



Calib. Std #1 Rare Earth Metals

Novachem Pty Ltd

Version No: 2.2

Safety Data Sheet according to WHS Regulations (Hazardous Chemicals) Amendment 2020 and ADG requirements

Chemwatch Hazard Alert Code: 4

Issue Date: 08/02/2023

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S.GHS.AUS.EN

SECTION 1 Identification of the substance / mixture and of the company / undertaking

Product Identifier

Product name	Calib. Std #1 Rare Earth Metals
Synonyms	Not Available
Proper shipping name	CORROSIVE LIQUID, ACIDIC, INORGANIC, N.O.S. (Nitric acid solution)
Other means of identification	MISA-01-1

Relevant identified uses of the substance or mixture and uses advised against

Relevant identified uses	Laboratory Chemical Reference Material
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Details of the manufacturer or supplier of the safety data sheet

Registered company name	Novachem Pty Ltd	Novachem Pty Ltd
Address	25 Crissane Road, Heidelberg West Victoria 3081 Australia	25 Crissane Road, Heidelberg West Victoria 3081 Australia
Telephone	+61384151255	+61384151255
Fax	+61386250088	+61386250088
Website	www.novachem.com.au	www.novachem.com.au
Email	novachem@novachem.com.au	novachem@novachem.com.au

Emergency telephone number

Association / Organisation	Victorian Poisons Information Centre	Victorian Poisons Information Centre
Emergency telephone numbers	13 11 26	13 11 26
Other emergency telephone numbers	Not Available	Not Available

SECTION 2 Hazards identification

Classification of the substance or mixture

Poisons Schedule	Not Applicable
Classification [1]	Specific Target Organ Toxicity - Single Exposure Category 2, Corrosive to Metals Category 1, Serious Eye Damage/Eye Irritation Category 1, Acute Toxicity (Oral) Category 4, Acute Toxicity (Inhalation) Category 2, Skin Corrosion/Irritation Category 1A
Legend:	1. Classified by Chemwatch; 2. Classification drawn from HCIS; 3. Classification drawn from Regulation (EU) No 1272/2008 - Annex VI

Label elements

Hazard pictogram(s)	
Signal word	Danger

Hazard statement(s)

H371	May cause damage to organs.
H290	May be corrosive to metals.
H302	Harmful if swallowed.
H330	Fatal if inhaled.
H314	Causes severe skin burns and eye damage.

Calib. Std #1 Rare Earth Metals

Precautionary statement(s) Prevention

P260	Do not breathe mist/vapours/spray.
P264	Wash all exposed external body areas thoroughly after handling.
P271	Use only outdoors or in a well-ventilated area.
P280	Wear protective gloves, protective clothing, eye protection and face protection.

Precautionary statement(s) Response

P301+P330+P331	IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.
P303+P361+P353	IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water [or shower].
P304+P340	IF INHALED: Remove person to fresh air and keep comfortable for breathing.
P305+P351+P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

Precautionary statement(s) Storage

P403+P233	Store in a well-ventilated place. Keep container tightly closed.
P405	Store locked up.

Precautionary statement(s) Disposal

P501	Dispose of contents/container to authorised hazardous or special waste collection point in accordance with any local regulation.
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SECTION 3 Composition / information on ingredients

Substances

See section below for composition of Mixtures

Mixtures

CAS No	%[weight]	Name
7732-18-5	94.756	<u>water</u>
10294-41-4	0.031	<u>cerium(III) nitrate</u>
1308-87-8	0.012	<u>dysprosium(III) oxide</u>
12061-16-4	0.011	<u>erbium(III) oxide</u>
1308-96-9	0.012	<u>europium(III) oxide</u>
12064-62-9	0.012	<u>gadolinium(III) oxide</u>
12055-62-8	0.012	<u>holmium(III) oxide</u>
1312-81-8	0.012	<u>lanthanum oxide</u>
12032-20-1	0.011	<u>lutetium(III) oxide</u>
1313-97-9	0.012	<u>neodymium(III) oxide</u>
12037-29-5	0.012	<u>praseodymium(III,IV) oxide</u>
12060-08-1	0.015	<u>scandium(III) oxide</u>
12060-58-1	0.012	<u>samarium(III) oxide</u>
12037-01-3	0.012	<u>terbium(III,IV) oxide</u>
13823-29-5	0.021	<u>thorium nitrate</u>
12036-44-1	0.011	<u>thulium oxide</u>
1314-37-0	0.011	<u>ytterbium(III) oxide</u>
1314-36-9	0.013	<u>yttrium(III) oxide</u>
7697-37-2	5	<u>nitric acid</u>
1344-59-8	0.012	<u>uranium mixed oxides (U3O8)</u>

Legend: 1. Classified by Chemwatch; 2. Classification drawn from HCIS; 3. Classification drawn from Regulation (EU) No 1272/2008 - Annex VI; 4. Classification drawn from C&L; * EU IOELVs available

SECTION 4 First aid measures

Description of first aid measures

Eye Contact	<ul style="list-style-type: none"> ▶ GET MEDICAL ATTENTION IMMEDIATELY ▶ Remove victim to a restricted area for decontamination. ▶ Thoroughly wash eyes with large amounts of water, occasionally lifting the upper and lower eyelids (for approximately 15 minutes). ▶ Following the water treatment, provide an isotonic solution. ▶ DO NOT use eye baths, rather provide a continuous and copious supply of fluid. ▶ Monitor the victim for radioactivity. If activity is present, rewash the eyes and remonitor until little or no radioactivity is present. ▶ Any water used to wash the victim's eyes must be stored in a metal container for later disposal. Any other articles that are used to decontaminate the victim must also be stored in metal containers for later decontamination or disposal. ▶ Any personnel involved in rendering first aid to the victim must be monitored for radioactivity and decontaminated if necessary <p>IAEA Safety Series No.: 47 Manual on Early Medical Treatment of Possible Radiation Injury, 1978, p.35.</p>
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Calib. Std #1 Rare Earth Metals

Skin Contact	<p>The objectives of skin decontamination are to remove as much of the radionucleotide as practicable in order to reduce the surface dose rate and to prevent activity from entering the body. Over-aggressive skin decontamination procedures must be avoided since these may injure the natural barriers of the skin and increase percutaneous absorption.</p> <p>IT IS IMPERATIVE THAT THE SKIN SHOULD BE DECONTAMINATED AS QUICKLY AS POSSIBLE</p> <p>It is IMPORTANT to review each potential exposure, prior to the first use of the radioactive substance, to establish whether an alternative decontamination regime exists should simple washing techniques prove to be inadequate. (see point 4 below)</p> <p>If radioactive contamination is suspected:</p> <ul style="list-style-type: none"> ▶ Gently brush away dry particles or blot excess liquids with absorbent materials; ensure responders are adequately protected. ▶ Where possible, rinse victim in warm water (30 deg. C.); caution must be exercised to ensure that areas of tissue damage or body cavity openings are NOT rinsed. ▶ Wash victim with mild liquid soap and large quantities of water. Pay particular attention to the head, finger nails and palms of the hands ▶ On completion of the washing, monitor the victim for radioactivity. If water and soap have been inadequate in removing the radioactive material, decontaminating compounds consisting of surfactants and absorbent substances may be effective. Complexing reagents may also be of use. ▶ The use of organic solvents is to be avoided as they may increase the solubility and absorption of the radioactive substance. ▶ Skin contamination with radiation may be an indication that other parts of the body have been exposed. ▶ Contaminated clothing must be stored in a metal container for later decontamination or disposal. ▶ The water used to wash the victim must be stored in metal containers for later disposal. ▶ Any personnel involved in rendering first aid to the victim must be monitored for radioactivity and decontaminated if necessary. <p>IAEA Safety Series No.: 47 Manual on Early Medical Treatment of Possible Radiation Injury, 1978, p.9.</p>
Inhalation	<p>IMPORTANT: For patients with life-threatening injuries (from incidents involving small quantity release) and particle or liquid exposure, decontamination procedures must be initiated:</p> <p>GET MEDICAL ATTENTION IMMEDIATELY.</p> <ul style="list-style-type: none"> ▶ NOTE: Personal Protective Equipment (PPE), including positive pressure self-contained breathing apparatus may be required to assure the safety of the rescuer. ▶ Remove from exposure area to a restricted area with fresh air as quickly as possible. ▶ Remove, as soon as possible, patient's clothing, jewelry and shoes. ▶ Prostheses such as false teeth, which may block airway, should be removed, where possible, prior to initiating first aid procedures ▶ If breathing has stopped, perform artificial respiration by administering oxygen; mouth-to-mouth resuscitation should be avoided to prevent exposure to the person rendering first aid. ▶ Any evidence of serious contamination indicates that treatment must be initiated. (Inhalation of radioactive particles may indicate that other parts of the body were also contaminated, such as the digestive tract, skin and eyes.) ▶ If time permits, wipe the face with wet filter paper, force coughing and blowing of the nose. Thorough decontamination should be started prior to the victim being removed to the medical area ▶ Package the patient using transportation bags, plastic or blankets; this ensures that contamination is limited during transportation. ▶ Provide adequate ambulance ventilation (intake and exhaust fans of appropriate design and capacity). ▶ Notify Emergency Department that a potentially contaminated patient is enroute; supply all available information regarding the nature and identity of the contaminant. ▶ Any personnel involved in rendering first aid must be monitored for radioactivity and thoroughly decontaminated if necessary.
Ingestion	<p>If poisoning occurs, contact a doctor or Poisons Information Centre.</p> <ul style="list-style-type: none"> ▶ In case of ingestion of radioactive substances, the mouth should be rinsed out immediately after the accident, care being taken not to swallow the water used for this purpose. ▶ Vomiting should be induced either mechanically, or with syrup of Ipecac. DO NOT induce vomiting in an unconscious person. * ▶ Further action depends on the nature of the radioactive substance. ▶ Get medical attention immediately. ▶ The victim must be monitored for radioactivity and decontaminated, if necessary, before being transported to a medical facility. ▶ Any personnel involved in rendering first aid to the victim must be monitored for radioactivity and decontaminated if necessary. - <p>* The vomitus and lavage fluids should be saved for examination and monitoring. The gastric fluids and fluids used for lavage must be stored in metal containers for later disposal. IAEA Safety Series No.: 47 Manual on Early Medical Treatment of Possible Radiation Injury, 1978, p.59.</p>

Indication of any immediate medical attention and special treatment needed

Treat symptomatically.

Although gamma radiation is present in all uranium mines, levels rarely exceed the acceptable standard of 5 rads per year. Adverse effects of uranium mining result from the inhalation of radon daughters. (The decay of radium produces radon, which in turn forms short life radon daughters i.e. isotopes of lead bismuth and polonium.) These products attach to dust particles which are inhaled by workers.

Alpha radiation delivers 95% of the radiation dose to the tracheobronchial epithelium. Lung cancer mortality and chronic lung disease [in uranium miners] strongly depends on radon exposure, cigarette smoking, and height. Although squamous and oat cell tumour types display a dose response effect, there is some difference in the strength of the association. [Ellenhorn & Barceloux]

For acute or short term repeated exposures to strong acids:

- ▶ Airway problems may arise from laryngeal edema and inhalation exposure. Treat with 100% oxygen initially.
- ▶ Respiratory distress may require cricothyroidotomy if endotracheal intubation is contraindicated by excessive swelling
- ▶ Intravenous lines should be established immediately in all cases where there is evidence of circulatory compromise.
- ▶ Strong acids produce a coagulation necrosis characterised by formation of a coagulum (eschar) as a result of the desiccating action of the acid on proteins in specific tissues.

INGESTION:

- ▶ Immediate dilution (milk or water) within 30 minutes post ingestion is recommended.
- ▶ **DO NOT attempt to neutralise the acid since exothermic reaction may extend the corrosive injury.**
- ▶ Be careful to avoid further vomit since re-exposure of the mucosa to the acid is harmful. Limit fluids to one or two glasses in an adult.
- ▶ Charcoal has no place in acid management.
- ▶ Some authors suggest the use of lavage within 1 hour of ingestion.

SKIN:

- ▶ Skin lesions require copious saline irrigation. Treat chemical burns as thermal burns with non-adherent gauze and wrapping.
- ▶ Deep second-degree burns may benefit from topical silver sulfadiazine.

EYE:

- ▶ Eye injuries require retraction of the eyelids to ensure thorough irrigation of the conjunctival cul-de-sacs. Irrigation should last at least 20-30 minutes. **DO NOT use neutralising agents or any other additives.** Several litres of saline are required.
- ▶ Cycloplegic drops, (1% cyclopentolate for short-term use or 5% homatropine for longer term use) antibiotic drops, vasoconstrictive agents or artificial tears may be indicated dependent on the severity of the injury.
- ▶ Steroid eye drops should only be administered with the approval of a consulting ophthalmologist).

[Ellenhorn and Barceloux: Medical Toxicology]

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Calib. Std #1 Rare Earth Metals

For radiation poisoning:

- ▶ Lavage may be useful. Care should be taken to avoid aspiration.
- ▶ The vomitus and lavage fluids should be saved for examination and monitoring. The gastric fluids and fluids used for lavage must be stored in metal containers for later disposal.
- ▶ There is no antidote for radiation sickness
- ▶ Treatment should be symptomatic and supportive, regardless of the dose received. IAEA Safety Series No.: 47; Manual on Early Medical Treatment of Possible Radiation Injury, 1978, p.35.

BASIC TREATMENT

- ▶ Establish a patent airway with suction where necessary.
- ▶ Watch for signs of respiratory insufficiency and assist ventilation as necessary.
- ▶ Administer oxygen by non-rebreather mask at 10 to 15 l/min.
- ▶ Monitor and treat, where necessary, for shock.
- ▶ Anticipate seizures.
- ▶ Routine emergency care may be necessary for associated injuries.
- ▶ **Do not use emetics.** Where ingestion is suspected rinse mouth and give up to 200 ml water (5 ml/kg recommended) for dilution where patient is able to swallow, has a strong gag reflex and does not drool.
- ▶ If necessary, perform BLS care.

ADVANCED TREATMENT

- ▶ Consider orotracheal or nasotracheal intubation for airway control in unconscious patient or where respiratory arrest has occurred.
- ▶ Monitor and treat, where necessary, for arrhythmias.
- ▶ Support vital signs with IV lactated Ringer's solution.
- ▶ Hypotension with signs of hypovolaemia requires the cautious administration of fluids. Fluid overload might create complications.
- ▶ Treat seizures with diazepam.
- ▶ Advanced life-support care may be needed.
- ▶ Proparacaine hydrochloride should be used to assist eye irrigation.
- ▶ Chelating agents may be useful if given before or immediately after exposure.

SPECIAL CONSIDERATIONS

- ▶ Symptoms associated with radioactive exposure are generally delayed. Treatment should address other medical problems or trauma.
- ▶ An accurate history of exposure is essential to determine proper treatment; Exposure to 100 rads is expected to produce GI symptoms such as nausea, vomiting, abdominal cramps, diarrhoea; onset of symptoms may be delayed for several hours. Exposure to 600 rads is expected to result in severe GI symptoms such as necrotic gastroenteritis which may result in dehydration and may be fatal within days. Exposure to several thousand rads is expected to produce neurological/ cardiovascular symptoms including confusion, lethargy, ataxia, seizures, coma, and cardiovascular collapse, within minutes or hours. Severe exposures may also produce bone marrow depression, leukopenia and infection.

BRONSTEIN, A.C. and CURRANCE, P.L. EMERGENCY CARE FOR HAZARDOUS MATERIALS EXPOSURE: 2nd Ed. 1994

SECTION 5 Firefighting measures

Extinguishing media

- ▶ Water spray or fog.
- ▶ Foam.
- ▶ Dry chemical powder.
- ▶ BCF (where regulations permit).

Special hazards arising from the substrate or mixture

Fire Incompatibility	None known.
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Advice for firefighters

Fire Fighting	<ul style="list-style-type: none"> ▶ Alert Fire Brigade and tell them location and nature of hazard. ▶ Wear breathing apparatus plus protective gloves in the event of a fire. ▶ Prevent, by any means available, spillage from entering drains or water courses. ▶ Use fire fighting procedures suitable for surrounding area.
Fire/Explosion Hazard	<p>Under certain conditions the material may become combustible because of the ease of ignition which occurs after the material reaches a high specific area ratio (thin sections, fine particles, or molten states). However, the same material in massive solid form is comparatively difficult to ignite. Nearly all metals will burn in air under certain conditions. Some are oxidised rapidly in the presence of air or moisture, generating sufficient heat to reach their ignition temperatures.</p> <ul style="list-style-type: none"> ▶ Non combustible. ▶ Not considered to be a significant fire risk. ▶ Acids may react with metals to produce hydrogen, a highly flammable and explosive gas. ▶ Heating may cause expansion or decomposition leading to violent rupture of containers. <p>Decomposition may produce toxic fumes of: metal oxides</p>
HAZCHEM	2X

SECTION 6 Accidental release measures

Personal precautions, protective equipment and emergency procedures

See section 8

Environmental precautions

See section 12

Methods and material for containment and cleaning up

Minor Spills	Any spills of radioactive materials should be cleaned immediately and all contaminated materials should be decontaminated or disposed of as radioactive waste via an authorised route. Contaminated surfaces should be washed with suitable detergent to remove traces of radioactivity.
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Calib. Std #1 Rare Earth Metals

	<p>Prior to working with radioactive material, devise a written procedure for handling a cleanup of small and large spills. For spillages involving less than 20 times the "Annual Limit on Intake (ALI)" value for inhalation</p> <ul style="list-style-type: none"> Wear rubber or plastic gloves Clean up liquid spillages with absorbent material Monitor the affected area when no visible spill material remains, to check the progress of the decontamination, preferably less than one "Derived Working Limit (DWL)" Treat all materials used in the decontamination process as radioactive waste Monitor all persons involved in the spillage or decontamination operation Remove contaminated clothing, place in plastic bags and seal
Major Spills	<ul style="list-style-type: none"> DO NOT touch damaged containers or spilled materials. Damage to outer container may not affect primary inner container. Isolate hazard area and deny entry. Evacuate the area if there is a significant radiological hazard to persons It may be necessary to dike far ahead of the spill area Enter spill area only to save life; limit entry to shortest possible time.

Personal Protective Equipment advice is contained in Section 8 of the SDS.

SECTION 7 Handling and storage

Precautions for safe handling

Safe handling	<ul style="list-style-type: none"> All work with unsealed radioactive substances shall be segregated from other work and, where possible, carried out in a laboratory or workplace reserved solely for this purpose. Where widely different levels of activity and radiotoxicity are to be in use, separate rooms are preferred. Eating, drinking, smoking and the application of cosmetics should not take place in a radioactive substances designated area. Before work with unsealed radioactive substances proceeds, written procedures describing good working practices, should be available.
Other information	<ul style="list-style-type: none"> Special security requirements apply in Federal/State regulation to the storage, packaging and handling of radioactive materials. Regulation may include restriction on package size and quantities stored. Store in an approved storage area and ensure that packages are appropriately labelled as required by relevant legislation. Keep locked up at all times.

Conditions for safe storage, including any incompatibilities

Suitable container	<ul style="list-style-type: none"> DO NOT use aluminium or galvanised containers <p>For packaging of radioisotopes. Packaging should be designed and finished so that external surfaces are free of protruding features and can be easily decontaminated. The outer layer of packaging should be designed so as to prevent the collection and retention of water. Many international standards, relating to correct package type and design, are in force and should be observed when repacking the contents of the original containers.</p>
Storage incompatibility	<p>Inorganic derivative of Group 11 metal. Derivative of very electropositive metal. Actinide (actinoid)</p> <p>Only thorium and uranium occur in usable quantities in nature. The other actinides are man-made elements. All actinides are radioactive. They share similar chemistry with the lanthanides (lanthanoids) The size of actinides decreases with increasing atomic number.</p> <ul style="list-style-type: none"> WARNING: Avoid or control reaction with peroxides. All <i>transition metal</i> peroxides should be considered as potentially explosive. For example transition metal complexes of alkyl hydroperoxides may decompose explosively. The pi-complexes formed between chromium(0), vanadium(0) and other transition metals (haloarene-metal complexes) and mono- or poly-fluorobenzene show extreme sensitivity to heat and are explosive. Avoid strong bases.

SECTION 8 Exposure controls / personal protection

Control parameters

Occupational Exposure Limits (OEL)

INGREDIENT DATA

Source	Ingredient	Material name	TWA	STEL	Peak	Notes
Australia Exposure Standards	yttrium(III) oxide	Yttrium, metal & compounds (as Y)	1 mg/m ³	Not Available	Not Available	Not Available
Australia Exposure Standards	nitric acid	Nitric acid	2 ppm / 5.2 mg/m ³	10 mg/m ³ / 4 ppm	Not Available	Not Available
Australia Exposure Standards	uranium mixed oxides (U3O8)	Uranium (natural), soluble & insoluble compounds (as H)	0.2 mg/m ³	0.6 mg/m ³	Not Available	Not Available

Emergency Limits

Ingredient	TEEL-1	TEEL-2	TEEL-3
cerium(III) nitrate	9.5 mg/m ³	100 mg/m ³	620 mg/m ³
cerium(III) nitrate	30 mg/m ³	330 mg/m ³	2,000 mg/m ³
cerium(III) nitrate	13 mg/m ³	140 mg/m ³	830 mg/m ³
dysprosium(III) oxide	15 mg/m ³	170 mg/m ³	990 mg/m ³
erbium(III) oxide	15 mg/m ³	170 mg/m ³	990 mg/m ³
europium(III) oxide	15 mg/m ³	170 mg/m ³	990 mg/m ³
gadolinium(III) oxide	15 mg/m ³	170 mg/m ³	990 mg/m ³
holmium(III) oxide	30 mg/m ³	330 mg/m ³	2,000 mg/m ³

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Calib. Std #1 Rare Earth Metals

Ingredient	TEEL-1	TEEL-2	TEEL-3
lanthanum oxide	4 mg/m ³	44 mg/m ³	270 mg/m ³
lutetium(III) oxide	30 mg/m ³	330 mg/m ³	2,000 mg/m ³
neodymium(III) oxide	15 mg/m ³	170 mg/m ³	990 mg/m ³
praseodymium(III,IV) oxide	15 mg/m ³	170 mg/m ³	990 mg/m ³
scandium(III) oxide	30 mg/m ³	330 mg/m ³	2,000 mg/m ³
samarium(III) oxide	15 mg/m ³	170 mg/m ³	990 mg/m ³
terbium(III,IV) oxide	30 mg/m ³	330 mg/m ³	2,000 mg/m ³
thorium nitrate	2.9 mg/m ³	32 mg/m ³	190 mg/m ³
thulium oxide	30 mg/m ³	330 mg/m ³	2,000 mg/m ³
ytterbium(III) oxide	30 mg/m ³	330 mg/m ³	2,000 mg/m ³
yttrium(III) oxide	3.8 mg/m ³	43 mg/m ³	260 mg/m ³
nitric acid	Not Available	Not Available	Not Available
uranium mixed oxides (U3O8)	0.71 mg/m ³	Not Available	Not Available

Ingredient	Original IDLH	Revised IDLH
water	Not Available	Not Available
cerium(III) nitrate	Not Available	Not Available
dysprosium(III) oxide	Not Available	Not Available
erbium(III) oxide	Not Available	Not Available
europium(III) oxide	Not Available	Not Available
gadolinium(III) oxide	Not Available	Not Available
holmium(III) oxide	Not Available	Not Available
lanthanum oxide	Not Available	Not Available
lutetium(III) oxide	Not Available	Not Available
neodymium(III) oxide	Not Available	Not Available
praseodymium(III,IV) oxide	Not Available	Not Available
scandium(III) oxide	Not Available	Not Available
samarium(III) oxide	Not Available	Not Available
terbium(III,IV) oxide	Not Available	Not Available
thorium nitrate	Not Available	Not Available
thulium oxide	Not Available	Not Available
ytterbium(III) oxide	Not Available	Not Available
yttrium(III) oxide	500 mg/m ³	Not Available
nitric acid	25 ppm	Not Available
uranium mixed oxides (U3O8)	Not Available	Not Available


Occupational Exposure Banding

Ingredient	Occupational Exposure Band Rating	Occupational Exposure Band Limit
cerium(III) nitrate	E	≤ 0.01 mg/m ³
erbium(III) oxide	E	≤ 0.01 mg/m ³
europium(III) oxide	E	≤ 0.01 mg/m ³
gadolinium(III) oxide	E	≤ 0.01 mg/m ³
lanthanum oxide	E	≤ 0.01 mg/m ³
lutetium(III) oxide	E	≤ 0.01 mg/m ³
praseodymium(III,IV) oxide	E	≤ 0.01 mg/m ³
thorium nitrate	E	≤ 0.01 mg/m ³
thulium oxide	E	≤ 0.01 mg/m ³

Notes:

Occupational exposure banding is a process of assigning chemicals into specific categories or bands based on a chemical's potency and the adverse health outcomes associated with exposure. The output of this process is an occupational exposure band (OEB), which corresponds to a range of exposure concentrations that are expected to protect worker health.

Exposure controls

Appropriate engineering controls	<p>For potential exposure to radioactive substances, local exhaust or process enclosure ventilation should be provided as a minimum. External radiation exposure may be controlled with adequate shielding. The absorbing material and its thickness will depend on the type of radiation, its energy, the flux and dimensions of the source.</p> <p>▶ For ALPHA PARTICLES fraction of a millimetre of any ordinary material will generally be sufficient to attenuate the energy of the particle.</p>
Personal protection	

Calib. Std #1 Rare Earth Metals

Eye and face protection	▶ Most safety glasses will provide protection against alpha particles, some protection against beta particles (depending on thickness) but will not shield gamma radiation.
Skin protection	See Hand protection below
Hands/feet protection	▶ Elbow length PVC gloves ▶ When handling corrosive liquids, wear trousers or overalls outside of boots, to avoid spills entering boots. Disposable gloves. Most gloves will provide protection against alpha particles, some protection against beta particles (depending on thickness) but will not shield gamma radiation. Used gloves may present a radiation hazard and should be disposed of as radioactive waste. Suitable gloves should be worn for all work with unsealed radioactive substances, and special care is to be exercised when putting on or removing gloves, to avoid contaminating the hands and the inside surfaces of the gloves.
Body protection	See Other protection below
Other protection	Disposable overgarments, including head and foot coverings should be worn by any employee engaged in handling radioactive substances <i>in the workplace</i> . These garments are recommended even if the employee is working with a "glove-box" containment system. Protective clothing reserved specifically for radioactive work, shall be worn at all times <i>in a laboratory</i> , even for very low levels of specific activity. The following should be considered.

Recommended material(s)

GLOVE SELECTION INDEX

Glove selection is based on a modified presentation of the:

"Forsberg Clothing Performance Index".

The effect(s) of the following substance(s) are taken into account in the **computer-generated** selection:

Calib. Std #1 Rare Earth Metals

Material	CPI
BUTYL	A
NEOPRENE	A
HYPALON	C
NATURAL RUBBER	C
NATURAL+NEOPRENE	C
NEOPRENE/NATURAL	C
NITRILE+PVC	C
PE/EVAL/PE	C
PVA	C
PVC	C
SARANEX-23	C
VITON	C

* CPI - Chemwatch Performance Index

A: Best Selection

B: Satisfactory; may degrade after 4 hours continuous immersion

C: Poor to Dangerous Choice for other than short term immersion

NOTE: As a series of factors will influence the actual performance of the glove, a final selection must be based on detailed observation. -

* Where the glove is to be used on a short term, casual or infrequent basis, factors such as "feel" or convenience (e.g. disposability), may dictate a choice of gloves which might otherwise be unsuitable following long-term or frequent use. A qualified practitioner should be consulted.

Respiratory protection

Type E-P Filter of sufficient capacity. (AS/NZS 1716 & 1715, EN 143:2000 & 149:2001, ANSI Z88 or national equivalent)

Where the concentration of gas/particulates in the breathing zone, approaches or exceeds the "Exposure Standard" (or ES), respiratory protection is required.

Degree of protection varies with both face-piece and Class of filter; the nature of protection varies with Type of filter.

Required Minimum Protection Factor	Half-Face Respirator	Full-Face Respirator	Powered Air Respirator
up to 10 x ES	E-AUS P2	-	E-PAPR-AUS / Class 1 P2
up to 50 x ES	-	E-AUS / Class 1 P2	-
up to 100 x ES	-	E-2 P2	E-PAPR-2 P2 ^

^ - Full-face

A(All classes) = Organic vapours, B AUS or B1 = Acid gasses, B2 = Acid gas or hydrogen cyanide(HCN), B3 = Acid gas or hydrogen cyanide(HCN), E = Sulfur dioxide(SO₂), G = Agricultural chemicals, K = Ammonia(NH₃), Hg = Mercury, NO = Oxides of nitrogen, MB = Methyl bromide, AX = Low boiling point organic compounds(below 65 degC)

SECTION 9 Physical and chemical properties

Information on basic physical and chemical properties

Appearance	Clear liquid		
Physical state	Liquid	Relative density (Water = 1)	1.02
Odour	Not Available	Partition coefficient n-octanol / water	Not Available
Odour threshold	Not Available	Auto-ignition temperature (°C)	Not Applicable
pH (as supplied)	Not Available	Decomposition temperature (°C)	Not Applicable
Melting point / freezing point (°C)	Not Available	Viscosity (cSt)	Not Available
Initial boiling point and boiling range (°C)	83	Molecular weight (g/mol)	Not Available
Flash point (°C)	Not Applicable	Taste	Not Available
Evaporation rate	Not Available	Explosive properties	Not Available
Flammability	Not Applicable	Oxidising properties	Not Available

Continued...

Calib. Std #1 Rare Earth Metals

Upper Explosive Limit (%)	Not Applicable	Surface Tension (dyn/cm or mN/m)	Not Available
Lower Explosive Limit (%)	Not Applicable	Volatile Component (%vol)	Not Available
Vapour pressure (kPa)	2.47	Gas group	Not Available
Solubility in water	Miscible	pH as a solution (1%)	<2.0
Vapour density (Air = 1)	0.62	VOC g/L	Not Available

SECTION 10 Stability and reactivity

Reactivity	See section 7
Chemical stability	<ul style="list-style-type: none"> ▶ Unstable in the presence of incompatible materials. ▶ Product is considered stable. ▶ Hazardous polymerisation will not occur.
Possibility of hazardous reactions	See section 7
Conditions to avoid	See section 7
Incompatible materials	See section 7
Hazardous decomposition products	See section 5

SECTION 11 Toxicological information

Information on toxicological effects

Inhaled	<p>The material can cause respiratory irritation in some persons. The body's response to such irritation can cause further lung damage. Corrosive acids can cause irritation of the respiratory tract, with coughing, choking and mucous membrane damage. There may be dizziness, headache, nausea and weakness.</p> <p>Inhalation of vapours or aerosols (mists, fumes), generated by the material during the course of normal handling, may produce severe damage to the health of the individual. Relatively small amounts absorbed through the lungs may prove fatal.</p> <p>Exposure to vapours of some rare earth salts can cause sensitivity to heat, itching, and increased sensitivity of smell and taste. Other effects include inflamed airways and lung, emphysema, regional narrowing of terminal airways and cell changes.</p> <p>Dusts and mists containing uranium compounds are highly toxic and more so if inhaled rather than ingested. A single large dose can produce radiation sickness.</p> <p>alpha-Radiation kills cells immediately adjacent to the source of contact. Damage may be irreversible.</p> <p>A whole body dose of 2-10 Gray may cause loss of appetite, tiredness, nausea and vomiting, most severe after 6-12 hours. After this subsides a gross disturbance in blood cell distribution occurs with loss of white blood cells and platelets over weeks.</p>
Ingestion	<p>Accidental ingestion of the material may be harmful; animal experiments indicate that ingestion of less than 150 gram may be fatal or may produce serious damage to the health of the individual.</p> <p>Ingestion of acidic corrosives may produce burns around and in the mouth, the throat and oesophagus. Immediate pain and difficulties in swallowing and speaking may also be evident.</p> <p>Dysprosium is a rare earth metal - heavy type (yttrium family). There have been no reports of poisoning in workers, although the metal can cause chest X-ray abnormalities due to its high density.</p> <p>The kidney and liver can be damaged by uranium, causing excessive acid and urea in the blood and generalised ill health.</p> <p>Uranium compounds are not highly poisonous in low concentrations but may be lethal in high concentrations.</p>
Skin Contact	<p>Skin contact with acidic corrosives may result in pain and burns; these may be deep with distinct edges and may heal slowly with the formation of scar tissue.</p> <p>Skin contact is not thought to produce harmful health effects (as classified under EC Directives using animal models). Systemic harm, however, has been identified following exposure of animals by at least one other route and the material may still produce health damage following entry through wounds, lesions or abrasions.</p> <p>All soluble uranium compounds are lethal when applied at sufficiently high concentrations in a single dose to the skin of rabbits; insoluble salts do not cause death and cause no signs of poisoning.</p> <p>Open cuts, abraded or irritated skin should not be exposed to this material</p> <p>Entry into the blood-stream, through, for example, cuts, abrasions or lesions, may produce systemic injury with harmful effects. Examine the skin prior to the use of the material and ensure that any external damage is suitably protected.</p> <p>A whole body dose of 2-10 Gray may cause loss of appetite, tiredness, nausea and vomiting, most severe after 6-12 hours. After this subsides a gross disturbance in blood cell distribution occurs with loss of white blood cells and platelets over weeks.</p>
Eye	<p>Direct eye contact with acid corrosives may produce pain, tears, sensitivity to light and burns. Mild burns of the epithelia generally recover rapidly and completely.</p> <p>If applied to the eyes, this material causes severe eye damage.</p> <p>Soluble uranium compounds are very dangerous. A single dose of 1 Gray may cause inflammation of the conjunctiva and cornea.</p> <p>alpha-Radiation produces severe inflammation of eyelid tissue and eye surface. There may be a delay of years before symptoms develop.</p> <p>Irritation of the eyes may produce a heavy secretion of tears (lacrimation).</p> <p>The eye is particularly sensitive to radioactivity. A single dose of 1 Gy can cause inflammation of the conjunctiva and cornea.</p>
Chronic	<p>Repeated or prolonged exposure to acids may result in the erosion of teeth, swelling and/or ulceration of mouth lining. Irritation of airways to lung, with cough, and inflammation of lung tissue often occurs.</p> <p>Repeated or long-term occupational exposure is likely to produce cumulative health effects involving organs or biochemical systems.</p> <p>Long-term exposure to respiratory irritants may result in airways disease, involving difficulty breathing and related whole-body problems.</p> <p>Europium is a rare earth metal - heavy type (yttrium family). There have been no reports of poisoning in workers, although the metal can cause chest X-ray abnormalities due to its high density.</p> <p>Terbium is a rare earth metal - heavy type (yttrium family). There have been no reports of poisoning in workers, although the metal can cause chest X-ray abnormalities due to its high density.</p>

Continued...

Calib. Std #1 Rare Earth Metals

	<p>Actinides accumulate in the bone and may produce bone cancers. If absorbed in the body, uranium can be a hazard due to its radioactivity (alpha and gamma radiation). Uranium accumulates in the bones and can cause cancers there. Thulium is a rare earth metal - heavy type (yttrium family). There have been no reports of poisoning in workers, although the metal can cause chest X-ray abnormalities due to its high density. Yttrium is a rare earth metal - heavy type (yttrium family). There have been no reports of poisoning in workers, although the metal can cause chest X-ray abnormalities due to its high density. A single large or prolonged low exposure to radiation can cause delayed effects, including blood cancers, genetic disorders, shortened lifespan and cataracts. Leukaemia is the most common cancer caused; cancers of the thyroid, bone, lung (due to radioactive particle deposits) and skin are also seen. Dysprosium is a rare earth metal - heavy type (yttrium family). There have been no reports of poisoning in workers, although the metal can cause chest X-ray abnormalities due to its high density.</p>	
Calib. Std #1 Rare Earth Metals	TOXICITY	IRRITATION
	Not Available	Not Available
water	TOXICITY	IRRITATION
	Oral (Rat) LD50: >90000 mg/kg ^[2]	Not Available
cerium(III) nitrate	TOXICITY	IRRITATION
	dermal (rat) LD50: >2000 mg/kg ^[1] Oral (Rat) LD50: 4200 mg/kg ^[2]	Eye: adverse effect observed (irritating) ^[1] Skin: no adverse effect observed (not irritating) ^[1]
dysprosium(III) oxide	TOXICITY	IRRITATION
	Oral (Rat) LD50: >1000 mg/kg ^[1]	Not Available
erbium(III) oxide	TOXICITY	IRRITATION
	Inhalation(Rat) LC50: >5.09 mg/4h ^[1] Oral (Rat) LD50: >2000 mg/kg ^[1]	Not Available
europium(III) oxide	TOXICITY	IRRITATION
	Oral (Rat) LD50: >5000 mg/kg ^[2]	Not Available
gadolinium(III) oxide	TOXICITY	IRRITATION
	Inhalation(Rat) LC50: >5.04 mg/4h ^[1] Oral (Rat) LD50: >2000 mg/kg ^[1]	Eye: no adverse effect observed (not irritating) ^[1] Skin: no adverse effect observed (not irritating) ^[1]
holmium(III) oxide	TOXICITY	IRRITATION
	Not Available	Not Available
lanthanum oxide	TOXICITY	IRRITATION
	Dermal (rabbit) LD50: >1087 mg/kg ^[1] Oral (Rat) LD50: >=10000 mg/kg ^[1]	Not Available
lutetium(III) oxide	TOXICITY	IRRITATION
	Oral (Rat) LD50: >2000 mg/kg ^[1]	Not Available
neodymium(III) oxide	TOXICITY	IRRITATION
	Inhalation(Rat) LC50: >4.98 mg/4h ^[1] Oral (Rat) LD50: >5000 mg/kg ^[1]	Eye: no adverse effect observed (not irritating) ^[1] Skin: no adverse effect observed (not irritating) ^[1]
praseodymium(III,IV) oxide	TOXICITY	IRRITATION
	Inhalation(Rat) LC50: >5.21 mg/4h ^[1] Oral (Rat) LD50: >2000 mg/kg ^[1]	Not Available
scandium(III) oxide	TOXICITY	IRRITATION
	Not Available	Not Available
samarium(III) oxide	TOXICITY	IRRITATION
	Oral (Rat) LD50: >1000 mg/kg ^[2]	Not Available
terbium(III,IV) oxide	TOXICITY	IRRITATION
	Not Available	Not Available
thorium nitrate	TOXICITY	IRRITATION
	Oral (Mouse) LD50: 1760 mg/kg ^[2]	Not Available

Calib. Std #1 Rare Earth Metals

	TOXICITY	IRRITATION
thulium oxide	Not Available	Not Available
ytterbium(III) oxide	Inhalation(Rat) LC50: >1.31 mg/l4h ^[1]	Not Available
	Oral (Rat) LD50: >2000 mg/kg ^[1]	
yttrium(III) oxide	Inhalation(Rat) LC50: >5.09 mg/l4h ^[1]	Not Available
	Oral (Rat) LD50: >5000 mg/kg ^[1]	
nitric acid	Inhalation(Rat) LC50: 0.13 mg/L4h ^[2]	Eye: adverse effect observed (irritating) ^[1]
		Skin: adverse effect observed (corrosive) ^[1]
uranium mixed oxides (U3O8)	Not Available	Not Available
Legend:	1. Value obtained from Europe ECHA Registered Substances - Acute toxicity 2. Value obtained from manufacturer's SDS. Unless otherwise specified data extracted from RTECS - Register of Toxic Effect of chemical Substances	

GADOLINIUM(III) OXIDE	The material may cause skin irritation after prolonged or repeated exposure and may produce on contact skin redness, swelling, the production of vesicles, scaling and thickening of the skin.
SCANDIUM(III) OXIDE	Scandium metal on its own is not considered to be toxic. It is often classified as a rare earth element. Animal testing revealed temporary eye irritation and extensive scar formation when applied to damaged skin. At extremely high doses, it depressed all body systems and caused death by paralysis of breathing and collapse of the heart and circulation.
THORIUM NITRATE	Thorium and its compounds are mainly alpha particle emitters although beta and gamma radiation is also encountered The radiological danger is considerably more serious than the chemical danger in view of the long time that all thorium compounds remain in the organs where they are deposited (mainly in bones, lungs, lymphatic glands etc.) leading to long-term alpha-irradiation of the tissues.
NITRIC ACID	Oral (?) LD50: 50-500 mg/kg * [Various Manufacturers] The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis. The material may produce respiratory tract irritation, and result in damage to the lung including reduced lung function. The material may cause severe skin irritation after prolonged or repeated exposure and may produce on contact skin redness, swelling, the production of vesicles, scaling and thickening of the skin. Repeated exposures may produce severe ulceration.
URANIUM MIXED OXIDES (U3O8)	US NRCP Permissible quarterly intakes of radionuclides for occupational Insolubles- 3.2 microcuries per quarter oral intake; critical organ being the GI tract Lower large intestine. 4.0 x 10 ⁻² per quarter inhalation; critical organ being the lungs. Solubles- 1.2 microcuries per quarter oral intake; critical organ being the kidneys. 4.5 x 10 ⁻² per quarter inhalation; critical organ being the kidneys.
Calib. Std #1 Rare Earth Metals & CERIUM(III) NITRATE & ERBIUM(III) OXIDE & EUROPIUM(III) OXIDE & LANTHANUM OXIDE & LUTETIUM(III) OXIDE & PRASEODYMIUM(III,IV) OXIDE & THULIUM OXIDE & YTTRIUM(III) OXIDE & NITRIC ACID	Asthma-like symptoms may continue for months or even years after exposure to the material ends. This may be due to a non-allergic condition known as reactive airways dysfunction syndrome (RADS) which can occur after exposure to high levels of highly irritating compound. Main criteria for diagnosing RADS include the absence of previous airways disease in a non-atopic individual, with sudden onset of persistent asthma-like symptoms within minutes to hours of a documented exposure to the irritant. Other criteria for diagnosis of RADS include a reversible airflow pattern on lung function tests, moderate to severe bronchial hyperreactivity on methacholine challenge testing, and the lack of minimal lymphocytic inflammation, without eosinophilia.
Calib. Std #1 Rare Earth Metals & NITRIC ACID	For acid mists, aerosols, vapours Test results suggest that eukaryotic cells are susceptible to genetic damage when the pH falls to about 6.5. Cells from the respiratory tract have not been examined in this respect. Mucous secretion may protect the cells of the airway from direct exposure to inhaled acidic mists (which also protects the stomach lining from the hydrochloric acid secreted there).
Calib. Std #1 Rare Earth Metals & CERIUM(III) NITRATE & DYSPROSIUM(III) OXIDE & ERBIUM(III) OXIDE & EUROPIUM(III) OXIDE & GADOLINIUM(III) OXIDE & HOLMIUM(III) OXIDE & LANTHANUM OXIDE & LUTETIUM(III) OXIDE & NEODYMIUM(III) OXIDE & PRASEODYMIUM(III,IV) OXIDE & SCANDIUM(III) OXIDE & SAMARIUM(III) OXIDE & TERBIUM(III,IV) OXIDE & THULIUM OXIDE & YTTERBIUM(III) OXIDE & YTTRIUM(III) OXIDE	Lanthanide poisoning causes immediate defaecation, writhing, inco-ordination, laboured breathing, and inactivity. Respiratory and heart failure may follow causing death.
Calib. Std #1 Rare Earth Metals & CERIUM(III) NITRATE & DYSPROSIUM(III) OXIDE & EUROPIUM(III) OXIDE & HOLMIUM(III) OXIDE &	For typical lanthanides: Symptoms of toxicity from rare earth elements include writhing, inco-ordination, laboured breathing, and sedation. They show low toxicity via swallowing. However, if given through the peritoneal cavity, they may be severely toxic, and injected through the skin, they are moderately toxic. They cause granulomas after exposure. Chronic inhalation toxicity: Chronically exposed humans have been shown to have lanthanide particles accumulate in the airway, with

Calib. Std #1 Rare Earth Metals

TERBIUM(III,IV) OXIDE & YTTERBIUM(III) OXIDE	enlargement of lymph nodes of the bronchi being observed. Developmental/reproductive toxicity: One animal study did not show lanthanum carbonate to affect fertility or harm the foetus. Mutation-causing potential: Animal studies showed cerium oxide to be negative with respect to mutation-causing potential. Cancer-causing potential: An long-term animal (rat) study showed that lanthanum carbonate is not carcinogenic.
WATER & DYSPROSIUM(III) OXIDE & ERBIUM(III) OXIDE & EUROPIUM(III) OXIDE & GADOLINIUM(III) OXIDE & HOLMIUM(III) OXIDE & LANTHANUM OXIDE & LUTETIUM(III) OXIDE & NEODYMIUM(III) OXIDE & PRASEODYMIUM(III,IV) OXIDE & SCANDIUM(III) OXIDE & TERBIUM(III,IV) OXIDE & THORIUM NITRATE & THULIUM OXIDE & YTTERBIUM(III) OXIDE	No significant acute toxicological data identified in literature search.
ERBIUM(III) OXIDE & GADOLINIUM(III) OXIDE & LANTHANUM OXIDE	The material may be irritating to the eye, with prolonged contact causing inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Acute Toxicity	✓	Carcinogenicity	✗
Skin Irritation/Corrosion	✓	Reproductivity	✗
Serious Eye Damage/Irritation	✓	STOT - Single Exposure	✓
Respiratory or Skin sensitisation	✗	STOT - Repeated Exposure	✗
Mutagenicity	✗	Aspiration Hazard	✗

Legend: ✗ – Data either not available or does not fill the criteria for classification
 ✓ – Data available to make classification

SECTION 12 Ecological information

Toxicity

Calib. Std #1 Rare Earth Metals	Endpoint	Test Duration (hr)	Species	Value	Source
	Not Available	Not Available	Not Available	Not Available	Not Available
water	Endpoint	Test Duration (hr)	Species	Value	Source
	Not Available	Not Available	Not Available	Not Available	Not Available
cerium(III) nitrate	Endpoint	Test Duration (hr)	Species	Value	Source
	ErC50	72h	Algae or other aquatic plants	4.16mg/l	2
	LC50	96h	Fish	0.13mg/l	2
	EC50	72h	Algae or other aquatic plants	0.63mg/l	2
	EC50	48h	Crustacea	>100mg/l	1
	EC50(ECx)	48h	Crustacea	>100mg/l	1
dysprosium(III) oxide	Endpoint	Test Duration (hr)	Species	Value	Source
	NOEC(ECx)	120h	Fish	390.5mg/L	4
erbium(III) oxide	Endpoint	Test Duration (hr)	Species	Value	Source
	LC50	96h	Fish	0.13mg/l	2
	NOEC(ECx)	792h	Fish	0.003mg/l	2
europium(III) oxide	Endpoint	Test Duration (hr)	Species	Value	Source
	Not Available	Not Available	Not Available	Not Available	Not Available
gadolinium(III) oxide	Endpoint	Test Duration (hr)	Species	Value	Source
	Not Available	Not Available	Not Available	Not Available	Not Available
holmium(III) oxide	Endpoint	Test Duration (hr)	Species	Value	Source
	NOEC(ECx)	120h	Fish	84mg/L	4
lanthanum oxide	Endpoint	Test Duration (hr)	Species	Value	Source
	EC50	72h	Algae or other aquatic plants	13mg/l	2
	NOEC(ECx)	196h	Algae or other aquatic plants	>=0.00245mg/l	2

Continued...

Calib. Std #1 Rare Earth Metals

lutetium(III) oxide	Endpoint	Test Duration (hr)	Species	Value	Source
	Not Available	Not Available	Not Available	Not Available	Not Available
neodymium(III) oxide	Endpoint	Test Duration (hr)	Species	Value	Source
	NOEC(ECx)	768h	Fish	0.01mg/l	2
praseodymium(III,IV) oxide	Endpoint	Test Duration (hr)	Species	Value	Source
	Not Available	Not Available	Not Available	Not Available	Not Available
scandium(III) oxide	Endpoint	Test Duration (hr)	Species	Value	Source
	Not Available	Not Available	Not Available	Not Available	Not Available
samarium(III) oxide	Endpoint	Test Duration (hr)	Species	Value	Source
	EC50	72h	Algae or other aquatic plants	0.08mg/l	2
	EC50	48h	Crustacea	>0.15mg/l	2
samarium(III) oxide	Endpoint	Test Duration (hr)	Species	Value	Source
	NOEC(ECx)	72h	Algae or other aquatic plants	0.019mg/l	2
	EC50	72h	Algae or other aquatic plants	0.019mg/l	2
terbium(III,IV) oxide	Endpoint	Test Duration (hr)	Species	Value	Source
	Not Available	Not Available	Not Available	Not Available	Not Available
thorium nitrate	Endpoint	Test Duration (hr)	Species	Value	Source
	Not Available	Not Available	Not Available	Not Available	Not Available
thulium oxide	Endpoint	Test Duration (hr)	Species	Value	Source
	Not Available	Not Available	Not Available	Not Available	Not Available
ytterbium(III) oxide	Endpoint	Test Duration (hr)	Species	Value	Source
	Not Available	Not Available	Not Available	Not Available	Not Available
yttrium(III) oxide	Endpoint	Test Duration (hr)	Species	Value	Source
	NOEC(ECx)	120h	Fish	250.5mg/L	4
nitric acid	Endpoint	Test Duration (hr)	Species	Value	Source
	EC50(ECx)	96h	Crustacea	39mg/l	2
	LC50	96h	Fish	102.24mg/L	4
nitric acid	Endpoint	Test Duration (hr)	Species	Value	Source
	EC50	48h	Crustacea	490mg/l	2
uranium mixed oxides (U3O8)	Endpoint	Test Duration (hr)	Species	Value	Source
	Not Available	Not Available	Not Available	Not Available	Not Available
Legend:	<i>Extracted from 1. IUCLID Toxicity Data 2. Europe ECHA Registered Substances - Ecotoxicological Information - Aquatic Toxicity 4. US EPA, Ecotox database - Aquatic Toxicity Data 5. ECETOC Aquatic Hazard Assessment Data 6. NITE (Japan) - Bioconcentration Data 7. METI (Japan) - Bioconcentration Data 8. Vendor Data</i>				

Although the components of an ecosystem can be divided into several major compartments, they function as a unit by means of connections or interchanges between them. Initial uranium deposition in a compartment, as well as exchanges between compartments (mobility), are dependent upon numerous factors such as chemical and physical form of the uranium, environmental media, organic material present, oxidation-reduction potential, nature of sorbing materials, and size and composition of sorbing particles. Environmental concerns related to uranium generally arise following deliberate release (in munitions) and notably address concerns related to ionising radiation. Less well recognised is exposure to depleted forms of uranium resulting from radioactive decay.

Ecotoxicity:

The tolerance of water organisms towards pH margin and variation is diverse. Recommended pH values for test species listed in OECD guidelines are between 6.0 and almost 9.

Acute testing with fish showed 96h-LC50 at about pH 3.5

For Metal:

Atmospheric Fate - Metal-containing inorganic substances generally have negligible vapour pressure and are not expected to partition to air.

Environmental Fate: Environmental processes, such as oxidation, the presence of acids or bases and microbiological processes, may transform insoluble metals to more soluble ionic forms. Environmental processes may enhance bioavailability and may also be important in changing solubilities.

Aquatic/Terrestrial Fate: When released to dry soil, most metals will exhibit limited mobility and remain in the upper layer; some will leach locally into ground water and/ or surface water ecosystems when soaked by rain or melt ice. A metal ion is considered infinitely persistent because it cannot degrade further.

For Cerium:

Environmental Fate: Despite their name, rare earth elements are relatively plentiful in the Earth's crust, with cerium being the 25th most abundant element. Cerium compounds include cerium oxide, cerium carbonate, and cerium chloride.

Atmospheric Fate: Cerium oxidizes very readily at room temperature, especially in moist air. Except for europium, cerium is the most reactive of the rare-earth metals.

For Lanthanoids (Formerly Lanthanides: Synonym Rare Earth Metals and their Salts):

Environmental Fate: Rare earths, such as the lanthanoids, are relatively abundant in the crust of the Earth. These elements are not rare -scientists once thought these substances were only found in very small amounts on the Earth Most of the lanthanides occur together in nature, and they are very difficult to separate from each other. The lanthanides form alloys, (mixtures), with many other metals, and these alloys exhibit a wide range of physical properties. Lanthanoid emissions to the environment have increased as a result of the

Calib. Std #1 Rare Earth Metals

growing industrial applications of these elements; however, robust data to evaluate the environmental fate of lanthanoids are scarce.
DO NOT discharge into sewer or waterways.

Persistence and degradability

Ingredient	Persistence: Water/Soil	Persistence: Air
water	LOW	LOW
cerium(III) nitrate	LOW	LOW

Bioaccumulative potential

Ingredient	Bioaccumulation
cerium(III) nitrate	LOW (LogKOW = 0.209)

Mobility in soil

Ingredient	Mobility
cerium(III) nitrate	LOW (KOC = 14.3)

SECTION 13 Disposal considerations

Waste treatment methods

Product / Packaging disposal	<ul style="list-style-type: none"> ▶ Containers may still present a chemical hazard/ danger when empty. ▶ Return to supplier for reuse/ recycling if possible. Otherwise: <ul style="list-style-type: none"> ▶ If container can not be cleaned sufficiently well to ensure that residuals do not remain or if the container cannot be used to store the same product, then puncture containers, to prevent re-use, and bury at an authorised landfill. ▶ Where possible retain label warnings and SDS and observe all notices pertaining to the product. ▶ WARNING Radioactive materials must not be disposed of as Industrial Waste or domestic garbage. Consult supplier/ appropriate Radiation Control Authority for disposal procedures
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SECTION 14 Transport information

Labels Required

	
Marine Pollutant	NO
HAZCHEM	2X

Land transport (ADG)

UN number	3264	
UN proper shipping name	CORROSIVE LIQUID, ACIDIC, INORGANIC, N.O.S. (Nitric acid solution)	
Transport hazard class(es)	Class	8
	Subrisk	Not Applicable
Packing group	III	
Environmental hazard	Not Applicable	
Special precautions for user	Special provisions	223 274
	Limited quantity	5 L

Air transport (ICAO-IATA / DGR)

UN number	3264	
UN proper shipping name	Corrosive liquid, acidic, inorganic, n.o.s. * (Nitric acid solution)	
Transport hazard class(es)	ICAO/IATA Class	8
	ICAO / IATA Subrisk	Not Applicable
	ERG Code	8L
Packing group	III	
Environmental hazard	Not Applicable	
Special precautions for user	Special provisions	A3 A803
	Cargo Only Packing Instructions	856
	Cargo Only Maximum Qty / Pack	60 L
	Passenger and Cargo Packing Instructions	852

Calib. Std #1 Rare Earth Metals

Passenger and Cargo Maximum Qty / Pack	5 L
Passenger and Cargo Limited Quantity Packing Instructions	Y841
Passenger and Cargo Limited Maximum Qty / Pack	1 L

Sea transport (IMDG-Code / GGVSee)

UN number	3264		
UN proper shipping name	CORROSIVE LIQUID, ACIDIC, INORGANIC, N.O.S. (Nitric acid solution)		
Transport hazard class(es)	IMDG Class	8	
	IMDG Subrisk	Not Applicable	
Packing group	III		
Environmental hazard	Not Applicable		
Special precautions for user	EMS Number	F-A, S-B	
	Special provisions	223 274	
	Limited Quantities	5 L	

Transport in bulk according to Annex II of MARPOL and the IBC code

Product name	Pollution Category	Ship Type
Nitric acid (less than 70%)	Y	2

Transport in bulk in accordance with MARPOL Annex V and the IMSBC Code

Product name	Group
water	Not Available
cerium(III) nitrate	Not Available
dysprosium(III) oxide	Not Available
erbium(III) oxide	Not Available
europium(III) oxide	Not Available
gadolinium(III) oxide	Not Available
holmium(III) oxide	Not Available
lanthanum oxide	Not Available
lutetium(III) oxide	Not Available
neodymium(III) oxide	Not Available
praseodymium(III,IV) oxide	Not Available
scandium(III) oxide	Not Available
samarium(III) oxide	Not Available
terbium(III,IV) oxide	Not Available
thorium nitrate	Not Available
thulium oxide	Not Available
ytterbium(III) oxide	Not Available
yttrium(III) oxide	Not Available
nitric acid	Not Available
uranium mixed oxides (U3O8)	Not Available

Transport in bulk in accordance with the ICG Code

Product name	Ship Type
water	Not Available
cerium(III) nitrate	Not Available
dysprosium(III) oxide	Not Available
erbium(III) oxide	Not Available
europium(III) oxide	Not Available
gadolinium(III) oxide	Not Available
holmium(III) oxide	Not Available
lanthanum oxide	Not Available
lutetium(III) oxide	Not Available
neodymium(III) oxide	Not Available
praseodymium(III,IV) oxide	Not Available
scandium(III) oxide	Not Available
samarium(III) oxide	Not Available
terbium(III,IV) oxide	Not Available

Calib. Std #1 Rare Earth Metals

Product name	Ship Type
thorium nitrate	Not Available
thulium oxide	Not Available
ytterbium(III) oxide	Not Available
yttrium(III) oxide	Not Available
nitric acid	Not Available
uranium mixed oxides (U3O8)	Not Available

SECTION 15 Regulatory information

Safety, health and environmental regulations / legislation specific for the substance or mixture

water is found on the following regulatory lists

Australian Inventory of Industrial Chemicals (AIIC)

cerium(III) nitrate is found on the following regulatory lists

Australian Inventory of Industrial Chemicals (AIIC)

International Agency for Research on Cancer (IARC) - Agents Classified by the IARC Monographs

International Agency for Research on Cancer (IARC) - Agents Classified by the IARC Monographs - Group 2A: Probably carcinogenic to humans

dysprosium(III) oxide is found on the following regulatory lists

Australian Inventory of Industrial Chemicals (AIIC)

International WHO List of Proposed Occupational Exposure Limit (OEL) Values for Manufactured Nanomaterials (MNMS)

erbium(III) oxide is found on the following regulatory lists

Australian Inventory of Industrial Chemicals (AIIC)

International WHO List of Proposed Occupational Exposure Limit (OEL) Values for Manufactured Nanomaterials (MNMS)

europium(III) oxide is found on the following regulatory lists

Australian Inventory of Industrial Chemicals (AIIC)

International WHO List of Proposed Occupational Exposure Limit (OEL) Values for Manufactured Nanomaterials (MNMS)

gadolinium(III) oxide is found on the following regulatory lists

Australian Inventory of Industrial Chemicals (AIIC)

International WHO List of Proposed Occupational Exposure Limit (OEL) Values for Manufactured Nanomaterials (MNMS)

holmium(III) oxide is found on the following regulatory lists

Australian Inventory of Industrial Chemicals (AIIC)

International WHO List of Proposed Occupational Exposure Limit (OEL) Values for Manufactured Nanomaterials (MNMS)

lanthanum oxide is found on the following regulatory lists

Australian Inventory of Industrial Chemicals (AIIC)

International WHO List of Proposed Occupational Exposure Limit (OEL) Values for Manufactured Nanomaterials (MNMS)

lutetium(III) oxide is found on the following regulatory lists

Australian Inventory of Industrial Chemicals (AIIC)

International WHO List of Proposed Occupational Exposure Limit (OEL) Values for Manufactured Nanomaterials (MNMS)

neodymium(III) oxide is found on the following regulatory lists

Australian Inventory of Industrial Chemicals (AIIC)

International WHO List of Proposed Occupational Exposure Limit (OEL) Values for Manufactured Nanomaterials (MNMS)

praseodymium(III,IV) oxide is found on the following regulatory lists

Australian Inventory of Industrial Chemicals (AIIC)

International WHO List of Proposed Occupational Exposure Limit (OEL) Values for Manufactured Nanomaterials (MNMS)

scandium(III) oxide is found on the following regulatory lists

Australian Inventory of Industrial Chemicals (AIIC)

samarium(III) oxide is found on the following regulatory lists

Australian Inventory of Industrial Chemicals (AIIC)

terbium(III,IV) oxide is found on the following regulatory lists

International WHO List of Proposed Occupational Exposure Limit (OEL) Values for Manufactured Nanomaterials (MNMS)

thorium nitrate is found on the following regulatory lists

Australian Inventory of Industrial Chemicals (AIIC)

International Agency for Research on Cancer (IARC) - Agents Classified by the IARC Monographs

International Agency for Research on Cancer (IARC) - Agents Classified by the IARC Monographs - Group 2A: Probably carcinogenic to humans

thulium oxide is found on the following regulatory lists

Australian Inventory of Industrial Chemicals (AIIC)

International WHO List of Proposed Occupational Exposure Limit (OEL) Values for Manufactured Nanomaterials (MNMS)

ytterbium(III) oxide is found on the following regulatory lists

Australian Inventory of Industrial Chemicals (AIIC)

International WHO List of Proposed Occupational Exposure Limit (OEL) Values for Manufactured Nanomaterials (MNMS)

Calib. Std #1 Rare Earth Metals

yttrium(III) oxide is found on the following regulatory lists

Australian Inventory of Industrial Chemicals (AIIC)

International WHO List of Proposed Occupational Exposure Limit (OEL) Values for Manufactured Nanomaterials (MNMS)

nitric acid is found on the following regulatory listsAustralia Hazardous Chemical Information System (HCIS) - Hazardous Chemicals
Australia Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP) - Schedule 5

Australian Inventory of Industrial Chemicals (AIIC)

uranium mixed oxides (U3O8) is found on the following regulatory listsAustralia Hazardous Chemical Information System (HCIS) - Hazardous Chemicals
Australian Inventory of Industrial Chemicals (AIIC)Chemical Footprint Project - Chemicals of High Concern List
International WHO List of Proposed Occupational Exposure Limit (OEL) Values for Manufactured Nanomaterials (MNMS)**National Inventory Status**

National Inventory	Status
Australia - AIIC / Australia Non-Industrial Use	No (terbium(III,IV) oxide)
Canada - DSL	No (dysprosium(III) oxide; holmium(III) oxide; terbium(III,IV) oxide; uranium mixed oxides (U3O8))
Canada - NDSL	No (water; erbium(III) oxide; europium(III) oxide; gadolinium(III) oxide; lanthanum oxide; lutetium(III) oxide; neodymium(III) oxide; praseodymium(III,IV) oxide; scandium(III) oxide; samarium(III) oxide; thorium nitrate; thulium oxide; ytterbium(III) oxide; yttrium(III) oxide; nitric acid)
China - IECSC	No (thulium oxide; uranium mixed oxides (U3O8))
Europe - EINEC / ELINCS / NLP	Yes
Japan - ENCS	No (erbium(III) oxide; thorium nitrate; uranium mixed oxides (U3O8))
Korea - KECI	No (uranium mixed oxides (U3O8))
New Zealand - NZIoC	No (erbium(III) oxide; lutetium(III) oxide; terbium(III,IV) oxide; uranium mixed oxides (U3O8))
Philippines - PICCS	No (dysprosium(III) oxide; erbium(III) oxide; europium(III) oxide; holmium(III) oxide; lutetium(III) oxide; scandium(III) oxide; samarium(III) oxide; thulium oxide; ytterbium(III) oxide; uranium mixed oxides (U3O8))
USA - TSCA	Yes
Taiwan - TCSI	No (uranium mixed oxides (U3O8))
Mexico - INSQ	No (cerium(III) nitrate; dysprosium(III) oxide; europium(III) oxide; gadolinium(III) oxide; holmium(III) oxide; lutetium(III) oxide; neodymium(III) oxide; scandium(III) oxide; samarium(III) oxide; terbium(III,IV) oxide; thulium oxide; ytterbium(III) oxide; uranium mixed oxides (U3O8))
Vietnam - NCI	No (scandium(III) oxide; thorium nitrate; uranium mixed oxides (U3O8))
Russia - FBEPH	No (holmium(III) oxide; terbium(III,IV) oxide; thorium nitrate; thulium oxide; ytterbium(III) oxide)
Legend:	Yes = All CAS declared ingredients are on the inventory No = One or more of the CAS listed ingredients are not on the inventory. These ingredients may be exempt or will require registration.

SECTION 16 Other information

Revision Date	08/02/2023
Initial Date	30/08/2018

SDS Version Summary

Version	Date of Update	Sections Updated
1.2	08/02/2023	Acute Health (eye), Acute Health (inhaled), Acute Health (skin), Acute Health (swallowed), Appearance, CAS Number, Chronic Health, Classification, Environmental, Fire Fighter (fire/explosion hazard), Personal Protection (hands/feet), Physical Properties, Storage (storage incompatibility), Synonyms

Other information

Classification of the preparation and its individual components has drawn on official and authoritative sources as well as independent review by the Chemwatch Classification committee using available literature references.

The SDS is a Hazard Communication tool and should be used to assist in the Risk Assessment. Many factors determine whether the reported Hazards are Risks in the workplace or other settings. Risks may be determined by reference to Exposures Scenarios. Scale of use, frequency of use and current or available engineering controls must be considered.

Definitions and abbreviations

PC—TWA: Permissible Concentration-Time Weighted Average
 PC—STEL: Permissible Concentration-Short Term Exposure Limit
 IARC: International Agency for Research on Cancer
 ACGIH: American Conference of Governmental Industrial Hygienists
 STEL: Short Term Exposure Limit
 TEEL: Temporary Emergency Exposure Limit.
 IDLH: Immediately Dangerous to Life or Health Concentrations
 ES: Exposure Standard
 OSF: Odour Safety Factor
 NOAEL :No Observed Adverse Effect Level
 LOAEL: Lowest Observed Adverse Effect Level
 TLV: Threshold Limit Value
 LOD: Limit Of Detection
 OTV: Odour Threshold Value
 BCF: BioConcentration Factors
 BEI: Biological Exposure Index
 AIIC: Australian Inventory of Industrial Chemicals
 DSL: Domestic Substances List

Calib. Std #1 Rare Earth Metals

NDSL: Non-Domestic Substances List
IECSC: Inventory of Existing Chemical Substance in China
EINECS: European INventory of Existing Commercial chemical Substances
ELINCS: European List of Notified Chemical Substances
NLP: No-Longer Polymers
ENCS: Existing and New Chemical Substances Inventory
KECI: Korea Existing Chemicals Inventory
NZIoC: New Zealand Inventory of Chemicals
PICCS: Philippine Inventory of Chemicals and Chemical Substances
TSCA: Toxic Substances Control Act
TCSI: Taiwan Chemical Substance Inventory
INSQ: Inventario Nacional de Sustancias Químicas
NCI: National Chemical Inventory
FBEPH: Russian Register of Potentially Hazardous Chemical and Biological Substances

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