicosis.

Chronic or Ordinary Silicosis is the most common form of silicosis and can occur after many years of exposure to levels above the occupational exposure limits for airborne respirable crystalline silica dust. Not all individuals with silicosis will exhibit symptoms (signs) of the disease. Symptoms of silicosis may include (but are not limited to): Shortness of breath; difficulty breathing with or without exertion; coughing; diminished work capacity; diminished chest expansion; reduction of lung volume; heart enlargement and/or failure. It is further defined as either simple or complicated silicosis.

Simple Silicosis is characterized by lung lesions (shown as radiographic opacities) less than 1 centimeter in diameter, primarily in the upper lung zones. Often, simple silicosis is not associated with symptoms, detectable changes in lung function or disability. Simple silicosis may be progressive and may develop into complicated silicosis or progressive massive fibrosis (PMF).

Section 11 - Toxicological Information, continued

Complicated Silicosis or PMF is characterized by lung lesions (shown as radiographic opacities) greater than 1 centimeter in diameter. Although there may be no symptoms associated with complicated silicosis or PMF, the symptoms, if present, are shortness of breath, wheezing, cough and sputum production. Complicated silicosis or PMF may be associated with decreased lung function and may be disabling. Advanced complicated silicosis or PMF may lead to death. Advanced complicated silicosis or PMF can result in heart disease (cor pulmonale) secondary to the lung disease.

Accelerated Silicosis can occur with exposure to high concentrations of respirable crystalline silica over a relatively short period; the lung lesions can appear within five (5) years of the initial exposure. The progression can be rapid. Accelerated silicosis is similar to chronic or ordinary silicosis, except that the lung lesions appear earlier and the progression is more rapid.

Acute Silicosis can occur with exposures to very high concentrations of respirable crystalline silica over a very short time period, sometimes as short as a few months. The symptoms of acute silicosis include progressive shortness of breath, fever, cough and weight loss. Acute silicosis is a rapidly progressive, incurable lung disease and is typically fatal.

B. CANCER

IARC: The International Agency for Research on Cancer concluded that there is "*sufficient evidence* in humans for the carcinogenicity of crystalline silica in the form of quartz or cristobalite"; there is "*sufficient evidence* in experimental animals for the carcinogenicity of quartz dust" and that there is "*limited evidence* in experimental animals for the carcinogenicity of tridymite dust and cristobalite dust." The overall IARC evaluation was that "crystalline silica inhaled in the form of quartz or cristobalite dust is *carcinogenic to humans (Group 1)*." The IARC evaluation noted that not all industrial circumstances studied evidenced carcinogenicity. The monograph also stated that "Carcinogenicity may be dependent on inherent characteristics of the crystalline silica or on external factors affecting its biological activity or distribution of its polymorphs." For further information on the IARC evaluation, see IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, Volume 100C, "Silica Dust, Crystalline, in the Form of Quartz or Cristobalite" (2012).

NTP: In its Eleventh Annual Report on Carcinogens, concluded that respirable crystalline silica is known to be a human carcinogen, based on sufficient evidence of carcinogenicity from studies in humans indicating a causal relationship between exposure to respirable crystalline silica and increased lung cancer rates in workers exposed to crystalline silica dust.

OSHA: Crystalline silica is not on the OSHA carcinogen list.

There have been many articles published on the carcinogenicity of crystalline silica, which the reader should consult for additional information; the following are examples of recently published articles: (1) "Dose-Response Meta-Analysis of Silica and Lung Cancer", *Cancer Causes Control*, (20):925-33 (2009); (2) "Occupational Silica Exposure and Lung Cancer Risk: A Review of Epidemiological Studies 1996-2005", *Ann Oncol*, (17) 1039-50 (2006); (3) "Lung Cancer Among Industrial Sand Workers Exposed to Crystalline Silica", *Am J Epidemiol*, (153) 695-703 (2001); (4) "Crystalline Silica and the Risk of Lung Cancer in the Potteries", *Occup Environ Med*, (55) 779-785 (1998); (5) "Is Silicosis Required for Silica-Associated Lung Cancer?", *American Journal of Industrial Medicine*, (37) 252- 259 (2000); (6) "Silica, Silicosis, and Lung Cancer: A Risk Assessment", *American Journal of Industrial Medicine*, (38) 8-18 (2000) and (7) "Silica, Silicosis, and Lung Cancer: A Response to a Recent Working Group Report", *Journal of Occupational and Environmental Medicine*, (42) 704-720 (2000).

Section 11 - Toxicological Information, continued

C. AUTOIMMUNE DISEASES

There is evidence that exposure to respirable crystalline silica (without silicosis) or that the disease silicosis may be associated with the increased incidence of several autoimmune disorders -- scleroderma, systemic lupus erythematosus, rheumatoid arthritis and diseases affecting the kidneys. For a review of the subject, the following may be consulted: (1) "Antinuclear Antibody and Rheumatoid Factor in Silica-Exposed Workers", *Arh Hig Rada Toksikol*, (60) 185-90 (2009); (2) "Occupational Exposure to Crystalline Silica and Autoimmune Disease", *Environmental Health Perspectives*, (107) Supplement 5, 793-802 (1999); (3) "Occupational Scleroderma", *Current Opinion in Rheumatology*, (11) 490-494 (1999) and (4) "Connective Tissue Disease and Silicosis", *Am J Ind Med*, (35), 375-381 (1999).

D. TUBERCULOSIS

Individuals with silicosis are at increased risk to develop pulmonary tuberculosis, if exposed to persons with tuberculosis. The following may be consulted for further information: (1) "Tuberculosis and Silicosis: Epidemiology, Diagnosis and Chemoprophylaxis", *J Bras Pneumol*, (34) 959-66 (2008); (2) *Occupational Lung Disorders*, Third Edition, Chapter 12, entitled "Silicosis and Related Diseases", Parkes, W. Raymond (1994); (3) "Risk of Pulmonary Tuberculosis Relative to Silicosis and Exposure to Silica Dust in South African Gold Miners," *Occup Environ Med*, (55) 496-502 (1998) and (4) "Occupational Risk Factors for Developing Tuberculosis", *Am J Ind Med*, (30) 148-154 (1996).

E. KIDNEY DISEASE

There is evidence that exposure to respirable crystalline silica (without silicosis) or that the disease silicosis is associated with the increased incidence of kidney diseases, including end stage renal disease. For additional information on the subject, the following may be consulted: (1) "Mortality from Lung and Kidney Disease in a Cohort of North American Industrial Sand Workers: An Update", *Ann Occup Hyg*, (49) 367-73 (2005); (2) "Kidney Disease and Silicosis", *Nephron*, (85) 14-19 (2000); (3) "End Stage Renal Disease Among Ceramic Workers Exposed to Silica", *Occup Environ Med*, (56) 559-561 (1999) and (4) "Kidney Disease and Arthritis in a Cohort Study of Workers Exposed to Silica", *Epidemiology*, (12) 405-412 (2001).

F. NON-MALIGNANT RESPIRATORY DISEASES

NIOSH has cited the results of studies that report an association between dusts found in various mining operations and non-malignant respiratory disease, particularly among smokers, including bronchitis, emphysema, and small airways disease. See *NIOSH Hazard Review – Health Effects of Occupational Exposure to Respirable Crystalline Silica*, published in April 2002, available from NIOSH, 4676 Columbia Parkway, Cincinnati, OH 45226, or at <http://www.cdc.gov/niosh/02-129A.html>.

Respirable dust containing newly broken particles has been shown to be more hazardous to animals in laboratory tests than respirable dust containing older silica particles of similar size. Respirable silica particles which had aged for sixty days or more showed less lung injury in animals than equal exposures of respirable dust containing newly broken pieces of silica.

Potential Health Effects from Phenolic Resin Dust:

Phenolic resin dust can be generated from abrasive handling of this product and the dust may cause eye, nose, throat and lung irritation if allowed to become airborne.

Section 12 - Ecological Information

Crystalline silica is not known to be toxic to the ecology.

Section 13 - Disposal Considerations

General: Dispose of according to local, state/provincial and federal requirements. Additional information concerning disposal can be obtained by contacting Badger Mining.

Recycling the material: SDS and disposal profile available on request.

This material may qualify to be landfilled based on the class of landfill and whether this material has been contaminated. Badger Mining will supply disposal company information and information related to the material and recycling.

Section 14 - Transportation Information

U.S. Department of Transportation: Non-regulated.

Canadian Transportation of Dangerous Goods (TDG): Non-regulated.

Consult other applicable international, national, state, provincial or local laws, as needed.

Section 15 - Regulatory Information

As determined by review according to the requirements of OSHA Hazardous Communication Standard 29CFR1910.1200, this material presents possible health hazards. The OSHA Hazardous Communication Standard 29 CFR 1910.1200 and state and local worker or community "Right to Know" laws and regulations should be strictly followed. Provide training about the OSHA precautions. It is the user's responsibility to make available this SDS to employees and others who may handle or be exposed to this product. Instruct your employees to handle this product properly.

OTHER US REGULATORY INFORMATION:

SARA Title III: Section 311 and 312: Immediate health hazard and delayed health hazard.

TSCA: Crystalline Silica – quartz and phenolic resin (as phenol, polymer with formaldehyde and formaldehyde, polymer with phenol & 1,3,5,7-tetraazatricyclo[3.3.1.1^{3,7}] decane) appear on the EPA TSCA inventory under the CAS No. 14808-60-7, 9003-35-4 and 37337-65-8, respectively.

RCRA: Crystalline silica (quartz) is not classified as a hazardous waste under the Resource Conservation and Recovery Act, or its regulations, 40 CFR §261 *et seq.*

CERCLA: Crystalline silica (quartz) is not classified as a hazardous substance under regulations of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), 40 CFR §302.4

EPCRA: Crystalline silica (quartz) is not an extremely hazardous substance under regulations of the Emergency Planning and Community Right to Know Act, 40 CFR Part 355, Appendices A and B and is not a toxic chemical subject to the requirements of Section 313.

Clean Air Act: Resin coated sand was not processed with or does not contain any Class I or Class II ozone depleting substances.

FDA: Silica is included in the list of substances that may be included in coatings used in food contact surfaces, 21 CFR §175.300(b)(3). (The FDA standard primarily applies to products containing silica used in the coatings of food contact surfaces).

National Pollutant Release Inventory (NPRI), CEPA subsection 16(1): None required.

California Proposition 65: Respirable crystalline Silica is classified as a substance known to the state of California to be a carcinogen.

Massachusetts Toxic Use Reduction Act: Respirable crystalline silica is considered toxic per the Massachusetts Toxic Use Reduction Act when used in abrasive blasting and molding.

Pennsylvania Worker and Community Right to Know Act: Quartz is considered hazardous for purposes of the Act, but it is not a special hazardous substance or an environmental hazardous substance.

Domestic Substances List: Quartz is on the public portion of the Canadian DSL.

Section 15 - Regulatory Information, continued

Canadian Regulations: All information required by Controlled Products Regulation (CPR) is contained in the SDS. Product classified according to the hazard criteria of CPR.

WHMIS: CLASS D 2A and CLASS D 2B

Local, county, state/provincial or national emergency planning, right to know, or other laws, regulations or ordinances may apply. CONSULT APPLICABLE LAWS, REGULATIONS OR ORDINANCES.

Section 16 - Other Information

Definitions of Acronyms/Abbreviations:

ACGIH: American Conference of Governmental Industrial Hygienists
ANSI: American National Standards Institute
APF: Assigned Protection Factor
California REL: California Inhalation Reference Exposure Limit
CAS: Chemical Abstracts Service
CCOHS: Canadian Centre for Occupational Health and Safety
CEPA: Canadian Environmental Protection Agency
CERCLA: Comprehensive Environmental Response, Compensation and Liability Act
CFR: US Code of Federal Regulations
CPR: Controlled Products Regulation
DHHS: Department of Health and Human Services
DSL: Domestic Substances List
EPA: Environmental Protection Agency
EPCRA: Emergency Planning and Community Right to Know Act
FDA: Food and Drug Administration
GHS: Globally Harmonized System
HEPA: High-Efficiency Particulate Air
HSG: Health & Safety Guidance
IARC: International Agency for Research on Cancer
IDLH: Immediately Dangerous to Life and Health
LEL: Lower Explosive Limit
MSHA: Mine Safety and Health Administration
NFPA: National Fire Protection Association
NIOSH: National Institute for Occupational Safety and Health, US Department of Health and Human Services
NIOSH REL: NIOSH Recommended Exposure Limit
NPRI: National Pollutant Release Inventory
NTP: National Toxicology Program
OEL: Occupational Exposure Limit
OSHA: Occupational Safety and Health Administration, US Department of Labor
PEL: Permissible Exposure Limit
PMF: Progressive Massive Fibrosis
PPE: Personal Protective Equipment
RCRA: Resource Conservation and Recovery Act
SARA Title III: Title III of the Superfund Amendments and Reauthorization Act, 1986
SDS: Safety Data Sheet
STOT: Specific Target Organ Toxicity
TDG: Transportation of Dangerous Goods
TLV: Threshold Limit Value
TSCA: Toxic Substance Control Act
TWA: Time-Weighted Average
UK HSE: United Kingdom Health and Safety Executive
WHMIS: Workplace Hazardous Materials Information System

Section 16 - Other Information, continued

User's Responsibility: The OSHA Hazard Communication Standard 29 CFR 1910.1200 requires that this SDS be made available to your employees who handle or may be exposed to this product. Educate and train your employees regarding applicable precautions. Instruct your employees to handle this product properly.

Disclaimer: The information contained in this document applies to this specific material as supplied. It may not be valid for this material if it is used in combination with other materials. It is the user's responsibility to satisfy oneself as to the suitability and completeness of this information for one's own particular use. Since the actual use of the product described herein is beyond our control, Badger Mining Corporation, assumes no liability arising out of the use of the product by others. Appropriate warnings and safe handling procedures should be provided to handlers and users. An electronic version of this SDS is available at www.badgerminingcorp.com. More information on the effects of crystalline silica exposure may be obtained from OSHA (phone number: 1-800-321-OSHA; website: <http://www.osha.gov>) or from NIOSH (phone number: 1-800-35-NIOSH; website: <http://www.cdc.gov/niosh>).

DATE OF PREPARATION April 2017

REPLACES 10/2016