

LTS RESEARCH LABORATORIES, INC.
MATERIAL SAFETY DATA SHEET
VANADIUM OXIDE

GENERAL

MANUFACTURER/SUPPLIER: LTS RESEARCH LABORATORIES, INC.

COMPANY'S STREET: 37 RAMLAND ROAD
COMPANY'S CITY: ORANGEBURG
COMPANY'S STATE: NEW YORK
COMPANY'S ZIP CODE: 10962
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COMPANY'S EMERGENCY TEL. #: 800-424-9300 (LOCAL)
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COMPANY'S TEL #: 845-494-2940
DATE MSDS REVISED: 02/19/09

1. PRODUCT IDENTIFICATION

PRODUCT NAME: VANADIUM OXIDE
FORMULA: V_2O_x , VO, V_2O_3 , VO_2 , V_2O_5
CAS #:
VANADIUM (II) OXIDE (VO): 12035-98-2
VANADIUM (III) OXIDE (V_2O_3): 1314-34-7
VANADIUM (IV) OXIDE (VO_2): 12036-21-4
VANADIUM (V) OXIDE (V_2O_5): 1314-62-1

2. PHYSICAL AND CHEMICAL CHARACTERISTICS

VANADIUM(II) OXIDE:

MELTING POINT: 950 °C
DENSITY AT 20°C: 5.76 G/CC
VAPOR DENSITY: N/A
VAPOR PRESSURE: N/A
% VOLATILES: N/A
SOLUBILITY IN H₂O: INSOLUBLE
APPEARANCE AND ODOR : CRYSTALLINE, LIGHT GRAY. ODOR NOT DETERMINED

VANADIUM(III) OXIDE:

MELTING POINT: 1970 °C
DENSITY AT 20°C: 4.87 G/CC
VAPOR DENSITY: N/A
VAPOR PRESSURE: N/A
% VOLATILES: N/A
SOLUBILITY IN H₂O: SLIGHTLY SOLUBLE
APPEARANCE AND ODOR : POWDER, BLACK & DARK BLUE. ODORLESS

VANADIUM(IV) OXIDE:

MELTING POINT: 1976 °C
DENSITY AT 20°C: 4.339 G/CC
VAPOR DENSITY: N/A
VAPOR PRESSURE: N/A
% VOLATILES: N/A
SOLUBILITY IN H₂O: INSOLUBLE
APPEARANCE AND ODOR : CRYSTALLINE, BLACK. ODOR NOT DETERMINED

VANADIUM(V) OXIDE:

MELTING POINT: 690 °C
BOILING POINT: 1750 °C
DENSITY AT 20°C: 3.357 G/CC
VAPOR DENSITY: N/A

VAPOR PRESSURE: N/A
% VOLATILES: N/A
SOLUBILITY IN H₂O: 8 G/L
APPEARANCE AND ODOR : PIECES, ORANGE & VARIOUS COLORS. ODORLESS

3. HAZARD IDENTIFICATION

VANADIUM(II) OXIDE:
HAZARD DESCRIPTION: T TOXIC
RISK PHRASES: R 21/22 HARMFUL IN CONTACT WITH SKIN AND IF SWALLOWED
R 23 TOXIC BY INHALATION

HMIS RATINGS:
HEALTH: 2
FLAMMABILITY: 0
REACTIVITY: 0

VANADIUM(III) OXIDE:
HAZARD DESCRIPTION: Xn HARMFUL
RISK PHRASES: R 23/25 HARMFUL BY INHALATION AND IF SWALLOWED
R 36/37 IRRITATING TO EYES AND RESPIRATORY SYSTEM

HMIS RATINGS:
HEALTH: 3
FLAMMABILITY: 0
REACTIVITY: 0

VANADIUM(IV) OXIDE:
HAZARD DESCRIPTION: T TOXIC
RISK PHRASES: R 20/22 TOXIC BY INHALATION AND IF SWALLOWED
R 36/37/38 IRRITATING TO EYES, RESPIRATORY SYSTEM, AND SKIN

HMIS RATINGS:
HEALTH: 3
FLAMMABILITY: 0
REACTIVITY: 0

VANADIUM(V) OXIDE:
HAZARD DESCRIPTION: T TOXIC
N DANGEROUS FOR THE ENVIRONMENT
RISK PHRASES: R 20/22 HARMFUL BY INHALATION AND IF SWALLOWED
R 37 IRRITATING TO RESPIRATORY SYSTEM
R 48/23 TOXIC: DANGER OF SERIOUS DAMAGE TO HEALTH BY PROLONGED EXPOSURE THROUGH INHALATION
R 68 POSSIBLE RISK OF IRREVERSIBLE EFFECTS
R 51/53 TOXIC TO AQUATIC ORGANISMS, MAY CAUSE LONG-TERM ADVERSE EFFECTS IN THE AQUATIC ENVIRONMENT
R 63 POSSIBLE RISK OF HARM TO UNBORN CHILD

HMIS RATINGS:
HEALTH: 2
FLAMMABILITY: 0
REACTIVITY: 0

4. FIRE FIGHTING MEASURES

VANADIUM(II) OXIDE:
FLASH POINT: N/A
FLAMMABLE LIMITS:
UPPER: N/A
LOWER: N/A
EXTINGUISHING MEDIA: CO₂, SAND, EXTINGUISHING POWDER. DO NOT USE WATER
SPECIAL FIRE FIGHTING

PROCEDURES: FIREFIGHTERS MUST WEAR FULL FACE, SELF CONTAINED BREATHING APPARATUS WITH FULL PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES. FUMES FROM FIRE ARE HAZARDOUS. ISOLATE RUNOFF TO PREVENT ENVIRONMENTAL POLLUTION

SPECIAL HAZARDS: TOXIC METAL OXIDE FUMES

VANADIUM(III) OXIDE:

FLASH POINT: N/A

FLAMMABLE LIMITS: N/A

UPPER: N/A

LOWER: N/A

EXTINGUISHING MEDIA: CO₂, SAND, EXTINGUISHING POWDER., OR WATER SPRAY. FIGHT LARGER FIRES WITH WATER SPRAY OR ALCOHOL RESISTANT FOAM.

SPECIAL FIRE FIGHTING PROCEDURES: FIREFIGHTERS MUST WEAR FULL FACE, SELF CONTAINED BREATHING APPARATUS WITH FULL PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES. FUMES FROM FIRE ARE HAZARDOUS. ISOLATE RUNOFF TO PREVENT ENVIRONMENTAL POLLUTION

SPECIAL HAZARDS: TOXIC METAL OXIDE FUMES

VANADIUM(IV) OXIDE:

FLASH POINT: N/A

FLAMMABLE LIMITS: N/A

UPPER: N/A

LOWER: N/A

EXTINGUISHING MEDIA: SPECIAL POWDER FOR METAL FIRES. DO NOT USE WATER.

SPECIAL FIRE FIGHTING PROCEDURES: FIREFIGHTERS MUST WEAR FULL FACE, SELF CONTAINED BREATHING APPARATUS WITH FULL PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES. FUMES FROM FIRE ARE HAZARDOUS. ISOLATE RUNOFF TO PREVENT ENVIRONMENTAL POLLUTION

SPECIAL HAZARDS: TOXIC METAL OXIDE FUMES

VANADIUM(V) OXIDE:

FLASH POINT: N/A

FLAMMABLE LIMITS: N/A

UPPER: N/A

LOWER: N/A

EXTINGUISHING MEDIA: PRODUCT IS NOT FLAMMABLE. USE FIRE FIGHTING MEASURES THAT SUIT THE SURROUNDING FIRE.

SPECIAL FIRE FIGHTING PROCEDURES: FIREFIGHTERS MUST WEAR FULL FACE, SELF CONTAINED BREATHING APPARATUS WITH FULL PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES. FUMES FROM FIRE ARE HAZARDOUS. ISOLATE RUNOFF TO PREVENT ENVIRONMENTAL POLLUTION

5. HEALTH HAZARD INFORMATION

INHALATION: BREATHING DUST AND FUMES CAN IRRITATE THE RESPIRATORY TRACT AND CAUSE CHEST TIGHTNESS, WHEEZING AND COUGHING.

INGESTION: MAY CAUSE ABDOMINAL DISCOMFORT SUCH AS NAUSEA, VOMITING OR CRAMPS. ALSO MAY CAUSE HARMLESS GREENISH-BLACK DISCOLORATION OF THE TONGUE, CNS DAMAGE

SKIN: HARMFUL AMOUNTS MAY BE ABSORBED THROUGH THE SKIN. CONTACT MAY CAUSE LOCAL IRRITATION WITH REDDENING AND ITCHING.

EYE: MAY CAUSE MODERATE TO SEVERE EYE IRRITATION AND POSSIBLE CORNEAL INJURY.

CHRONIC AFFECTS:
INHALATION: MAY RESULT IN CHRONIC BRONCHITIS OR ASTHMATIC REACTION WITH POSSIBLE LUNG INJURY IN SUSCEPTIBLE INDIVIDUALS. WHEN EXPOSURE CEASES, EFFECTS ARE USUALLY REVERSIBLE.

INGESTION: NO DATA

SKIN: ALLEGEDLY CAUSES ALLERGIC SKIN REACTION IN SUSCEPTIBLE INDIVIDUALS. WHEN EXPOSURE CEASES, EFFECTS ARE USUALLY REVERSIBLE.

EYE: NO DATA

ROUTES OF EXPOSURE: INHALATION, INGESTION, SKIN, EYE.

TARGET ORGAN: MAY AFFECT THE KIDNEYS, RESPIRATORY SYSTEM, SKIN AND EYES, REPRODUCTIVE SYSTEM, CNS.

CARCINOGENICITY:

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| NTP: | NO |
| IARC: | NO |
| OSHA: | NO |

6. STABILITY

STABILITY: STABLE

MATERIAL TO AVOID:

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| VANADIUM (II) OXIDE: | NONE |
| VANADIUM (III) OXIDE: | HEAT |
| VANADIUM (IV) OXIDE: | HALOGENS |
| VANADIUM (V) OXIDE: | ACIDS, ALKALI METALS, INTERHALOGENS |

HAZARDOUS DECOMPOSITION PRODUCTS: TOXIC METAL OXIDE FUME.

HAZARDOUS POLYMERIZATION: WILL NOT OCCUR.

7. EMERGENCY AND FIRST AID PROCEDURES:

GENERAL: IMMEDIATELY REMOVE ANY CLOTHING SOILED BY THE PRODUCT

INHALATION: LEAVE DUSTY AREA AND GET FRESH AIR. PROVIDE ARTIFICIAL RESPIRATION IS NECESSARY.

INGESTION: SEEK IMMEDIATE MEDICAL ADVICE

SKIN: WASH WITH SOAP AND WATER. SEEK MEDICAL ADVICE

EYES: FLUSH WITH WATER FOR 10-20 MINUTES TO MAKE SURE NO PARTICLES REMAIN IN THE EYE. SEE A PHYSICIAN, PREFERABLY AN OPHTHALMOLOGIST, PROMPTLY

8. HANDLING AND STORAGE

HANDLING AND STORAGE STORE IN A COOL DRY AREA IN A TIGHTLY SEALED CONTAINER, STORE AWAY FROM INCOMPATIBLE MATERIAL, AND WASH THOROUGHLY AFTER HANDLING. TAKE CARE WHEN MACHINING OR PERFORMING OPERATIONS THAT PRODUCE DUSTS NOT TO BREATHE DUSTS.

OTHER PRECAUTIONS: IMPLEMENT ENGINEERING AND WORK PRACTICE CONTROLS TO REDUCE AND MAINTAIN CONCENTRATION OF EXPOSURE AT LOW LEVELS. USE GOOD HOUSEKEEPING AND SANITATION PRACTICES. DO NOT USE TOBACCO OR FOOD IN WORK AREA. WASH THOROUGHLY BEFORE EATING OR SMOKING. DO NOT

BLOW DUST OFF CLOTHING OR SKIN WITH COMPRESSED AIR. MAINTAIN EYEWASH CAPABLE OF SUSTAINED FLUSHING, SAFETY DRENCH SHOWER AND FACILITIES FOR WASHING NORMAL LAB COAT.

9. SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN
CASE MATERIAL IS
RELEASED OR SPILLED:

MATERIAL SHOULD BE SWEEPED UP OR VACUUMED, USING VENTILATION TO CONTROL THE LEVEL OF AIRBORNE DUST. AVOID USING COMPRESSED AIR OR ANY METHOD THAT CREATES AIRBORNE DUST. IF CLEANUP MAY CREATE AIRBORNE DUST, PERSONNEL SHOULD WEAR SKIN AND EYE PROTECTION AS WELL AS RESPIRATORY PROTECTION

RESPIRATORY PROTECTION
(SPECIFY TYPE):

FOR OPERATIONS SUCH AS GRINDING OR POLISHING, WHICH WILL PRODUCE DUSTS OF METAL POWDER OR OXIDE ABOVE 0.5 MG/M³: NIOSH APPROVED DUST-MIST-FUME RESPIRATOR.

VENTILATION:

PROVIDE SUFFICIENT VENTILATION TO KEEP EXPOSURE TO DUST BELOW PERMISSIBLE EXPOSURE LIMITS.

PROTECTIVE GLOVES

RUBBER

EYE PROTECTION:

SAFETY GLASSES

OTHER PROTECTIVE

CLOTHING OR EQUIPMENT:

PROTECTIVE GEAR SUITABLE TO PREVENT CONTAMINATION

WASTE DISPOSAL METHOD:

IN ACCORDANCE WITH LOCAL, STATE AND FEDERAL REGULATIONS.

10. TOXICITY DATA

VANADIUM (II), (III), & (IV) OXIDE:
CHRONIC TOXICITY:

VANADIUM COMPOUNDS ACT CHIEFLY AS AN IRRITANT TO THE EYES AND RESPIRATORY TRACT. EXPOSURE MAY CAUSE CONJUNCTIVITIS, RHINITIS, AND REVERSIBLE IRRITATION OF THE RESPIRATORY TRACT. MORE SEVERE CASES MAY CAUSE BRONCHITIS, BRONCHOSPASMS, AND ASTHMA-LIKE DISEASE. MAY CAUSE POLYCYTHEMIA, RED BLOOD CELL DESTRUCTION AND ANEMIA, ALBUMINURIA AND HEMATURIA, GASTROINTESTINAL DISORDERS, NERVOUS COMPLAINTS, AND SEVERE COUGH
TO OUR BEST KNOWLEDGE THE TOXICITY OF THIS SUBSTANCE IS NOT FULLY KNOWN.
NO CLASSIFICATION DATA ON CARCINOGENIC PROPERTIES OF THIS MATERIAL IS AVAILABLE.
VANADIUM (II) OXIDE: DANGER THROUGH SKIN ABSORPTION.

ADDITIONAL INFORMATION:

VANADIUM (V) OXIDE:
CHRONIC TOXICITY:

VANADIUM PENTOXIDE IS POISONOUS BY INGESTION AND INHALATION AS WELL AS OTHER ROUTES. INGESTION CAUSES DISTURBANCES OF THE GASTROINTESTINAL TRACT. MAY ALSO CAUSE A PAPULAR SKIN RASH. VANADIUM PENTOXIDE IS A RESPIRATORY IRRITANT. EFFECTS INCLUDE SKIN PALLOR, GREENISH-BLACK TONGUE, CHEST PAIN, COUGH, DSYPNEA, PALPITATION, AND LUNG CHANGES. CAUSES REPRODUCTIVE AND MUTAGENIC EFFECTS IN LABORATORY ANIMALS.
TO OUR BEST KNOWLEDGE THE TOXICITY OF THIS SUBSTANCE IS NOT FULLY KNOWN.

ADDITIONAL INFORMATION:

ACGIH A4: NOT CLASSIFIABLE AS A HUMAN CARCINOGEN;
INADEQUATE DATA ON WHICH TO CLASSIFY THE AGENT
IN TERMS OF ITS CARCINOGENICITY IN HUMANS AND/OR
ANIMALS.

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| VANADIUM PENTOXIDE DUST: TERATOGENICITY: EPIDEMIOLOGY: | ORAL RAT LD50: 10 MG/KG EFFECT HAS SHOWN IN LABORATORY ANIMAL. IN A STUDY OF 55 BOILERMAKERS EXPOSED TO VANADIUM PENTOXIDE FUME AT > 0.05 MG/M3, THE MOST FREQUENT CLINICAL PRESENTATION WAS SECONDARY BRONCHITIS. |
| REPRODUCTIVE EFFECTS: | SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATION. |
| NEUROTOXICITY: | NO DATA AVAILABLE. |
| MUTAGENICITY: | LABORATORY EXPERIMENTS HAVE SHOWN MUTAGENIC EFFECTS. |
| OTHER STUDIES: CARCINOGENICITY: | NO DATA AVAILABLE |
| EPA: | NO |
| IARC: | NO |
| NTP: | NO |
| OSHA: | NO |
| ACGIH: | NO |

11. TRANSPORTATION DATA

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| UN# | |
| VANADIUM (II) OXIDE: | 3285 |
| VANADIUM (III) OXIDE: | 3285 |
| VANADIUM (IV) OXIDE: | 3285 |
| VANADIUM (V) OXIDE: | 2862 |
| HAZARD CLASS: | 6.1 |
| ADR//RID CLASS: | 6.1 |
| IMDG CLASS: | 6.1 |
| AIR TRAN. ICAO/IATA CLASS: | 6.1 |
| MARITIME TRAN. IMDG CLASS: | 6.1 |

12. OTHER INFORMATION

THIS SAFETY DATA SHEET SHOULD BE USED IN CONJUNCTION WITH TECHNICAL SHEETS. IT DOES NOT REPLACE THEM. THE INFORMATION GIVEN IS BASED ON OUR KNOWLEDGE OF THIS PRODUCT, AT THE TIME OF PUBLICATION. IT IS GIVEN IN GOOD FAITH. THE ATTENTION OF THE USER IS DRAWN TO THE POSSIBLE RISKS INCURRED BY USING THE PRODUCT FOR ANY OTHER PURPOSE OTHER THAN THAT FOR WHICH IT WAS INTENDED. THIS DOES NOT IN ANY WAY EXCUSE THE USER FROM KNOWING AND APPLYING ALL THE REGULATIONS GOVERNING HIS ACTIVITY. IT IS THE SOLE RESPONSIBILITY OF THE USER TO TAKE ALL PRECAUTIONS REQUIRED IN HANDLING THE PRODUCT. THE AIM OF THE MANDATORY REGULATIONS MENTIONED IS TO HELP THE USER TO FULFILL HIS OBLIGATIONS REGARDING THE USE OF HAZARDOUS PRODUCTS.