



**SAFETY DATA SHEET**  
**THORIUM OXIDE - ThO<sub>2</sub> (IMPURITY STANDARD)**

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SECTION 1: CHEMICAL PRODUCTS & COMPANY IDENTIFICATION \_

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NBL Program Office  
U. S. Department of Energy,  
1 Science.gov Way,  
Oak Ridge, TN 37830  
1-865-576-0598

Off Hours Emergency Numbers:  
1-865-576-0598

Substance: Thorium Oxide (Impurity Standard)

Trade Names/Synonyms: CRM 66 (1-7)

Chemical Family: Metal Oxide (Crystalline)

Radioactive

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SECTION 2: HAZARDS IDENTIFICATION

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**OSHA Hazards**

Toxic by inhalation, toxic by ingestion, toxic by skin absorption, may cause cancer.

**Target Organs**

Blood, kidneys, liver, lungs, bone marrow, reproductive system.

**GHS Classification** in accordance with 29 CFR 1910 (OSHA HCS)

Acute toxicity, Oral (Category 3), H301

Acute toxicity, Inhalation (Category 3), H331

Acute toxicity, Dermal (Category 3), H311

Carcinogenicity (Category 1B), H350

Specific target organ toxicity - repeated exposure (Category 2), H373

GHS Label elements, including precautionary statements



Pictogram:

Signal word: Danger

Hazard statement(s)

H301 + H311 + H331 Toxic if swallowed, in contact with skin or if inhaled  
H350 May cause cancer.  
H373 May cause damage to organs through prolonged or repeated exposure.

Precautionary statement(s)

P201 Obtain special instructions before use.  
P202 Do not handle until all safety precautions have been read and understood.  
P260 Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.  
P264 Wash skin thoroughly after handling.  
P270 Do not eat, drink or smoke when using this product.  
P271 Use only outdoors or in a well-ventilated area.  
P280 Wear protective gloves/ protective clothing.  
P301 + P310 IF SWALLOWED: Immediately call a POISON CENTER or doctor/ physician.  
P302 + P352 IF ON SKIN: Wash with plenty of soap and water.  
P304 + P340 IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.  
P308 + P313 IF exposed or concerned: Get medical advice/ attention.  
P322 Specific measures (see supplemental first aid instructions on this label).  
P330 Rinse mouth.  
P361 Remove/Take off immediately all contaminated clothing.  
P363 Wash contaminated clothing before reuse.  
P403 + P233 Store in a well-ventilated place. Keep container tightly closed.  
P405 Store locked up.  
P501 Dispose of contents/ container to an approved waste disposal plant.

Hazards not otherwise classified (HNOC) or not covered by GHS  
Radioactive.

CERCLA Ratings (SCALE 0-3): HEALTH=3 FIRE=0 REACTIVITY=0  
PERSISTENCE = 3

NFPA RATINGS (SCALE 0-4): HEALTH=2 FIRE=0 REACTIVITY=0

HMIS Rating (SCALE 0-4): HEALTH=2, FIRE=0, REACTIVITY=0.

EMERGENCY OVERVIEW: White, heavy, hexagonal crystals or amorphous powder. Cancer hazard (may cause cancer in humans). Risk of cancer depends on duration and level of exposure. May damage the lungs. May be irritating to skin and eyes. May affect the heart. May cause blood disorders. May cause convulsions. May affect the central nervous system. May cause adverse reproductive effects. May cause eye damage. Do not breathe dust. Do not get in eyes, on skin, or on clothing. Keep container tightly closed. Wash thoroughly after handling. Use only with adequate ventilation. Handle with caution.

#### POTENTIAL HEALTH EFFECTS:

##### INHALATION:

Short Term Exposure: May cause coughing. No information available on significant adverse effects.

Long Term Effects: May cause coughing, weight loss, bloody sputum, difficulty in breathing, weakness, bluish skin color, lung damage and heart disorders. May also cause anemia, cataracts and cancer. May cause liver and kidney damage.

##### SKIN CONTACT:

Short Term Exposure: May cause irritation.

Long Term Effects: No information is available.

##### EYE CONTACT:

Short Term Exposure: May cause irritation, redness and swelling of the eyes and eye damage.

Long Term Effects: Same as short term exposure with increased risk of eye damage due to scratching of corneas and radiation induced cataracts.

##### INGESTION:

Short Term Exposure: May cause irritation of the digestive tract.

Long Term Effects: May cause liver and kidney damage. The toxicologic properties of this substance have not been fully investigated. May cause bone marrow damage. May cause blood abnormalities. May cause lung damage.

##### CARCINOGEN STATUS:

OSHA: N

NTP: Y

IARC: N

ACGIH: N

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## SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

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Thorium Oxide (ThO<sub>2</sub>) CAS Number 1314-20-1 >99%

Other contaminants: Trace amounts of the following elements may be present. These elements are present in concentrations of less than one tenth of one percent. See the Certificate of Analysis provided with each CRM for actual quantities of these impurities: Aluminum, Cadmium, Iron, Magnesium, Manganese, Nickel, Zinc, Silver, Copper, Chromium, Lead, Beryllium, Calcium, Bismuth, Vanadium, Molybdenum, Phosphorus, Tin, Boron, Sodium, Potassium.

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#### SECTION 4: FIRST AID MEASURES

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**INHALATION:** Remove from exposure area to fresh air immediately. If breathing has stopped, perform artificial respiration. Keep person warm and at rest. Treat symptomatically and supportively. Get medical attention immediately.

**SKIN CONTACT:** Remove victim to a suitable area for decontamination as quickly as possible. Remove clothing and shoes immediately. Thoroughly wash the victim with soap and water, paying particular attention to the head, finger nails and palms of the hands

**EYE CONTACT:** Wash eyes immediately with large amounts of water or normal saline, occasionally lifting upper and lower lids, until no evidence of chemical remains (approximately 15-20 minutes). Get medical attention immediately.

**INGESTION:** In the case of ingestion of radioactive substances, the mouth should be rinsed out immediately after the accident. Care should be taken not to swallow the water used for this purpose. Vomiting should be induced either mechanically, or with syrup of ipecac. Get medical attention immediately.

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#### SECTION 5: FIREFIGHTING MEASURES

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**FIRE AND EXPLOSION HAZARD:** Negligible fire hazard when exposed to heat or flame.

**EXTINGUISHING MEDIA:** Dry chemical, carbon dioxide, water spray or regular foam (see most recent *Emergency Response Guidebook*, (ERG), developed jointly by Transport Canada (TC), the U. S. Department of Transportation (DOT) and the Secretariat of Transportation and Communications of Mexico (SCT).) For Larger Fires,

use water spray or fog (flooding amounts) (most recent *Emergency Response Guidebook*, ERG ).

**FIREFIGHTING:** Do not move damaged containers; move undamaged containers out of fire zone. (most recent *Emergency Response Guidebook*, ERG ) Contact the local, State, or Department of Energy radiological response team. Use suitable agent for surrounding fire. Cool containers with flooding amounts of water, apply from as far a distance as possible. Avoid breathing dusts or vapors, keep upwind. Keep unnecessary people out of area until declared safe by radiological response team.

**HAZARDOUS COMBUSTION PRODUCTS:** Thermal decomposition may release toxic and/or hazardous gases.

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## SECTION 6: ACCIDENTAL RELEASE MEASURES

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**OCCUPATIONAL SPILL:** Do not touch damaged containers or spilled material. For large spills, dike far ahead of spill for later disposal. For dry spills, cover with plastic sheet of tarp to minimize spreading. Keep unnecessary people at least 150 feet upwind of spill. Isolate hazard area and deny entry. Limit entry to shortest time possible. Clean-up should be performed only by qualified radiation worker(s).

**WATER SPILL:** Contaminating any known source of drinking water with substances known to cause cancer and/or reproductive toxicity is prohibited by the California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65).

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## SECTION 7: HANDLING AND STORAGE

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Observe all Federal, State, and local regulations when storing this substance.

Store in accordance with 10 CFR 20.

Store in a designated radioactive materials area.

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## SECTION 8: EXPOSURE CONTROL/PERSONAL PROTECTION

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**EXPOSURE LIMITS:**

No exposure limit (OSHA, ACGIH, NIOSH) has been established for any component comprising greater than 1/10 of 1% of these CRMs. Subject to SARA section 313 Annual Toxic Chemical Release Reporting (Thorium oxide). Subject to California Proposition 65 cancer and/or reproductive toxicity warning and release requirements (Thorium oxide).

**VENTILATION:** At a minimum, provide local exhaust or process enclosure ventilation. Depending upon the specific work place activity, a more stringent ventilation system may be necessary to comply with exposure limits set forth in 10 CFR 20.103. One method of controlling external radiation exposure is to provide adequate shielding.

**ALPHA PARTICLES:** The typical alpha particles emitted by thorium oxide are easily shielded by a fraction of a millimeter of any ordinary material or a few inches of air. Thick paper, plastic, or cardboard will suffice.

**BETA PARTICLES:** Beta particles are more penetrating than alpha, and require additional shielding. These certified reference materials do not emit significant amounts of beta radiation.

**GAMMA RAYS:** Gamma rays are highly penetrating and are most easily shielded by heavier elements (high z number). These certified reference materials, in the quantities used for laboratory work, do not emit significant amounts of gamma radiation. If large (kg) quantities of this material are to be stored or used, consult a radiation protection specialist or health physicist to determine if shielding is required.

**EYE PROTECTION:** Employee must wear eye protection to prevent eye contact with this substance. Contact lenses should not be worn. Emergency eye wash: If there is any possibility that an employee's eyes may be exposed to this substance, the employer must provide an eye wash station within the immediate area for emergency use.

**CLOTHING:** Employee must wear impervious clothing to prevent repeated or prolonged skin contact with this substance.

**GLOVES:** Employee must wear appropriate protective gloves to prevent contact with this substance. Used gloves that may have contacted this substance should be disposed of as radioactive waste.

**RESPIRATOR:** The following respirators and maximum use concentrations are recommendations by the U.S. Department of Health Services, NIOSH Pocket Guide to Chemical Hazards; or by the U.S. Department of Labor, 29 CFR 1910 Subpart Z. The specific respirator selected must be based on contamination levels found in the work place. Airborne contamination levels must not exceed the working limits of the respirator. Respirators must be jointly approved by the National Institute for Occupational Safety and Health and the Mine Safety and Health Administration (NIOSH-MSHA). Escape - Any air-purifying full facepiece respirator with a high-efficiency particulate filter. Any appropriate escape-type self-contained breathing apparatus.

**FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:**

Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode. Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

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**SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES**

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Appearance: Powder, white.

Odor: no data available.

Odor Threshold: no data available.

pH; no data available.

Flash point: no data available.

Evaporation rate: no data available.

Flammability: no data available.

Vapor pressure: no data available.

Vapor density: no data available.

Auto-ignition temperature: no data available.

Description: White, heavy, infusible, crystal, cubes or powder.

Molecular weight: 264.04

Molecular formula: ThO<sub>2</sub>

Boiling point: 7952\_F (4400\_C)

Melting point: 5738-5918\_F (3170-3270\_C)

Specific Gravity: 9.86

Water Solubility: insoluble

Solvent Solubility: Soluble in hot sulfuric acid; insoluble in alkalis and dilute acids.

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**SECTION 10: STABILITY AND REACTIVITY**

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**REACTIVITY:** Stable under normal temperatures and pressures.

**CONDITIONS TO AVOID:** Prevent dispersion of dust in air. Thorium oxide may burn but does not ignite readily.

**INCOMPATIBILITIES:**

No data available for incompatibilities of Thorium oxide.

**HAZARDOUS DECOMPOSITION:**

Thermal decomposition may release toxic and/or hazardous gases.

**POLYMERIZATION:**

Hazardous polymerization has not been reported to occur under normal temperature and pressure.

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**SECTION 11: TOXICOLOGY INFORMATION**

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**TOXICITY DATA:** Tumorigenic data (RTECS).

**CARCINOGEN STATUS:** Known Human Carcinogen (NTP). Intravascular injection in humans produced tumors of the liver, including hepatocellular carcinomas, cholangiocellular carcinomas, carcinomas of the extra-hepatic biliary system, sarcomas, hemangiomas, reticulum cell sarcomas, carcinomas of the common hepatic duct, adenocarcinomas, liver cell carcinomas, undifferentiated carcinomas, hepatomas, tumors of the kidney, including carcinomas of the renal parenchyma, and sarcomas and carcinomas of the renal pelvis. In addition, carcinomas of the maxillary sinuses, spindle cell sarcomas in the later cervical region, leukemias, and other hematologic disorders have been related to intravascular injection of thorium oxide. Studies suggest a latency of 21-36 years. A variety of carcinomas have been induced in animals following intravenous, subcutaneous, and submucosal administration.

**ACUTE TOXICITY LEVEL:** No data available.

**TARGET EFFECTS:** Radioactive

**HEALTH EFFECTS**

**INHALATION**

Animal exposure to 11-76 mg/m<sup>3</sup> of thorium compounds for 2-10 weeks resulted in blood abnormalities. Inhalation of dusts of radioactive particles may result in permanent deposits in the lungs and pulmonary lymph nodes.

**ACUTE EXPOSURE** - Alpha radiation is densely ionizing with very high energy. Cells immediately adjacent to the source of radiation may be killed or damaged. Damaged cells may not recover or be repaired. Thorium oxide is biologically insoluble. Insoluble compounds may remain at or near the site of deposition as opposed to soluble compounds that may rapidly enter the bloodstream. Heavier particles will be brought up to the throat by ciliary action, and may then be swallowed. The lighter particles, typically less than 10 microns in diameter, may enter the gas exchange region of the lungs. These small particles are what is commonly referred to as the respirable



particulate mass. The damage depends on how quickly they are eliminated, and the susceptibility of the tissue in which they are stored.

**CHRONIC EXPOSURE** - The effects of chronic exposure by internally deposited alpha radiation is dependent upon the dose and target organ(s). Possible disorders include lung cancer, anemia, leukemia, or bone cancer.

#### **SKIN CONTACT:**

**ACUTE EXPOSURE** - Alpha radiation is not usually an external hazard as the large, highly charged particles are not very penetrating. However, absorption or penetration through damaged skin may result in internal damage or deposition of radioactive materials.

**CHRONIC EXPOSURE** - Prolonged or repeated uptake may result in increased cancer risks.

#### **EYE CONTACT**

**ACUTE EXPOSURE** - Radiation affects the eye by inducing acute inflammation of the conjunctiva and the cornea. The most sensitive part of the eye is the lens. An effect of eye irradiation is cataract formation. Cataracts may begin to develop anywhere from 6 months to several years after a single, large exposure or after prolonged exposure. The rate of growth and the degree of opacity are dependent upon the dose of radiation. The silicon content of these certified reference materials is expected to preclude any long term eye contact via irritation.

**CHRONIC EXPOSURE** - Repeated or prolonged exposure to alpha radiation may result in cataract formation, as described above. Of the well-documented late effects of radiation on man, leukemia and cataracts have been observed at doses lower than those producing skin scarring and cancer or bone tumors. The lens of the eye is considered to be a critical organ for exposure to radiation. It is important to note that long term eye contact with these Certified Reference Materials would most likely result in serious damage to the cornea long before cataracts would be formed.

#### **INGESTION:**

**ACUTE EXPOSURE** - The fate of ingested alpha emitters depends on their solubility and valence. Thorium oxide is not soluble and the primary dose received would be to the lining of the gut.

**CHRONIC EXPOSURE** - Repeated ingestion of alpha emitters may lead to increased cancer risk.

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## **SECTION 12: ECOLOGICAL INFORMATION**

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Environmental Impact Rating (0-4): No data available  
Acute Aquatic Toxicity: No data available  
Degradability: No data available  
Log Bioconcentration Factor (BCF): No data available  
Log Octanol/water partition coefficient: No data available

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### SECTION 13: DISPOSAL INFORMATION

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Observe all Federal, State and local Regulations when disposing of this substance. This substance may contain levels of hazardous contaminants at or above levels defined in the Resource Conservation and Recovery Act of 1976 (RCRA). Specific levels of contaminant are listed on the *Certificate of Analysis* for the purchased Certified Reference Material. Depending on the specific use of this material, waste products may or may not be considered hazardous and regulated by RCRA. Consult an environmental protection specialist prior to disposing of any waste generated through use of this material. Use of this material may result in the production of mixed waste due to the presence of both radioactivity and hazardous contaminants at or above levels defined in RCRA. The best means of controlling any type of waste is through an effective pollution prevention program.

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### SECTION 14: TRANSPORTATION INFORMATION

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The U.S. Department of Transportation (D.O.T.) Code of Federal Regulations (49 CFR Parts 100-185), the International Air Transportation Association (IATA), International Civil Aviation Organization (ICAO) and International Maritime Organization (IMDG) are all factored into the classification and transport of material.

Proper Shipping Name:  
Hazard Class:  
UN/ID Number:  
Special Information:  
Packing Group:

} To be determined on a case by case basis.

Classification of substances with multiple hazards must be determined in accordance with the criteria presented in the above mentioned regulations. Due to the various quantities/combinations of materials being shipped at one time, the information above must be determined based on the characteristics of the specific shipment.

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## SECTION 15: REGULATORY INFORMATION

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TSCA STATUS: Y  
CERCLA SECTION 103 (40 CFR 302.4): N  
SARA SECTION 302 (40 CFR 355.30): N  
SARA SECTION 304 (40 CFR 355.40): N  
SARA SECTION 313 (40 CFR 372.65): Y  
OSHA PROCESS SAFETY (29 CFR 1910.119): N  
CALIFORNIA PROPOSITION 65: Y (Thorium dioxide - carcinogen)  
MASSACHUSETTS RIGHT TO KNOW COMPONENTS: Y (Thorium dioxide)  
PENNSYLVANIA RIGHT TO KNOW COMPONENTS: Y (Thorium dioxide)  
NEW JERSEY RIGHT TO KNOW COMPONENTS: Y (Thorium dioxide)  
SARA HAZARD CATEGORIES, SARA SECTIONS 311/312 (40 CFR 370.21)  
ACUTE HAZARD: Y  
CHRONIC HAZARD: Y  
FIRE HAZARD: N  
REACTIVITY HAZARD: N  
SUDDEN RELEASE HAZARD: N

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## SECTION 16: OTHER INFORMATION

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This material is prepared for use as a standard or in inter-laboratory comparison programs at analytical laboratories that routinely handle radionuclides including uranium and plutonium. The New Brunswick Laboratory (NBL) assumes that recipients of this material have developed internal safety procedures that guard against accidental exposure to radioactive and toxic materials, contamination of the laboratory environment, or criticality. NBL further expects that personnel who handle radioactive materials have been thoroughly trained in the safety procedures developed by and for their Laboratory. The information and recommendations set forth herein are presented in good faith and believed to be correct as of the revision date. However, recipients of this material should use this information only as a supplement to other information gathered by them, and should make independent judgment of the suitability and accuracy of this information. This statement is not intended to provide comprehensive instruction in developing an appropriate safety program and does not include all regulatory guidelines. This information is furnished without warranty, and any use of the product not in conformance with this Material Safety Data Sheet, or in combination with any other product or process, is the responsibility of the user.

Creation Date: March 18, 1994

Revision Date: June 23, 2020