MATERIAL SAFETY DATA SHEET

1. Chemical product and company identification

A. Product name **Tronox® Titanium Dioxide, All Grades**

Synonyms CR-470, CR-800E, CR-813, CR-822, CR-826, CR-828, CR-834, 8120, CR-880, 8300, 8400, 8410, 8670, 8800, 8870, 8140, 41J.

Product code 77891, Pigment White #6

B. Recommended use and Limitations on use

Recommended use White pigment for applications in coatings, inks, fibers, plastics, paper.

Manufacturer/Importer/Distributor Information

Manufacturer/Supplier

Company name Tronox LLC
3301 NW 150th Street
Oklahoma City, OK 73134

Country USA

Email ChemProdSteward@tronox.com

Telephone +1-405-775-5000 (24-hours)

Emergency telephone number +1-760-476-3960 (Access code 333318)

MSDS number B-5017

2. Hazards identification

A. Hazard category/Classification

Physical hazards Not classified.

Health hazards Not classified.

Environmental hazards Not classified.

B. Warning label items including precautionary statement

• Pictogram None.

• Signal word None.

• Hazard statement The product does not meet the criteria for classification.

• Precautionary statement

Prevention Observe good industrial hygiene practices.

Response Flush skin thoroughly with water.

Storage Store in a sealed container.

Disposal Dispose of waste and residues in accordance with local authority requirements.

C. Other hazards not included in the hazard category criteria (e.g. dust explosion hazard) Dusts or powder may irritate the respiratory tract, skin and eyes. Frequent inhalation of fume/dust over a long period of time may increase the risk of developing lung diseases although epidemiological studies among titanium dioxide workers could not demonstrate this.

3. Composition/information on ingredients

Chemical identity	Common and alternative names	CAS number	ID number	Content in percent (%)
Titanium dioxide		13463-67-7	KE-33900	80 - 97
Silicon dioxide		7631-86-9	KE-31032	0 - 15
Aluminum hydroxide		21645-51-2	KE-00980	0 - 10
Zirconium dioxide		1314-23-4	KE-35630	0 - 2

Composition comments Components listed make up an inseparable chemically reacted pigment. Silicon dioxide is present in finished product as amorphous silica.

4. First aid measures

A. In case of eye contact Do not rub eyes. Immediately rinse eyes with water. Remove any contact lenses, and continue flushing eyes with running water for at least 15 minutes. Hold eyelids apart to ensure rinsing of the entire surface of the eye and lids with water. Get immediate medical attention.

B. In case of skin contact	Flush skin thoroughly with water. Get medical attention if irritation develops or persists.
C. In case of inhalation	Move to fresh air. Get medical attention if any discomfort continues.
D. In case of swallowing	Rinse mouth thoroughly. Do not induce vomiting without advice from poison control center. Never give anything by mouth to an unconscious person. If ingestion of a large amount does occur, call a poison control center immediately.
E. Note to physician	Treat symptomatically.
General advice	Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

5. Fire-fighting measures

A. Suitable (and unsuitable) extinguishing media

Suitable extinguishing media	Use fire-extinguishing media appropriate for surrounding materials.
Unsuitable extinguishing media	No restrictions known.
B. Specific hazards arising from the chemical (example: hazardous combustion products)	None known.

C. Specific methods of fire-fighting

Special protective equipment for firefighters	Selection of respiratory protection for firefighting: follow the general fire precautions indicated in the workplace. Self-contained breathing apparatus and full protective clothing must be worn in case of fire.
Special fire fighting procedures	Move containers from fire area if you can do so without risk. Prevent runoff from fire control or dilution from entering streams, sewers, or drinking water supply.
General fire hazards	The product is not flammable.

6. Accidental release measures

A. Personal precautions, protective equipment and emergency measures	Avoid inhalation of dust and contact with skin and eyes. Wear appropriate protective equipment and clothing during clean-up. Local authorities should be advised if significant spillages cannot be contained.
B. Environmental precautions	Prevent further leakage or spillage if safe to do so. Do not contaminate water.
C. Methods and materials for containment and cleaning up	Avoid dust formation. Collect powder using special dust vacuum cleaner with particle filter or carefully sweep into closed container. Prevent entry into waterways, sewer, basements or confined areas. For waste disposal, see Section 13 of the MSDS.

7. Handling and storage

A. Precautions for safe handling	Avoid inhalation of dust and contact with skin and eyes. Use only with adequate ventilation. Use Personal Protective Equipment recommended in section 8 of the MSDS. Wash thoroughly after handling. Observe good industrial hygiene practices.
B. Conditions for safe storage (including any incompatibilities)	Titanium dioxide is a stable chemical compound that does not decompose during storage but can pick up moisture from the environment if not stored properly effecting product performance. Store indoors in a dry place, away from rain and wet floors. Use on a first-in first-out basis from receipt of the shipment.

8. Exposure controls/personal protection

A. Exposure limit values, biological limit values, etc

Korea. OELs. Standards for Exposure to Chemical Substances and Physically Hazardous Factors

Components	Type	Value
Silicon dioxide (CAS 7631-86-9)	TWA	10 mg/m3
Titanium dioxide (CAS 13463-67-7)	TWA	10 mg/m3
Zirconium dioxide (CAS 1314-23-4)	STEL	10 mg/m3
	TWA	5 mg/m3

US. ACGIH Threshold Limit Values

Components	Type	Value	Form
Aluminum hydroxide (CAS 21645-51-2)	TWA	1 mg/m3	Respirable fraction.
Titanium dioxide (CAS 13463-67-7)	TWA	10 mg/m3	
Zirconium dioxide (CAS 1314-23-4)	STEL	10 mg/m3	

US. ACGIH Threshold Limit Values

Components	Type	Value	Form
	TWA	5 mg/m3	

Biological limit values No biological exposure limits noted for the ingredient(s).

B. Appropriate engineering controls Ventilate as needed to control airborne dust. Provide adequate ventilation. Observe Occupational Exposure Limits and minimize the risk of inhalation of dust.

C. Personal protective equipment

- **Respiratory protection** In case of inadequate ventilation or risk of inhalation of dust, use suitable respiratory equipment with particle filter. Seek advice from local supervisor.
- **Eye protection** Wear dust-resistant safety goggles where there is risk of eye contact.
- **Hand protection** Wear suitable gloves. Suitable gloves can be recommended by the glove supplier.
- **Body protection** Wear appropriate clothing to prevent repeated or prolonged skin contact.

Hygiene measures Do not breathe dust. Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants.

9. Physical and chemical properties

A. Appearance White powder.

- **Physical state** Solid.
- **Form** Powder.
- **Color** White.

B. Odor Odorless.

C. Odor threshold Not applicable.

D. pH Not applicable.

E. Melting point/freezing point

- **Melting point** 3326 - 3362 °F (1830 - 1850 °C)

F. Boiling point, initial boiling point, and boiling range 4532 - 5432 °F (2500 - 3000 °C)

G. Flash point Not available.

H. Evaporation rate Not available.

I. Flammability (solid, gas) Not applicable.

J. Upper/lower limit on flammability or explosive limits

- **Flammability limit - lower (%)** Not available.
- **Flammability limit - upper (%)** Not available.
- **Explosive limit - lower (%)** Not available.
- **Explosive limit - upper (%)** Not available.

K. Vapor pressure Not available.

L. Solubility

- **Solubility (water)** Insoluble in water.

M. Vapor density Not available.

N. Specific gravity 4.1 Approx. (@ 20°C)

O. n-octanol/water partition coefficient Not applicable.

P. Auto-ignition temperature Not available.

Q. Decomposition temperature Not available.

R. Viscosity Not applicable.

S. Molecular weight Not available.

Other data

- **Bulk density** 600 kg/m³ Approx. (@ 20°C)
- **Explosive properties** Not explosive.
- **Oxidizing properties** Not oxidizing.

10. Stability and reactivity

Reactivity The product is stable and non-reactive under normal conditions of use, storage and transport.

A. Stability and hazardous reaction potential

Stability	Material is stable under normal conditions.
Hazardous reaction potential	Hazardous polymerization does not occur.
B. Conditions to avoid (e.g. static discharge, shock or vibration, etc)	Avoid dust formation.
C. Incompatible materials	None known.
D. Hazardous decomposition products	No hazardous decomposition products are known.

11. Toxicological information

A. Information on likely routes of exposure

• Respiratory organs	Dust may irritate respiratory system.
• Skin	Dust may irritate skin.
• Eyes	Dust may irritate the eyes.
• Mouth	Ingestion may cause irritation and malaise.

B. Information on health hazards

• Acute toxicity (list all possible routes of exposure)	May cause discomfort if swallowed.

Components	Species	Test Results
Aluminum hydroxide (CAS 21645-51-2)		
Acute		
Oral		
LD50	Rat	> 5000 mg/kg

• Corrosivity or irritation to the skin	Dust may irritate skin. Skin irritation occurs on contact with moist or wet skin.
• Serious eye damage/eye irritation	Dust may irritate the eyes. Dust in the eyes: Exposed individuals may experience eye tearing, redness, and discomfort.
• Respiratory sensitization	None known.
• Skin sensitization	Not a skin sensitizer.
• Carcinogenic properties /Carcinogenicity	Suspected of causing cancer. IARC has classified TIO2 as 2B Possibly carcinogenic to humans. However, the only evidence of carcinogenicity is in rats exposed to very high concentrations. Two major epidemiology studies among titanium dioxide workers in the US and in EUROPE could not demonstrate an elevated lung cancer risk. Boffetta et. al. Mortality among workers employed in the titanium dioxide production industry in Europe. Cancer Causes Control. 2004 Sep;15(7):697-706. Fryzek et. al. A cohort mortality study among titanium dioxide manufacturing workers in the United States. J Occup Environ Med. 2003 Apr;45(4):400-9. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans. IARC Monographs, Volume 93 (Summary)

IARC Monographs. Overall Evaluation of Carcinogenicity

Silicon dioxide (CAS 7631-86-9)	3 Not classifiable as to carcinogenicity to humans.
Titanium dioxide (CAS 13463-67-7)	2B Possibly carcinogenic to humans.

• Mutagenic properties /Mutagenicity	No data available to indicate product or any components present at greater than 0.1% are mutagenic or genotoxic.
• Reproductive toxicity	None known.
• Specific target organ toxicity - single exposure	None known.
• Specific target organ toxicity - repeated exposure	None known.
• Aspiration hazard	Not classified.

12. Ecological information

A. Ecotoxicity

Hazardous to the aquatic environment, acute hazard	An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

Hazardous to the aquatic environment, long-term hazard	An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.
B. Persistence/degradability	The degradability of the product has not been stated.
C. Bioaccumulative potential	Bioaccumulation is unlikely to be significant because of the low water solubility of this product.
D. Mobility in soil	The product is insoluble in water and will sediment in water systems.
E. Other adverse effects	Not established.

13. Disposal considerations

A. Method of disposal	Disposal recommendations are based on material as supplied. Disposal must be in accordance with current applicable laws and regulations, and material characteristics at time of disposal. Dispose of this material and its container to hazardous or special waste collection point. Do not allow this material to drain into sewers/water supplies.
B. Disposal considerations (including disposal of contaminated containers or packaging)	Since emptied containers may retain product residue, follow label warnings even after container is emptied.

14. Transport information

IATA

A. UN number	Not applicable.
B. UN proper shipping name	Not applicable.
C. Transport hazard class(es)	
Class	Not applicable.
Subsidiary risk	-
D. Packing group	Not applicable.
E. Environmental hazards	No.
F. Special precautions for user	Not applicable.

IMDG

A. UN number	Not applicable.
B. UN proper shipping name	Not applicable.
C. Transport hazard class(es)	
Class	Not applicable.
Subsidiary risk	-
D. Packing group	Not applicable.
E. Environmental hazards	
Marine pollutant	No.
EmS	Not applicable.
F. Special precautions for user	Not applicable.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not applicable.

15. Regulatory information

A. Restrictions under the Industrial Safety and Health Law

Harmful Substances Prohibited from Manufacturing

Not regulated.

Harmful Substances Requiring Permission for Manufacture or Use

Not regulated.

Controlled Hazardous Substances

Aluminum hydroxide (CAS 21645-51-2)
Titanium dioxide (CAS 13463-67-7)
Zirconium dioxide (CAS 1314-23-4)

Harmful Substances Requiring Special Medical Examination

Aluminum hydroxide (CAS 21645-51-2)
Zirconium dioxide (CAS 1314-23-4)

Workplace Environmental Monitoring Harmful Materials

Aluminum hydroxide (CAS 21645-51-2)
Titanium dioxide (CAS 13463-67-7)
Zirconium dioxide (CAS 1314-23-4)

Occupational Exposure Limit

Silicon dioxide (CAS 7631-86-9)

Titanium dioxide (CAS 13463-67-7)
Zirconium dioxide (CAS 1314-23-4)

B. Restrictions under the Toxic Chemicals Control Law

Accidental Release Prevention Substances

Not regulated.

Banned Toxic Chemicals

Not regulated.

Observational Chemicals

Not regulated.

Restricted Chemical Substances

Not regulated.

Toxic Chemicals

Not regulated.

C. Restrictions under the Dangerous Substance Safety Management Act

Not dangerous goods under the Dangerous Substance Safety Management Law

D. Restrictions under the Wastes Control Act

Halogenated Materials in Waste Organic Solvents

Not regulated.

Hazardous Substances

Not regulated

E. Restrictions under other foreign or domestic laws

Clean Air Conservation Act

Air Pollutants

Aluminum hydroxide (CAS 21645-51-2)

Specific Air Pollutants

Not regulated.

Further information This material safety data sheet was prepared in accordance with Article 41 of the Industrial Safety and Health Law.

Inventory status

Country(s) or region	Inventory name	On inventory (yes/no)*
Korea	Existing Chemicals List (ECL)	Yes

*A "Yes" indicates this product complies with the inventory requirements administered by the governing country(s).
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

16. Other information

A. Source of information IARC Monographs. Overall Evaluation of Carcinogenicity
HSDB® - Hazardous Substances Data Bank

B. Issue date 07-January-2011

C. Number of revisions and date of most recent revision 13-March-2015 (09 revision)

D. Other Not available.

Further information Nanoparticle Statement- The average primary particle size of this product is larger than the nanoparticle size range as described by ISO/TC 229 and should not be considered as manufactured nanoparticles or nanomaterials. As with other particulate materials there will be a distribution of particle sizes around the average and a small portion of these may be covered by the nanoparticle definition. In this product, the primary particle size is in the 200-300 nm range. However, the primary particle size does not represent the size of particles in this product as supplied since these tend to aggregate or agglomerate into larger particles.

Synonyms:
CR-470, CR-800E, CR-813, CR-822, CR-826, CR-828, CR-834, 8120, CR-880, 8300, 8400, 8410, 8670, 8800, 8870, 8140, 41J.

Disclaimer The information in the sheet was written based on the best knowledge and experience currently available.

This MSDS contains revisions in the following section(s): This safety data sheet contains revisions in the following section(s): 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16