DENTSPLY International

Material Safety Data Sheet

Ransom & Randolph

1. Product and Company Name

Product Name Zircon powder, flour, sand, FasShell™, zircon CS & ES	*MSDS Code Number* 016
Trade Name & Synonyms Zircon	*Date of Last Revision* 07/03
Chemical Name Zirconium Silicate	*Manufacturer* Ransom & Randolph
C.A.S. Number	*Address* 3535 Briarfield Blvd, Maumee, OH 43537
Grades or Minor Variant Identities	*Information Telephone Number* 419/865-9497 FAX 419/865-9997
Product Use Investment casting	*Emergency Telephone Number* 419/865-9497

2. Composition

Hazardous Components	C.A.S. Number	%
Zirconium silicate	14940-68-2	>97
Aluminum silicate	1302-76-7	<2.0
Silica quartz	14808-60-7	<0.5
Titanium dioxide	13463-67-7	<0.3

3. Hazardous Identification

Emergency Overview

May cause eye irritation. Contains crystalline silica.

Routes of Exposure	*Signs & Symptoms*	*Single, Repeated, or Lifetime Exposure*	*Severity (Mild, Moderate, Severe)*	*Acute and Chronic Health Effect(s)*	*Target Organ(s)*
Eye	Irritation				
Skin	Inflammation				
Inhalation				Silicosis	Lungs
Ingestion				Silicosis	

Other	**Crystalline Silica** - Prolonged exposure to respirable crystalline silica may cause delayed (chronic) lung injury (silicosis, pneumoconiosis). Acute or rapidly developing silicosis may occur in a short period of time in heavy exposure in certain occupations such as sandblasters. Silicosis is a form of disabling pulmonary fibrosis, which can be progressive and may lead to death. There is evidence that individuals with silicosis may also experience incidences of scleroderma (immune system disorder), tuberculosis and nephrotoxicity (kidney lesions). **Titanium Dioxide** - inhalation of excessive amounts of titanium dioxide dust are reported to produce mild and temporary respiratory tract irritations with cough, sneezing, and shortness of breath. Grossly excessive and prolonged exposure may lead to lung injury (non-progressive lung fibrosis). Titanium Dioxide is considered to have a low degree of oral and dermal toxicity and to be practically non-irritating to skin. **Zirconium Silicate** - Contains trace quantities of naturally occurring radio active uranium, thorium, and radium (106-120 picocuries/gram) over-exposure to respirable dusts containing radioactive uranium, thorium and radium may cause lung cancer. Zircon is exempt from NRC regulations for source material per 10 CFR 40, since it falls under the definition of unprocessed material containing less than 0.05% uranium or thorium. However, calculations show that observance of 2.2-2.8 mg/m^3 of respirable dust will, under voluntary guidelines ensure that intake is less than 10% of the annual limits on intake (ALIS) specified in 10 CFR 20.1502(B) and NRC standards for protection against radiation for uranium, thorium, radium and radioactive daughter decay products.

Medical Conditions Aggravated by Exposure

Any pre-existing respiratory or pulmonary disease or condition, such as, but not limited to, bronchitis, emphysema and asthma. Individuals with silicosis are predisposed to develop tuberculosis.
Crystalline Silica: Symptoms may not appear until significant injury has occurred. Silicosis (onset may be from 2-30 years); cancer (unknown). Silicosis (onset may be from 2-30 years); cancer (unknown). Acute signs of exposure may be cough, tightness in chest, shortness of breath, eye irritation, wheezing and sputum production. Lung scarring produced by such inhalation may lead to a progressive massive fibrosis of the lung, which may aggravate other pulmonary tuberculosis. Progressive, massive fibrosis may be accompanied by right heart enlargement, heart failure, and pulmonary failure. Smoking aggravates the effects of exposure.

Carcinogenicity (IARC, NTP)

NTP: Yes	The National Toxicology Program (NTP) published its Ninth Annual Report on Carcinogens which concludes that "silica, crystalline (respirable)" is known to be a human carcinogen. The NTP conclusion is based on sufficient evidence for the carcinogenicity of respirable crystalline silica in experimental animals and limited evidence in humans.
IARC: Yes	IARC Monograph Volume 68: Silica, silicates, coal dust, and para-aramid fibrils states that there is sufficient evidence in humans for the carcinogenicity of inhaled crystalline silica in the forms of quartz and cristobalite from occupational sources. Crystalline silica is categorized in the "Group 1" category which the IARC defines as the agent is carcinogenic to humans.
OSHA: No	Not regulated by OSHA.
OTHER: California Proposition 65	Crystalline Silica (quartz) is classified as a substance known to the State of California to be a carcinogen.

Potential Environmental Effects

4. First Aid Measures

Routes of Exposure	*First Aid Instructions*	*Immediate Medical Attention*	*Delayed Effects*
Eye	Immediately flush with water.		Seek medical attention if irritation persists.

Skin	Flush material from skin with water.		Seek medical attention if irritation develops or persists.
Inhalation	Remove to fresh air.		Seek medical attention if any adverse reaction develops.
Ingestion			Seek medical attention as a precaution if discomfort occurs.
Other			

Note to Physicians (Treatment, Testing, and Monitoring)
Treat symptomatically

5. Fire-fighting Measures

Flashpoint: (Method) N/A	*Flammable (Explosive) Limits in Air* LEL: N/A *UEL:* N/A	*Autoignition Temperature:* None	*Other* This product is not flammable and does not support combustion.
Flame Propagation or Burning Rate (for solids):	*Properties Contributing to Fire Intensity*	*Flammability Classification NFDA Rating*:	

Extinguishing Media Use any media that is appropriate for the surrounding fire.	*Extinguishing Media to Avoid*	

Protection and Procedures for Firefighters:
Avoid eye and skin contact. Do not breathe fumes. Fire fighters who may be exposed to products of combustion should wear full fire fighting, turnout gear and approved self-contained breathing apparatus.

Unusual Fire and Explosion Hazards:
None

6. Accidental Release Measures

Containment Techniques

Spill/Leak Clean-Up Procedures and Equipment
Use dustless methods (vacuum) and place into closable container. Do not dry sweep. Wear protective equipment.

Evacuation Procedures

Special Instructions

Reporting Requirements
Consult a regulatory specialist to determine appropriate reporting requirements.

7. Handling and Storage

Handling Practices and Warnings
Avoid breakage of bagged material or spills of bulk material. Avoid breathing dust. Wash thoroughly after handling.

Storage Practices and Warnings

8. Exposure Controls/Personal Protection

Ventilation	*Other Engineering Controls* Use sufficient local exhaust to reduce the level of respirable dust to the permissible exposure limit.	
Routes of Entry:	*Personal Protective Equipment (PPE) for Normal Use:*	*PPE for Emergencies:*
Eye/Face	Wear protective shield (safety glasses) when exposed to dust particles.	Eye wash and shower.
Skin	Wear appropriate chemical resistant protective clothing and chemical resistant gloves.	

Zirconium Silicate		
ACGIH STEL	-Zirconium compound, as Zr	10 mg/m^3
ACGIH TWA	-Zirconium compound, as Zr	5 mg/m^3
OSHA TWA PEL	-Zirconium compound, as Zr	5 mg/m^3

See TABLE OF OCCUPATIONAL EXPOSURE LIMITS VALUES for quartz, cristobalite, and tridymite.

General Hygiene Considerations and Work Practices

Avoid inhalation and ingestion of this material. Avoid eye contact. Avoid creating dust.

Other Protective Measures and Equipment

Other precautions:	Use dustless systems for handling, storage and clean up so that airborne dust does not exceed the PEL. Use adequate ventilation and dust collection. Practice good housekeeping. Do not permit dust to collect on walls, floors, sills, ledges, machinery, or equipment. Maintain, clean and fit test respirators in accordance with OSHA regulations. Maintain and test ventilation and dust collection equipment. Wash or vacuum clothing which has become dusty. See OSHA Hazard Communication Rule 29 CFR Sections 1910.1200, 1915.99, 1917.28, 1918.90, 1926.59 and 1928.21, and state and local worker or community "right to know" laws and regulations. We recommend that smoking be prohibited in all areas where respirators must be used. WARN YOUR EMPLOYEES (AND CUSTOMERS-USERS IN CASE OF RESALE) BY POSTING AND OTHER MEANS OF THE HAZARD AND OSHA PRECAUTIONS TO BE USED. PROVIDE TRAINING FOR YOUR EMPLOYEES ABOUT THE OSHA PRECAUTIONS. See also American Society for Testing and Materials (ASTM) Standard Practice E1132-86, "Standard Practice for Health Requirements Relating to Exposure to Quartz Dust."

Respirator Protection: The following chart specifies the types of respirators, which may provide respiratory protection for crystalline silica.

CONDITION Particulate Concentration	**RESPIRATORY PROTECTION FOR CRYSTALLINE SILICA MINIMUM RESPIRATORY PROTECTION***
Up to 5 x PEL	Any dust respirator.
Up to 10 x PEL	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.
Up to 50 x PEL	A high efficiency particulate filter respirator with a full-face piece. Any supplied-air respirator with a full-face piece, helmet, or hood. Any self-contained breathing apparatus with a full-face piece.
Up to 500 x PEL	A powered air-purifying respirator with a high efficiency particulate filter. A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode.
Greater than 500 x PEL or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full-face piece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full-face piece operated in pressure-demand or other positive pressure continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Abrasive Blasting	Any Type CE, supplied-air respirator with a full-face piece, hood, or helmet, operated in a positive-pressure mode. (See 29 CFR Section 1910.94 (a).)

9. Physical and Chemical Properties

Appearance White grain or powder			*Odor* Odorless
Normal Physical State: *Liquid* *Gas* *Solid* X		*Boiling Point* *Melting Point* *Freezing Point*	N/A N/A N/A
Specific Gravity or Density (H_20=1) 4.68	*Solubility in Water* Insoluble		*pH* @10
Vapor Pressure (mm Hg.) N/A	*Vapor Density (AIR = 1)* N/A		*Evaporation Rate (Butyl Acetate=1)*
Other			

10. Stability and Reactivity

Incompatibility (Materials to Avoid) None			
Hazardous Products Produced During Decomposition Zircon will disassociate to zirconium oxide (ZrO_2) and silicon dioxide (SiO_2) when heated above 1540° C.			
Hazardous Polymerization?	*May Occur*	*May Not Occur* Y	*Conditions to Avoid* N/A
Stability?	*Stable* Y	*Unstable*	*Conditions to Avoid* None

11. Toxicological Information

Toxicity Data, Epidemiology Studies, Carcinogenicity, Neurological Effects, Genetic Effects, Reproductive Effects, or Structure Activity Data

Data on this material and/or its components are summarized below. Zirconium Silicate - Following single or repeated intraperitoneal doses, this material was considered to be physiologically inert. Following repeated inhalation exposure to dust of this material, radiographic lung shadows were reported in rats; however, histological examination of the lung tissues showed no changes. Following implantation of a disc of this material into the muscle tissue of rabbits, histological examination of the surrounding tissues did not show any effects that were different from other materials used in medical implants.

This material contains trace quantities of naturally occurring radioactive uranium, thorium, and radium (106-120 picocuries/gram). Overexposure to respirable dusts containing radioactive uranium, thorium, and radium may cause lung cancer. (Zircon is exempt from NRC regulations for source material per 10 CFR 40, since it falls under the definition of material containing less than 0.05% uranium or thorium. However, calculations show that observance of 2.2-2.8 mg/m^3 of respirable dust will, under voluntary guidelines, ensure that intake is less than 10% of the annual limits on intake (ALIS) specified in 10 CFR 20.1502(B) and NRC standards for protection against radiation for uranium, thorium, radium and radioactive daughter decay products.) Zirconium and Zirconium Compounds - Single exposure (acute) studies indicate that zirconium and zirconium compounds are slightly toxic to mice, rats, and guinea pigs if swallowed [LD50 990 to 2,290 mg/kg (insoluble zirconium salts)] and practically non-toxic to rats, guinea pigs, rabbits, cats, and dogs if inhaled (LC.6 mg/l). Studies of humans suggest that repeated overexposure to zirconium causes allergic skin granulomas with symptoms of rough and grainy skin. Following repeated or long-term inhalation exposure to zirconium oxide dust, no adverse effects were observed in rats. No adverse effects were observed in long-term drinking water or feeding studies of zirconium metal in rats and mice. Zirconium metal did not increase the incidence of tumors in long-term oral studies in rats. Zirconium has produced no genetic changes in standard tests using bacterial cells. Quartz Chronic inhalation of crystalline silica may cause a progressive pneumoconiosis (silicosis), a form of disabling lung disease (pulmonary fibrosis). Data from animal studies on crystalline forms of silica confirm the capacity of free crystalline silica to induce a fibrinogenic response in lungs. Studies on a variety of laboratory animals (rats, guinea pigs, rabbits, and monkeys) using inhalation as well as intratracheal routes of exposure indicate the ability of crystalline silica to produce silicosis similar to that seen in man. In addition, experiments in animals have confirmed human experience that the presence of crystalline silica in the lung increased susceptibility to tuberculosis and other lung infections. Crystalline silica inhaled in the form of quartz is classified as “carcinogenic to humans” by the International Agency for Research on Cancer (IARC), and respirable forms of crystalline silica are listed as substances that “may reasonably be anticipated to be carcinogens” by the National Toxicology Program. The IARC listing is based on the determination that there is sufficient evidence in humans for the carcinogenicity of inhaled crystalline silica in the form of quartz from occupational exposures. Epidemiology studies cited by IARC give indications of increased risk for lung cancer from inhaled crystalline silica (quartz) resulting from occupational exposure. Studies involving heavy industrial exposure to silica in granite and foundry workers, brick factories and sandblasting produced increased levels of protein and enzymes in urine, which is indicative of kidney damage.

12. Ecological Information

Toxicity, Environmental Fate, Physical/Chemical Data, or Other Data Supporting Environmental Hazard Statements

Data on this material and/or its components are summarized below. Zirconium and Zirconium Compounds Zirconium is moderately toxic to green algae (96-hr EC50 2.6 mg/l), no more than slightly toxic to rainbow trout (96-hr LC50 >20 mg/l), slightly to moderately toxic to bluegill sunfish (96-hr LC50 15-240 mg/l) and slightly toxic to practically non-toxic to fathead minnow (96-hr LC50 14-115 mg/l).

Chemical Fate Information

Data on this material and/or its components are summarized below. Zirconium and Zirconium Compounds Zirconium is an element and will not degrade. It occurs in the environment in insoluble forms which remain unavailable to living organisms. In a bioconcentration assay in bluegill sunfish, zirconium showed a low potential bioaccumulate with a bioconcentration factor of 3.3.

13. Disposal Considerations

Regulations

Properties (Physical/Chemical) Affecting Disposal

Dispose in accordance with Federal, State, and Local regulations. Zircon may contain traces of radioactive materials, such as uranium and thorium. The combined content of uranium and thorium is less than the 500-ppm limit for source material as set by the Nuclear Regulatory Commission. Zircon mineral products are not currently regulated by the EPA as hazardous wastes, but individual states and localities do have disposal regulations so it is advisable to check with them for specific disposal instructions.

14. Transport Information

Regulated for shipping?	*Proper Shipping Name*	*Packing Group*
Yes *No* X	Sand	N/A
Do changes in quality, packaging, or shipment method change product classification?	*Hazard Class*	*Identification Number*
Yes *No* X	N/A	N/A

Other

15. Regulator Information

Federal Regulations

Hazard Categories Under Criteria of SARA Title IIII Rules (40 CFT Part 370)

Immediate (Acute) Health	Fire	N
Delayed (Chronic Health	Reactive	N
	Sudden Release of Pressure	N

The components of this product are all on the TSCA inventory list.

Ingredient Related Regulatory Information:

SARA Reportable Quantities	CERCLA RQ	SARA TPQ
Quartz	NE	
Zirconium Silicate	NE	
Aluminum Silicate	NE	

SARA Title III, Section 313

This product does contain chemical(s) which are defined as toxic chemicals under and subject to the reporting requirements of, Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 986 and 40 CFR Part 372. See Section 2
Alumina Silicate

California Prop 65 – Carcinogen

This product does contain the following chemical(s), as indicted below, currently on the California list of Known Carcinogens.
Quartz

Massachusetts Right to Know

This product does contain the following chemicals(s), as indicated below, currently on the Massachusetts Right to Know Substance List.
Aluminum Silicate
Quartz
Zirconium Silicate

New Jersey Right to Know

This product does contain the following chemical(s), as indicated below, currently on the New Jersey Right-to-Know substances List.
Aluminum Silicate
Quartz
Zirconium Silicate

Pennsylvania Right to Know

This product does contain the following chemical(s), as indicated below, currently on the Pennsylvania Hazardous Substance List.
Aluminum Silicate
Quartz
Zirconium Silicate

International Regulations

Other

16. Other Information

NFPA Hazard Rating	**Health:** 1	**Flammability:** 0	**Reactivity:** 0
HMIS Hazard Rating	**Health:** 3	**Flammability:** 0	**Reactivity:** 0
	Personal Protection: Use NIOSH/OSHA approved respirator.		

The information set forth herein has been gathered from standard reference materials and/or Ransom & Randolph Company test data and is, to the best knowledge and belief of Ransom & Randolph Company accurate and reliable. Such information is offered solely for your consideration, investigation and verification and it is not suggested or guaranteed that the hazard precautions or procedures mentioned are the only ones which exist. Ransom & Randolph Company makes no warranties, express or implied, with respect to the use of such information or the use of the specific material identifies here in combination with any other material or process, and assumes no responsibility therefore.

TABLE OF OCCUPATIONAL EXPOSURE LIMIT VALUES

The following table shows the Occupational Exposure Limits (OEL) for quartz, cristobalite and tridymite in application in Europe and in some other countries.

Country	Occupational Exposure Limit (OEL) Name	Adopted by	Quartz (q)	Cristobalite (c)	Tridymite (t)
Australia	National Exposure Standard	Worksafe Australia, National Occupational Health & Safety Commission	0.2	0.1	
Austria	Maximalen ArbeitsplatzKoncentration	Bundesministerium für Arbeit und Soziales	0.15	0.15	0.15
Belgium		Ministére de l'Emploi et du Travail	0.1	0.05	0.05
Denmark	Threshold Limit Value	Direktoratet fot Arbeidstilsynet	0.1	0.05	0.05
Finland	Occupational Exposure Standard	National Board of Labour Protection	0.2	0.1	0.1
France	Empoussiérage de reference	Ministére de l'Industrie (RGIE)	5 or 25k/Q		
	Valeur limite de Moyenne d'Exposition	Ministére du Travail	0.1	0.05	0.05
Germany	Maximalen ArbeitsplatzKoncentration	Grenzwerte in der Luft am Arbeitsplatz	0.15	0.15	0.15
Greece		Legislation for mining activities	0.1	0.05	0.05
Ireland		2001 Code of practice for the Safety, Health & Welfare at Work (CoP)	0.05	0.4	0.4
Italy	Threshold Limit Value	Associazone Itallana Degli Igienisti Industriali	0.05	0.05	0.05
Luxembourg	Maximlen ArbeitsplatzKoncentration	Grenzwerte in der Luft am Arbeitsplatz	0.15	0.15	0.15
Netherlands	Maximaal Aanvarde Concentratie	Ministerie van Sociale Zaken en Werkgelegenheid	0.075	0.075	0.075
Norway	Threshold Limit Value	Direktoratet for Arbeidstilsynet	0.1	0.05	0.05
Portugal	Threshold Limit Value	Instituto Portuges da Qualidade, Hygiene & Safety at Workplace	0.1	0.05	0.05
Spain	Valores Limites	Instituto Nacional de Seguridad e Higiene en el Trabajo	0.1		
		Instrucciones de Técnicas Complementarias (ITC)	0.1	0.05	0.05
		Reglamento General de Normas Basicas de Seguridad Minera	5 or 25k/Q		
Sweden		National Board of Occupational Safety and Health	0.1	0.05	0.05
Switzerland	Valeur limite de Moyenne d'Exposition		0.15	0.15	0.15
United Kingdom	Maximum Exposure Limit	Health & Safety Executive	0.3	0.3	0.3
	Occupational Exposure Standard				
USA	Permissible Exposure Limit	Occupational Safety & Health Administration	$10/(\%SiO_2+2)$	PEL (Quartz)/2	PEL (Quartz)/2
	Threshold Limit Value	American Conference of Governmental Industrial Hygienists	0.05	0.05	0.05

Q: quartz percentage
Source: Adapted from IMA-Europe
Date: 08/05/03, Updated version available at http://www.ima-eu.org/en/silhsefacts.html
OELs are applicable to 100 % quartz, cristobalite or tridymite.
Some countries have special rules for mixed dust, e.g. in France the following equation is applied: $C_{ns}/5 + C_q/0.05+C_t/0.05 \leq 1$ (C = mean concentration, ns = non silicogen)