

MATERIAL SAFETY DATA SHEET

Prepared to U.S. OSHA, CMA, ANSI and Canadian WHMIS Standards

PART I *What is the material and what do I need to know in an emergency*

1. PRODUCT IDENTIFICATION

TRADE NAME (AS LABELED): **VANADIUM PENTOXIDE**
CHEMICAL NAME/CLASS: Vanadium Pentoxide
SYNONYMS: Vanadic Anhydride
PRODUCT USE: General Industrial Use
SUPPLIER/MANUFACTURER'S NAME: **Pechiney World Trade (U.S.A), Inc.**
ADDRESS: 333 Ludlow Street
 Stamford, CT 06902
EMERGENCY PHONE: United States: (800) 424-9300
 International: (703) 527-3887
BUSINESS PHONE: 203/541-9190
DATE OF PREPARATION: 6/1/01

2. COMPOSITION and INFORMATION ON INGREDIENTS

CHEMICAL NAME	CAS #	% w/w	EXPOSURE LIMITS IN AIR					
			ACGIH		OSHA		NIOSH IDLH mg/m ³	OTHER mg/m ³
			TLV mg/m ³	STEL mg/m ³	PEL mg/m ³	STEL mg/m ³		
Vanadium Pentoxide	1314-62-1	100	0.05 (Respirable dust or fume)	NE	0.05 (Respirable dust) 0.05 ceiling (Fume) [Vacated 1989 PEL]	0.5 ceiling (Respirable dust) 0.1 ceiling (Fume)	35	NIOSH REL: STEL = 0.05 ceiling (15 min, total dust as vanadium) DFG MAK: TWA = 0.05 (Respirable fraction of the aerosol) PEAK = 5•MAK 30 min, average value) Carcinogen: TLV-A4

NE = Not Established . See Section 16 for Definitions of Terms Used.

NOTE: ALL WHMIS required information is included in appropriate sections based on the ANSI Z400.1-1998 format. Vanadium Pentoxide has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

3. HAZARD IDENTIFICATION

EMERGENCY OVERVIEW: Vanadium Pentoxide is a yellow to red crystalline powder or orange solid. Vanadium Pentoxide is irritating and prolonged exposure may burn contaminated tissue. Vanadium Pentoxide is highly toxic and may cause skin and respiratory sensitization. Vanadium Pentoxide is not flammable or reactive. Emergency responders must wear proper personal protective equipment and have adequate fire protection for the situation to which they are responding.

SYMPTOMS OF OVEREXPOSURE BY ROUTE OF EXPOSURE: Vanadium Pentoxide can irritate and may damage skin, eyes, and respiratory system.

INHALATION: If airborne dusts of Vanadium Pentoxide are inhaled, irritation or damage to the mucus membranes, lungs, and bronchial airways may occur. Symptoms can include inflammation, greenish-black tongue, headache, cough, shortness of breath, and tightness in the chest.

3. HAZARD IDENTIFICATION (Continued)

INHALATION (continued): Inhalation overexposure may cause pulmonary edema (a potentially fatal accumulation of fluid in the lungs). Chronic inhalation overexposure can cause dry cough, blood stained sputum, anemia, pallor, loss of appetite, blood in urine, tremors, dizziness, hysteria, and depression. Chronic inhalation of Vanadium Pentoxide may increase an individual's susceptibility to colds and other respiratory illnesses. Vanadium Pentoxide can cause respiratory sensitization, subsequent exposure to very small amounts can cause allergic reaction in susceptible individuals.

CONTACT WITH SKIN or EYES: Eye contact with Vanadium Pentoxide will cause irritation, pain, itching, swelling, tearing, and redness. Prolonged eye contact may cause burns. Skin contact can cause redness, pain, and irritation. Depending on extent and duration of overexposure, Vanadium Pentoxide may cause burns. Vanadium Pentoxide can cause skin sensitization, subsequent exposure to very small amounts can cause allergic reaction.

SKIN ABSORPTION: Vanadium Pentoxide can be absorbed through intact skin. Symptoms may include those described under "Inhalation".

INGESTION: Ingestion is not anticipated to be a significant route of overexposure to Vanadium Pentoxide. If Vanadium Pentoxide is swallowed, it can cause nausea, vomiting, headache, dizziness, abdominal cramps, diarrhea, drowsiness, and unconsciousness. Chronic ingestion exposure may cause symptoms described for chronic "Inhalation". Severe ingestion overexposure may be fatal.

INJECTION: Accidental injection of Vanadium Pentoxide, via laceration or puncture by a contaminated object, may cause pain and irritation in addition to the wound. Symptoms described for "Inhalation and Ingestion" may occur.

HEALTH EFFECTS OR RISKS FROM EXPOSURE: An Explanation in **Lay Terms**. In the event of exposure, the following symptoms may be observed:

ACUTE: Depending on extent and duration of overexposure, Vanadium Pentoxide may burn contaminated tissue. Inhalation overexposure may cause pulmonary edema (a potentially fatal accumulation of fluid in the lungs). Severe ingestion overexposure may be fatal.

CHRONIC: Chronic inhalation and ingestion overexposure may cause dry cough, blood stained sputum, anemia, pallor, loss of appetite, blood in urine, tremors, dizziness, hysteria, and depression. Vanadium Pentoxide can cause respiratory and skin sensitization, subsequent exposure to very small amounts can cause allergic reaction.

TARGET ORGANS: ACUTE: Skin, eyes, respiratory system, gastrointestinal system. CHRONIC: Skin, respiratory system, gastrointestinal system.

HAZARDOUS MATERIAL IDENTIFICATION SYSTEM			
HEALTH		(BLUE)	3
FLAMMABILITY		(RED)	0
REACTIVITY		(YELLOW)	1
PROTECTIVE EQUIPMENT			C
EYES	RESPIRATORY	HANDS	BODY
	SEE SECTION 8		
For Routine Industrial Applications			

See Section 16 for Definition of Ratings

PART II *What should I do if a hazardous situation occurs?*

4. FIRST-AID MEASURES

Victims of chemical exposure must be taken for medical attention. Rescuers should be taken for medical attention, if necessary. Take a copy of the label and the MSDS to health professional with victim.

SKIN EXPOSURE: If Vanadium Pentoxide contaminates the skin, immediately begin decontamination with warm, running water. Minimum flushing is for 15 minutes. Remove exposed or contaminated clothing, taking care not to contaminate eyes. Victim must seek medical attention if any adverse effect occurs.

EYE EXPOSURE: If Vanadium Pentoxide enters the eyes, open victim's eyes while under gently running water. Use sufficient force to open eyelids. Have victim "roll" eyes. Minimum flushing is for 15 minutes. Victim must seek immediate medical attention.

INHALATION: If mists or sprays from Vanadium Pentoxide are inhaled, remove victim to fresh air. If necessary, use artificial respiration to support vital functions. Remove or cover gross contamination to avoid exposure to rescuers.

INGESTION: If Vanadium Pentoxide is swallowed, CALL PHYSICIAN OR POISON CONTROL CENTER FOR MOST CURRENT INFORMATION. If professional advice is not available, do not induce vomiting. Never induce vomiting or give diluents (milk or water) to someone who is unconscious, having convulsions, or unable to swallow. If victim is convulsing, maintain an open airway and obtain immediate medical attention.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Pre-existing respiratory problems, dermatitis, and eye, skin and gastrointestinal system disorders may be aggravated by exposure to Vanadium Pentoxide.

RECOMMENDATIONS TO PHYSICIANS: Treat symptoms and eliminate overexposure.

5. FIRE-FIGHTING MEASURES

FLASH POINT: Not flammable.

AUTOIGNITION TEMPERATURE: Not flammable.

FLAMMABLE LIMITS (in air by volume, %):

Lower (LEL): Not applicable.

Upper (UEL): Not applicable.

FIRE EXTINGUISHING MATERIALS:

Water Spray: YES

Foam: YES

Halon: YES

Carbon Dioxide: YES

Dry Chemical: YES

Other: Any "ABC" Class.

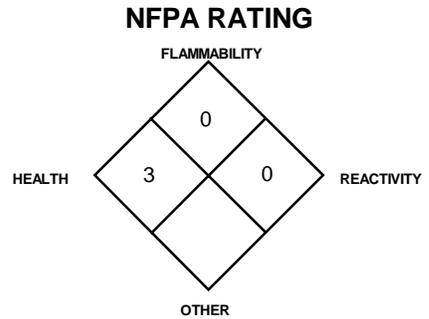
UNUSUAL FIRE AND EXPLOSION HAZARDS: Vanadium Pentoxide is highly toxic and may cause skin and respiratory sensitization. Vanadium Pentoxide is irritating and poses a contact hazard to firefighters. When involved in a fire, this material may decompose and produce acrid, irritating vapors and toxic gases.

Explosion Sensitivity to Mechanical Impact: Not sensitive.

Explosion Sensitivity to Static Discharge: Not sensitive.

SPECIAL FIRE-FIGHTING PROCEDURES: Incipient fire responders should

wear eye protection. Structural firefighters must wear Self-Contained Breathing Apparatus and full protective equipment. If protective equipment is contaminated by Vanadium Pentoxide, it should be thoroughly washed with running water prior to removal of SCBA respiratory protection. Firefighters whose protective equipment becomes contaminated should thoroughly shower with warm, soapy water and should receive medical evaluation if they experience any adverse effects. Move fire-exposed containers, if it can be done without risk to firefighters. If possible, prevent runoff water from entering storm drains, bodies of water, or other environmentally sensitive areas.



**See Section 16 for
Definition of Ratings**

6. ACCIDENTAL RELEASE MEASURES

SPILL AND LEAK RESPONSE: Uncontrolled releases should be responded to by trained personnel using pre-planned procedures. Proper protective equipment should be used. In case of a spill, clear the affected area, protect people, and respond with trained personnel. In the event of a non-incident release, minimum Personal Protective Equipment should be **Level B: triple-gloves (rubber gloves and nitrile gloves over latex gloves), chemical resistant suit and boots, hard hat, and Self-Contained Breathing Apparatus**. Sweep up spilled material, avoiding the generation of airborne dusts. Place all spill residue in a suitable container and seal. Decontaminate the area thoroughly. Dispose of in accordance with U.S. Federal, State, and local hazardous waste disposal regulations and those of Canada and its Provinces (see Section 13, Disposal Considerations).

PART III *How can I prevent hazardous situations from occurring*

7. HANDLING and STORAGE

WORK PRACTICES AND HYGIENE PRACTICES: As with all chemicals, avoid getting Vanadium Pentoxide ON YOU or IN YOU. Wash thoroughly after handling Vanadium Pentoxide. Do not eat or drink while handling this material. Remove contaminated clothing immediately. Use ventilation and other engineering controls to minimize potential exposure to Vanadium Pentoxide.

STORAGE AND HANDLING PRACTICES: All employees who handle this material should be trained to handle it safely. Minimize all exposures to this substance. Avoid breathing airborne dusts of Vanadium Pentoxide. Use in a well-ventilated location. Open containers slowly, on a stable surface. Keep container tightly closed when not in use. Inspect all incoming containers before storage, to ensure containers are properly labeled and not damaged. Store containers in a cool, dry location, away from direct sunlight, sources of intense heat, or where freezing is possible. Material should be stored in secondary containers, or in a diked area, as appropriate. Store containers away from incompatible chemicals. If appropriate, post warning signs in storage and use areas. Empty containers may contain residual Vanadium Pentoxide; therefore, empty containers should be handled with care.

Do not perform any welding, cutting, soldering, drilling, or other hot work on an empty container until all liquid and vapors have been cleared. Use forklifts or other material handling equipment when moving large containers of Vanadium Pentoxide (to prevent back injury or other potential physical injuries).

PROTECTIVE PRACTICES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT: Follow practices indicated in Section 6 (Accidental Release Measures). Make certain that application equipment is locked and tagged-out safely. Decontaminate equipment as necessary. Collect all rinsates and dispose of according to applicable U.S. Federal, State, or local procedures and those of Canada and its Provinces.

8. EXPOSURE CONTROLS - PERSONAL PROTECTION

VENTILATION AND ENGINEERING CONTROLS: Use with adequate ventilation. Use a mechanical fan or vent area to outside. Ensure eyewash/safety shower stations are available near areas where Vanadium Pentoxide is used.

RESPIRATORY PROTECTION (continued): If necessary, use only respiratory protection authorized in the U.S. Federal OSHA Respiratory Protection Standard (29 CFR 1910.134) or equivalent U.S. State standards, and Canadian CSA Standard Z94.4-93. Oxygen levels below 19.5% are considered IDLH by OSHA. In such atmospheres, use of a full-facepiece pressure/demand SCBA or a full facepiece, supplied air respirator with auxiliary self-contained air supply is required under OSHA's Respiratory Protection Standard (1910.134-1998). NIOSH respiratory protection guidelines for Vanadium Pentoxide are available as follows:

VANADIUM PENTOXIDE (DUST)

CONCENTRATION

RESPIRATORY PROTECTION

Up to 0.5 mg/m³: Any air-purifying respirator with a high-efficiency particulate (HEPa) filter or any Supplied-Air Respirator (SAR).

Up to 1.25 mg/m³: Any SAR operated in a continuous-flow mode or any powered, air-purifying respirator with a HEPa filter.

Up to 2.5 mg/m³: Any air-purifying, full-facepiece respirator with a HEPa filter, any Powered, Air-Purifying Respirator (PAPR) with a tight-fitting facepiece and a HEPa filter, any Self-Contained Breathing Apparatus (SCBA) with a full facepiece, or any SAR with a full facepiece.

Up to 35 mg/m³: Any SAR that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

Emergency or Planned Entry into Unknown Concentrations or IDLH Conditions: SCBA that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode or any SAR that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary SCBA operated in pressure-demand or other positive-pressure mode.

Escape: Any air-purifying, full-facepiece respirator with a HEPa filter or any appropriate escape-type, SCBA.

FUME:

Up to 0.5 mg/m³: Any air-purifying respirator with a high-efficiency particulate (HEPa) filter or any Supplied-Air Respirator (SAR).

Up to 1.25 mg/m³: Any SAR operated in a continuous-flow mode or any Powered, Air-Purifying Respirator (PAPR) with a HEPa filter.

Up to 2.5 mg/m³: Any air-purifying, full-facepiece respirator with a HEPa filter, any PAPR with a tight-fitting facepiece and a HEPa filter, any SCBA with a full facepiece, or any SAR with a full facepiece.

Up to 35 mg/m³: Any SAR that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

Emergency or Planned Entry into Unknown Concentrations or IDLH Conditions: Any SCBA that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode or any SAR that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary SCBA operated in pressure-demand or other positive-pressure mode.

Escape: Any air-purifying, full-facepiece respirator with a HEPa filter or any appropriate escape-type, SCBA.

EYE PROTECTION: Splash goggles or safety glasses with side shields. If necessary, refer to U.S. OSHA 29 CFR 1910.133, or Canadian Standards.

HAND PROTECTION: Wear Butyl, Natural, Neoprene, Nitrile rubber or Polyvinyl Chloride Vinyl gloves for routine industrial use. Use triple gloves for spill response, as stated in Section 6 (Accidental Release Measures) of this MSDS. If necessary, refer to U.S. OSHA 29 CFR 1910.138, or appropriate Standards of Canada.

BODY PROTECTION: Use body protection appropriate for task. Impervious clothing such as boots, lab coat, apron, and coveralls, as needed, is suggested. Full-body chemical protective clothing is recommended for emergency response procedures.

9. PHYSICAL and CHEMICAL PROPERTIES

RELATIVE VAPOR DENSITY (air = 1): Not established.

EVAPORATION RATE (water = 1): Not established.

SPECIFIC GRAVITY (water = 1): 3.36 @ 20°C

FREEZING/MELTING POINT: 685°C (1265°F)

SOLUBILITY IN WATER: 1 g/125 mL

BOILING POINT: 1750°C (3182°F) [decomposes]

VAPOR PRESSURE: Not established.

pH: Not established.

ODOR THRESHOLD: Odorless.

COEFFICIENT WATER/OIL DISTRIBUTION: Not established.

APPEARANCE, ODOR AND COLOR: Vanadium Pentoxide is a yellow to red crystalline powder or orange solid.

HOW TO DETECT THIS SUBSTANCE (warning properties): The appearance may be a distinctive property of Vanadium Pentoxide.

10. STABILITY and REACTIVITY

STABILITY: Stable under conditions of normal pressure and temperature.

DECOMPOSITION PRODUCTS: Acrid, irritating vapors and toxic gases.

MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: Lithium, chlorine trifluoride, peroxyformic acid, acids, bases.

HAZARDOUS POLYMERIZATION: Will not occur.

CONDITIONS TO AVOID: Avoid exposure to or contact with extreme temperatures and incompatible chemicals.

PART IV *Is there any other useful information about this material?*

11. TOXICOLOGICAL INFORMATION

TOXICITY DATA:

VANADIUM PENTOXIDE (DUST):

Standard Draize Test (skin, rabbit) = 20 mg/24 hours; Moderate

DNA Repair (Bacteria, *Bacillus subtilis*) = 500 mmol/L

DNA Damage (leukocyte, human) = 300 nmol/L

DNA Damage (lymphocyte, human) = 30 μ mol/L

Sex Chromosome Loss and Nondisjunction (lymphocyte, human) = 10 nmol/L

Micronucleus Test (lung, hamster) = 1 mg/L

TCLo (inhalation, human) = 346 mg/m³; Lungs, Thorax, or Respiration: cough, dyspnea, sputum

TCLo (inhalation, human) = 1 mg/m³/8 hours/ Lungs, Thorax, or Respiration: cough, bronchiolar constriction; Sense Organs and Special Senses (Eye): conjunctive irritation

TDLo (oral, rat) = 91 mg/kg/26 weeks/intermittent; Behavioral: alteration of operant conditioning

TDLo (oral, rat) = 1280 mg/kg/ weeks/intermittent; Blood: pigmented or nucleated red blood cells, changes in erythrocyte (RBC) count; Skin and Appendages: hair

TDLo (oral, rat) = 90 mg/kg/female 6–15 days after conception; Reproductive: Fertility: post-implantation mortality (e.g. dead and/or resorbed implants per total number of implants); Effects on Embryo or Fetus: fetal death

TDLo (oral, rat) = 180 mg/kg/female 6–15 days after conception; Reproductive: Effects on Embryo or Fetus: other effects to embryo

TCLo (inhalation, rat) = 100 μ g/m³/24 hours/24 days/continuous; Brain and Coverings: recordings from specific areas of CNS; Nutritional and Gross Metabolic: weight loss or decreased weight gain; Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: phosphatases

TCLo (inhalation, rat) = 2 mg/m³/1 hour/13 weeks/intermittent; Behavioral: alteration of classical conditioning

TCLo (inhalation, rat) = 56 mg/kg/14 days/intermittent; Lungs, Thorax, or Respiration: other changes; Biochemical: Metabolism (Intermediary): lipids including transport

VANADIUM PENTOXIDE (DUST) [continued]:

TDLo (intraperitoneal, rat) = 10 mg/kg/female 6–15 days after conception; Reproductive: Fertility: post-implantation mortality (e.g. dead and/or resorbed implants per total number of implants); Effects on Embryo or Fetus: fetal death; Specific Developmental Abnormalities: other developmental abnormalities

TDLo (intraperitoneal, rat) = 50 mg/kg/female 6–15 days after conception; Specific Developmental Abnormalities: skin and skin appendages, musculoskeletal system, other developmental abnormalities

TDLo (intraperitoneal, rat) = 5 mg/kg/female 10 days after conception; Specific Developmental Abnormalities: skin and skin appendages, musculoskeletal system, other developmental abnormalities

TDLo (intraperitoneal, rat) = 10 mg/kg/female 6–15 days after conception; Reproductive: Fertility: pre-implantation mortality (e.g. reduction in number of implants per female; total number of implants per corpora lutea); post-implantation mortality (e.g. dead and/or resorbed implants per total number of implants)

TDLo (intratracheal, rat) = 7200 μ g/kg/1 year/intermittent; Lungs, Thorax, or Respiration: other changes, changes in lung weight; Biochemical: Metabolism (Intermediary): amino acids (including renal excretion)

TDLo (intraperitoneal, mouse) = 85 mg/kg/female 6–15 days after conception; Reproductive: Effects on Embryo or Fetus: fetotoxicity (except death, e.g., stunted fetus), musculoskeletal system, other developmental abnormalities

TDLo (intraperitoneal, mouse) = 170 mg/kg/male 60 days pre-mating; Reproductive: Fertility: post-implantation mortality (e.g. dead and/or resorbed implants per total number of implants); Fertility: litter size (e.g. # fetuses per litter; measured before birth); Effects on Embryo or Fetus: fetotoxicity (except death, e.g., stunted fetus)

VANADIUM PENTOXIDE (DUST) [continued]:

TDLo (intraperitoneal, mouse) = 85 mg/kg/female 6–15 days after conception; Reproductive: Effects on Embryo or Fetus: other effects to embryo

TDLo (intraperitoneal, mouse) = 170 mg/kg/male 60 days pre-mating; Reproductive: Paternal Effects: spermatogenesis (incl. genetic material, sperm morphology, motility, and count), testes, epididymis, sperm duct; Fertility: male fertility index (e.g. # males impregnating females per # males exposed to fertile non-pregnant females)

TDLo (intravenous, mouse) = 10,900 mg/kg/female 8 days after conception; Specific Developmental Abnormalities: musculoskeletal system

LD₅₀ (oral, rat) = 10 mg/kg; Behavioral: coma
LC₅₀ (inhalation, rat) = 126 mg/m³/6 hours; Sense Organs and Special Senses (Eye): effect, not otherwise specified; Behavioral: ataxia; Lungs, Thorax, or Respiration: dyspnea

LD₅₀ (intraperitoneal, rat) = 12 mg/kg
LD₅₀ (subcutaneous, rat) = 14 mg/kg; Behavioral: coma

LD₅₀ (intratracheal, rat) = 6 mg/kg

LD₅₀ (oral, mouse) = 5 mg/kg

LD₅₀ (intraperitoneal, mouse) = 23 mg/kg

LD₅₀ (subcutaneous, mouse) = 10 mg/kg

LD₅₀ (skin, rabbit) = 50 mg/kg; Liver: other changes; Kidney, Ureter, Bladder: other changes

LCLo (inhalation, cat) = 500 mg/m³/23 minutes

LDLo (subcutaneous, guinea pig) = 20 mg/kg

TCLo (inhalation, rat) = 27 μ g/m³/24 hours/70 days/continuous; Kidney, Ureter, Bladder: changes in tubules (including acute renal failure, acute tubular necrosis); Blood: changes in serum composition (e.g. TP, bilirubin, cholesterol); Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: true cholinesterase

TCLo (inhalation, rat) = 100 μ g/m³/24 hours/17 weeks/continuous; Kidney, Ureter, Bladder: changes in bladder weight; Blood: changes in erythrocyte (RBC) count; Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: monoamine oxidase

SUSPECTED CANCER AGENT: Vanadium Pentoxide is not on the following lists: FEDERAL OSHA Z LIST, NTP, IARC, CAL/OSHA and therefore is not considered to be or suspected to be a cancer-causing agent by these agencies.

IRRITANCY OF PRODUCT: Vanadium Pentoxide can irritate or burn contaminated tissue.

SENSITIZATION TO THE PRODUCT: Vanadium Pentoxide can cause respiratory and skin sensitization, subsequent exposure to very small amounts can cause allergic reaction.

11. TOXICOLOGICAL INFORMATION (Continued)

REPRODUCTIVE TOXICITY INFORMATION: Listed below is information concerning the effects of Vanadium Pentoxide on the human reproductive system.

Mutagenicity: Animal mutation data are available for Vanadium Pentoxide; these data were obtained during clinical studies on specific animal tissues exposed to high doses of this compound.

Embryotoxicity: Vanadium Pentoxide is not reported to produce embryotoxic effects in humans.

Teratogenicity: Clinical studies on test animals exposed to relatively high doses of Vanadium Pentoxide provided teratogenic data.

Reproductive Toxicity: Clinical studies on test animals exposed to relatively high doses of Vanadium Pentoxide provided reproductive toxicity data.

A **mutagen** is a chemical that causes permanent changes to genetic material (DNA) such that the changes will propagate through generational lines. An **embryotoxin** is a chemical that causes damage to a developing embryo (i.e. within the first eight weeks of pregnancy in humans), but the damage does not propagate across generational lines. A **teratogen** is a chemical that causes damage to a developing fetus, but the damage does not propagate across generational lines. A **reproductive toxin** is any substance that interferes in any way with the reproductive process.

ACGIH BIOLOGICAL EXPOSURE INDICES: Currently, there are an ACGIH Biological Exposure Indices (BEIs) determined for Vanadium Pentoxide, as follows:

CHEMICAL: DETERMINANT	SAMPLING TIME	BEI
Vanadium Pentoxide • Vanadium in urine	• End of shift at end of workweek	• 50 µg/g/ creatinine

12. ECOLOGICAL INFORMATION

ALL WORK PRACTICES MUST ELIMINATE POTENTIAL OR ACTUAL RELEASES TO THE ENVIRONMENT.

ENVIRONMENTAL STABILITY: Vanadium Pentoxide is expected to be stable under ambient environmental conditions. Additional environmental data are available as follows:

VANADIUM PENTOXIDE:

Solubility: 1 g/L25 ml water.

Persistence: Will persist in sediments indefinitely.

Harmful to aquatic life in very low concentrations.

EFFECT OF MATERIAL ON PLANTS or ANIMALS: Vanadium Pentoxide is harmful or fatal to contaminated plant and animal life.

EFFECT OF CHEMICAL ON AQUATIC LIFE: Vanadium Pentoxide can be extremely toxic to fish and aquatic plants. Additional aquatic toxicity data are available as follows:

VANADIUM PENTOXIDE:

TLm (fathead minnow) 96 hours = 55 ppm (hard water)

VANADIUM PENTOXIDE (continued):

TLm (fathead minnow) 96 hours = 13 ppm (soft water)

13. DISPOSAL CONSIDERATIONS

PREPARING WASTES FOR DISPOSAL: Waste disposal must be in accordance with appropriate U.S. Federal, State, and local regulations or those of Canada and its Provinces. Vanadium Pentoxide, if unaltered by use, may be disposed of by treatment at a permitted facility or as advised by your local hazardous waste regulatory authority.

EPA WASTE NUMBER: Not applicable to wastes consisting only of Vanadium Pentoxide.

14. TRANSPORTATION INFORMATION

VANADIUM PENTOXIDE IS HAZARDOUS AS DEFINED BY 49 CFR 172.101 BY THE U.S. DEPARTMENT OF TRANSPORTATION.

PROPER SHIPPING NAME: Vanadium Pentoxide

HAZARD CLASS NUMBER and DESCRIPTION: 6.1 (Toxic)

UN IDENTIFICATION NUMBER: UN 2862

PACKING GROUP: III

DOT LABEL(S) REQUIRED: TOXIC

EMERGENCY RESPONSE GUIDEBOOK NUMBER, 2000: 151

MARINE POLLUTANT: Vanadium Pentoxide is not designated by the Department of Transportation to be a Marine Pollutant (49 CFR 172.101, Appendix B).

TRANSPORT CANADA TRANSPORTATION OF DANGEROUS GOODS REGULATIONS: Vanadium Pentoxide is considered as dangerous goods, per regulations of Transport Canada. Use the above U.S. DOT information for the preparation of Canadian Shipments.

14. TRANSPORTATION INFORMATION (Continued)

INTERNATIONAL AIR TRANSPORT ASSOCIATION (IATA): Vanadium Pentoxide is considered as dangerous goods under the rules of IATA.

PROPER SHIPPING NAME: Vanadium Pentoxide
HAZARD CLASS NUMBER and DESCRIPTION: 6.1 (Toxic)
UN IDENTIFICATION NUMBER: UN 2862
PACKING GROUP: III
HAZARD LABEL(S) REQUIRED: TOXIC
ERG CODE: 6L

PROPER SHIPPING NAME	PASSENGER AND CARGO AIRCRAFT				CARGO AIRCRAFT ONLY	
	Limited Quantity		Packing Instruction	Max. Qty per Pkg	Packing Instruction	Max. Qty per Pkg
	Packing Instruction	Max. Qty per Pkg				
Vanadium Pentoxide	Y619	10 kg	619	100 kg	619	200 kg

15. REGULATORY INFORMATION

ADDITIONAL UNITED STATES REGULATIONS:

U.S. SARA REPORTING REQUIREMENTS: Vanadium Pentoxide is subject to the reporting requirements of Section 302, 304 and 313 of Title III of the Superfund Amendments and Reauthorization Act., as follows:

CHEMICAL NAME	SARA 302 (40 CFR 355, Appendix A)	SARA 304 (40 CFR Table 302.4)	SARA 313 (40 CFR 372.65)
Vanadium Pentoxide	YES	YES	NO

U.S. SARA THRESHOLD PLANNING QUANTITY: 100 lb (45.4 kg)/10,000 lb (4,540 kg)

U.S. TSCA INVENTORY STATUS: Vanadium Pentoxide is listed on the TSCA Inventory.

CE U.S. CERCLA REPORTABLE QUANTITY (RQ): 1000 lb (454 kg)

OTHER U.S. FEDERAL REGULATIONS: Not applicable.

U.S. STATE REGULATORY INFORMATION: Components of Vanadium Pentoxide are covered under specific State regulations, as denoted below:

<p>Alaska - Designated Toxic and Hazardous Substances: None.</p> <p>California - Permissible Exposure Limits for Chemical Contaminants: Vanadium Pentoxide.</p> <p>Florida - Substance List: Vanadium Pentoxide.</p> <p>Illinois - Toxic Substance List: Vanadium Pentoxide.</p> <p>Kansas - Section 302/313 List: Vanadium Pentoxide.</p> <p>Massachusetts - Substance List: Vanadium Pentoxide.</p>	<p>Michigan - Critical Materials Register: None.</p> <p>Minnesota - List of Hazardous Substances: Vanadium Pentoxide.</p> <p>Missouri - Employer Information/Toxic Substance List: Vanadium Pentoxide.</p> <p>New Jersey - Right to Know Hazardous Substance List: Vanadium Pentoxide.</p> <p>North Dakota - List of Hazardous Chemicals, Reportable Quantities: Vanadium Pentoxide.</p>	<p>Pennsylvania - Hazardous Substance List: Vanadium Pentoxide.</p> <p>Rhode Island - Hazardous Substance List: Vanadium Pentoxide.</p> <p>Texas - Hazardous Substance List: None.</p> <p>West Virginia - Hazardous Substance List: None.</p> <p>Wisconsin - Toxic and Hazardous Substances: None.</p>
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CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65): Vanadium Pentoxide is not on the California Proposition 65 lists.

ANSI LABELING (Z129.1) LABELING (Precautionary Statements): **DANGER!** MAY BE FATAL IF SWALLOWED. HARMFUL IF INHALED. CAUSES EYE ANDD SKIN IRRITATION. MAY BE HARMFUL IF ABSORBED THROUGH SKIN. MAY CAUSE ALLERGIC RESPIRATORY AND SKIN REACTION. Do not taste or swallow. Do not get on skin or in eyes. Do not breathe dust. Keep container closed. Use only with adequate ventilation. Wash thoroughly after handling. Wear gloves, goggles, faceshields, suitable body protection, and NIOSH-approved respiratory protection as appropriate. **FIRST-AID:** In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. If inhaled, remove to fresh air. If ingested, do not induce vomiting. Get medical attention. **IN CASE OF FIRE:** Use water fog, dry chemical, CO₂, or "alcohol" foam. **IN CASE OF SPILL:** Sweep up spilled material, avoiding the generation of airborne dusts. Place residue in suitable container. Consult Material Safety Data Sheet for additional information.

15. REGULATORY INFORMATION (Continued)

ADDITIONAL CANADIAN REGULATIONS:

CANADIAN DSL/NDL INVENTORY STATUS: Vanadium Pentoxide is on the DSL Inventory.

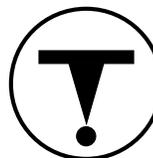
OTHER CANADIAN REGULATIONS: Not applicable.

CANADIAN ENVIRONMENTAL PROTECTION ACT (CEPA) PRIORITY SUBSTANCES LISTS: Vanadium Pentoxide is not on the CEPA Priority Substances Lists.

CANADIAN WHMIS SYMBOLS:

Class D2A: Material Causing Toxic Effects

Class D2B: Material Causing Other Toxic Effects-Contains Sensitizer



16. OTHER INFORMATION

PREPARED BY:

CHEMICAL SAFETY ASSOCIATES, Inc.
9163 Chesapeake Drive, San Diego, CA 92123-1002
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The information contained herein is based on data considered accurate. However, no warranty is expressed or implied regarding the accuracy of these data or the results to be obtained from the use thereof. Pechiney assumes no responsibility for injury to the vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, Pechiney assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in his use of the material.

DEFINITIONS OF TERMS

A large number of abbreviations and acronyms appear on a MSDS. Some of these, which are commonly used, include the following:

CAS #: This is the Chemical Abstract Service Number that uniquely identifies each constituent.

EXPOSURE LIMITS IN AIR:

ACGIH - American Conference of Governmental Industrial Hygienists, a professional association which establishes exposure limits. **TLV** - Threshold Limit Value - an airborne concentration of a substance that represents conditions under which it is generally believed that nearly all workers may be repeatedly exposed without adverse effect. The duration must be considered, including the 8-hour Time Weighted Average (**TWA**), the 15-minute Short Term Exposure Limit, and the instantaneous Ceiling Level (**C**). Skin absorption effects must also be considered.

OSHA - U.S. Occupational Safety and Health Administration.

PEL - Permissible Exposure Limit - This exposure value means exactly the same as a TLV, except that it is enforceable by OSHA. The OSHA Permissible Exposure Limits are based in the 1989 PELs and the June, 1993 Air Contaminants Rule (Federal Register: 58: 35338-35351 and 58: 40191). Both the current PELs and the vacated PELs are indicated. The phrase, "Vacated 1989 PEL," is placed next to the PEL that was vacated by Court Order. **IDLH** - Immediately Dangerous to Life and Health - This level represents a concentration from which one can escape within 30-minutes without suffering escape-preventing or permanent injury. **The DFG - MAK** is the Republic of Germany's Maximum Exposure Level, similar to the U.S. PEL. **NIOSH** is the National Institute of Occupational Safety and Health, which is the research arm of the U.S. Occupational Safety and Health Administration (**OSHA**). NIOSH issues exposure guidelines called Recommended Exposure Levels (**RELs**). When no exposure guidelines are established, an entry of **NE** is made for reference.

HAZARD RATINGS:

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM: This rating system was developed by the National Paint and Coating Association and has been adopted by industry to identify the degree of chemical hazards. Health Hazard: **0** (minimal acute or chronic exposure hazard); **1** (slight acute or chronic exposure hazard); **2** (moderate acute or significant chronic exposure hazard); **3** (severe acute exposure hazard; onetime overexposure can result in permanent injury and may be fatal); **4** (extreme acute exposure hazard; onetime overexposure can be fatal). Flammability Hazard: **0** (minimal hazard); **1** (materials that require substantial pre-heating before burning); **2** (combustible liquid or solids; liquids with a flash point of 38-93°C [100-200°F]); **3** (Class IB and IC flammable liquids with flash points below 38°C [100°F]); **4** (Class IA flammable liquids with flash points below 23°C [73°F] and boiling points below 38°C [100°F]. Reactivity Hazard: **0** (normally stable); **1** (material that can become unstable at elevated temperatures or which can react slightly with water); **2** (materials that are unstable but do not detonate or which can react violently with water); **3** (materials that can detonate when initiated or which can react explosively with water); **4** (materials that can detonate at normal temperatures or pressures). PPE Rating X: Special attention should be given to selection of personal protective equipment.

NATIONAL FIRE PROTECTION ASSOCIATION: Health Hazard: **0** (material that on exposure under fire conditions would offer no hazard beyond that of ordinary combustible materials); **1** (materials that on exposure under fire conditions could cause irritation or minor residual injury); **2** (materials that on intense or continued exposure under fire conditions could cause temporary incapacitation or possible residual injury); **3** (materials that can on short exposure could cause serious temporary or residual injury); **4** (materials that under very short exposure causes death or major residual injury). Flammability Hazard and Reactivity Hazard: Refer to definitions for "Hazardous Materials Identification System".

FLAMMABILITY LIMITS IN AIR:

Much of the information related to fire and explosion is derived from the National Fire Protection Association (**NFPA**). Flash Point - Minimum temperature at which a liquid gives off sufficient vapors to form an ignitable mixture with air. Autoignition Temperature: The minimum temperature required to initiate combustion in air with no other source of ignition. LEL - the lowest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source. UEL - the highest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source.

TOXICOLOGICAL INFORMATION:

Human and Animal Toxicology: Possible health hazards as derived from human data, animal studies, or from the results of studies with similar compounds are presented. Definitions of some terms used in this section are: **LD₅₀** - Lethal Dose (solids & liquids) which kills 50% of the exposed animals; **LC₅₀** - Lethal Concentration (gases) which kills 50% of the exposed animals; **ppm** concentration expressed in parts of material per million parts of air or water; **mg/m³** concentration expressed in weight of substance per volume of air; **mg/kg** quantity of material, by weight, administered to a test subject, based on their body weight in kg. Other measures of toxicity include **TDLo**, the lowest dose to cause a symptom and **TCLo** the lowest concentration to cause a symptom; **TDo**, **LDLo**, and **LDo**, or **TC**, **TCo**, **LCLo**, and **LCo**, the lowest dose (or concentration) to cause lethal or toxic effects. **Cancer Information:** The sources are: **IARC** - the International Agency for Research on Cancer; **NTP** - the National Toxicology Program, **RTECS** - the Registry of Toxic Effects of Chemical Substances, **OSHA** and **CAL/OSHA**. IARC and NTP rate chemicals on a scale of decreasing potential to cause human cancer with rankings from 1 to 4. Subrankings (2A, 2B, etc.) are also used. **Other Information:** **BEI** - ACGIH Biological Exposure Indices, represent the levels of determinants which are most likely to be observed in specimens collected from a healthy worker who has been exposed to chemicals to the same extent as a worker with inhalation exposure to the TLV. **Ecological Information:** **EC** is the effect concentration in water. **BCF** = Bioconcentration Factor, which is used to determine if a substance will concentrate in lifeforms which consume contaminated plant or animal matter. **TL_m** = median threshold limit; Coefficient of Oil/Water Distribution is represented by **log K_{ow}** or **log K_{oc}** and is used to assess a substance's behavior in the environment.

REGULATORY INFORMATION:

This section explains the impact of various laws and regulations on the material. **U.S.:** **EPA** is the U.S. Environmental Protection Agency. **DOT** is the U.S. Department of Transportation. **SARA** is the Superfund Amendments and Reauthorization Act. **TSCA** is the U.S. Toxic Substance Control Act. **CERCLA (or Superfund)** refers to the Comprehensive Environmental Response, Compensation, and Liability Act. Labeling is per the American National Standards Institute (**ANSI Z129.1**). **CANADA:** **CEPA** is the Canadian Environmental Protection Act. **WHMIS** is the Canadian Workplace Hazardous Materials Information System. **TC** is Transport Canada. **DSL/NDSL** are the Canadian Domestic/Non-Domestic Substances Lists. package label.