1. Identification

Product identifier
Product name Vanadium Oxide (V2O5, pieces)
Internal identification Replaces M-2200-322
Synonyms; trade names divanadium pentaoxide, vanadium pentoxide
CAS number 1314-62-1

Recommended use of the chemical and restrictions on use
Application Exterior surface coating.
Uses advised against No specific uses advised against are identified.

Details of the supplier of the safety data sheet
Supplier Kurt J Lesker Company
Manufacturer Kurt J Lesker Company
1925 Route 51
Jefferson Hills, PA 15025
+1 412-387-9200
Kurt J Lesker Company LTD
United Kingdom
15-16 Burgess Road
Hastings, East Sussex, TN35 4NR
England
Customer Service: +44 (0) 1424 458100
msds@lesker.com

Emergency telephone number
Emergency telephone North America [USA, Canada, Mexico]: 1-866-519-4752
Mainland China: (+86) 4001 2001 74
Europe: (int'l call prefix)-1-760-476-3961
Asia Pacific: (int'l call prefix)-1-760-476-3960
Middle East & Africa: (int'l call prefix)-1-760-476-3959

2. Hazard(s) identification

Classification of the substance or mixture
Physical hazards Not Classified
Health hazards Acute Tox. 4 - H302 Acute Tox. 4 - H332 Muta. 2 - H341 Repr. 2 - H361 STOT SE 3 - H335
STOT RE 1 - H372
Environmental hazards Aquatic Acute 1 - H400 Aquatic Chronic 2 - H411
Label elements
Vanadium Oxide (V2O5, pieces)

Pictogram

Signal word

Danger

Hazard statements

H302+H332 Harmful if swallowed or if inhaled.
H335 May cause respiratory irritation.
H341 Suspected of causing genetic defects.
H361 Suspected of damaging fertility or the unborn child.
H372 Causes damage to organs through prolonged or repeated exposure.
H400 Very toxic to aquatic life.
H411 Toxic to aquatic life with long lasting effects.

Precautionary statements

P260 Do not breathe vapor/spray.
P273 Avoid release to the environment.
P301+P310 If swallowed: Immediately call a poison center/doctor.
P304+P340 If inhaled: Remove person to fresh air and keep comfortable for breathing.
P312 Call a poison center/doctor if you feel unwell.
P391 Collect spillage.

Contains

Vanadium Oxide (V2O5, pieces)

Other hazards

This substance is not classified as PBT or vPvB according to current EU criteria.

3. Composition/information on ingredients

Mixtures

<table>
<thead>
<tr>
<th>Vanadium Oxide (V2O5, pieces)</th>
<th>0 - 100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAS number: 1314-62-1</td>
<td></td>
</tr>
<tr>
<td>M factor (Acute) = 1</td>
<td></td>
</tr>
</tbody>
</table>

Classification

Acute Tox. 4 - H302
Acute Tox. 4 - H332
Muta. 2 - H341
Repr. 2 - H361
STOT SE 3 - H335
STOT RE 1 - H372
Aquatic Acute 1 - H400
Aquatic Chronic 2 - H411

The Full Text for all Hazard Statements are Displayed in Section 16.

4. First-aid measures

Description of first aid measures

General information
Get medical attention if any discomfort continues. Show this Safety Data Sheet to the medical personnel.
Vanadium Oxide (V2O5, pieces)

Inhalation
Move affected person to fresh air and keep warm and at rest in a position comfortable for breathing. Maintain an open airway. Loosen tight clothing such as collar, tie or belt. When breathing is difficult, properly trained personnel may assist affected person by administering oxygen. Get medical attention. Place unconscious person on their side in the recovery position and ensure breathing can take place.

Ingestion
Rinse mouth thoroughly with water. Give a few small glasses of water or milk to drink. Stop if the affected person feels sick as vomiting may be dangerous. Never give anything by mouth to an unconscious person. Place unconscious person on their side in the recovery position and ensure breathing can take place. Keep affected person under observation. Get medical attention.

Skin Contact
Rinse with water.

Eye contact
Rinse with water. Get medical attention if any discomfort continues.

Protection of first aiders
First aid personnel should wear appropriate protective equipment during any rescue.

Most important symptoms and effects, both acute and delayed
General information
The severity of the symptoms described will vary dependent on the concentration and the length of exposure.

Inhalation
A single exposure may cause the following adverse effects: Headache. Exhaustion and weakness.

Ingestion
May cause discomfort if swallowed. Stomach pain. Nausea, vomiting.

Skin contact
Prolonged contact may cause dryness of the skin.

Eye contact
No specific symptoms known. May be slightly irritating to eyes.

Indication of immediate medical attention and special treatment needed
Notes for the doctor
Treat symptomatically.

5. Fire-fighting measures

Extinguishing media

Suitable extinguishing media
The product is not flammable. Extinguish with alcohol-resistant foam, carbon dioxide, dry powder or water fog. Use fire-extinguishing media suitable for the surrounding fire.

Unsuitable extinguishing media
Do not use water jet as an extinguisher, as this will spread the fire.

Special hazards arising from the substance or mixture

Specific hazards
This product is toxic.

Hazardous combustion products
Thermal decomposition or combustion products may include the following substances: Toxic gases or vapors.

Advice for firefighters

Protective actions during firefighting
Avoid breathing fire gases or vapors. Evacuate area. Keep upwind to avoid inhalation of gases, vapors, fumes and smoke. Ventilate closed spaces before entering them. Cool containers exposed to heat with water spray and remove them from the fire area if it can be done without risk. Cool containers exposed to flames with water until well after the fire is out. Avoid discharge to the aquatic environment. Control run-off water by containing and keeping it out of sewers and watercourses. If risk of water pollution occurs, notify appropriate authorities.

Special protective equipment for firefighters
Wear positive-pressure self-contained breathing apparatus (SCBA) and appropriate protective clothing. Standard Firefighter's clothing including helmets, protective boots and gloves will provide a basic level of protection for chemical incidents.
Vanadium Oxide (V2O5, pieces)

6. Accidental release measures

<table>
<thead>
<tr>
<th>Personal precautions, protective equipment and emergency procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Personal precautions</strong></td>
</tr>
<tr>
<td><strong>Environmental precautions</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Methods and material for containment and cleaning up</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Methods for cleaning up</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reference to other sections</th>
</tr>
</thead>
<tbody>
<tr>
<td>For personal protection, see Section 8. See Section 11 for additional information on health hazards. See Section 12 for additional information on ecological hazards. For waste disposal, see Section 13.</td>
</tr>
</tbody>
</table>

7. Handling and storage

<table>
<thead>
<tr>
<th>Precautions for safe handling</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Usage precautions</strong></td>
</tr>
<tr>
<td><strong>Advice on general occupational hygiene</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Conditions for safe storage, Including any incompatibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Storage precautions</strong></td>
</tr>
<tr>
<td><strong>Storage class</strong></td>
</tr>
<tr>
<td><strong>Specific end use(s)</strong></td>
</tr>
</tbody>
</table>

8. Exposure Controls/personal protection

<table>
<thead>
<tr>
<th>Control parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Occupational exposure limits</strong></td>
</tr>
</tbody>
</table>
Vanadium Oxide (V2O5, pieces)

Long-term exposure limit (8-hour TWA):  ACGIH 0.05 mg/m³  inhalable fraction as V
A3
Ceiling exposure limit:  OSHA 0.1 mg/m³  fume as V2O5
Ceiling exposure limit:  OSHA 0.5 mg/m³  respirable dust as V2O5

Vanadium Oxide (V2O5, pieces)

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A3
Ceiling exposure limit:  OSHA 0.1 mg/m³  fume as V2O5
Ceiling exposure limit:  OSHA 0.5 mg/m³  respirable dust as V2O5

ACGIH = American Conference of Governmental Industrial Hygienists.
A3 = Confirmed Animal Carcinogen with Unknown Relevance to Humans.
OSHA = Occupational Safety and Health Administration.

Immediate danger to life and health

35 mg/m³ 35 mg/m³

Vanadium Oxide (V2O5, pieces) (CAS: 1314-62-1)

Immediate danger to life and health

35 mg/m³ 35 mg/m³

Exposure controls

Protective equipment

Appropriate engineering controls

Provide adequate general and local exhaust ventilation. Ensure the ventilation system is regularly maintained and tested. Good general ventilation should be adequate to control worker exposure to airborne contaminants. Observe any occupational exposure limits for the product or ingredients.

Eye/face protection

Unless the assessment indicates a higher degree of protection is required, the following protection should be worn: Tight-fitting safety glasses.

Hand protection

Wear protective gloves. The most suitable glove should be chosen in consultation with the glove supplier/manufacturer, who can provide information about the breakthrough time of the glove material. To protect hands from chemicals, gloves should comply with OSHA 1910.138 and be demonstrated to be impervious to the chemical and resist degradation. Considering the data specified by the glove manufacturer, check during use that the gloves are retaining their protective properties and change them as soon as any deterioration is detected. Frequent changes are recommended.

Other skin and body protection

Wear appropriate clothing to prevent any possibility of skin contact.

Hygiene measures

Wash hands thoroughly after handling. Wash at the end of each work shift and before eating, smoking and using the toilet. Do not eat, drink or smoke when using this product.
Vanadium Oxide (V2O5, pieces)

Respiratory protection  Ensure all respiratory protective equipment is suitable for its intended use and is NIOSH approved. Check that the respirator fits tightly and the filter is changed regularly. Gas and combination filter cartridges should comply with OSHA 1910.134. Full face mask respirators with replaceable filter cartridges should comply with OSHA 1910.134. Half mask and quarter mask respirators with replaceable filter cartridges should comply with OSHA 1910.134.

Environmental exposure controls  Keep container tightly sealed when not in use. Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

9. Physical and Chemical Properties

<table>
<thead>
<tr>
<th>Information on basic physical and chemical properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
</tr>
<tr>
<td>Color</td>
</tr>
<tr>
<td>Odor</td>
</tr>
<tr>
<td>Odor threshold</td>
</tr>
<tr>
<td>pH</td>
</tr>
<tr>
<td>Melting point</td>
</tr>
<tr>
<td>Initial boiling point and range</td>
</tr>
<tr>
<td>Flash point</td>
</tr>
<tr>
<td>Evaporation rate</td>
</tr>
<tr>
<td>Flammability (solid, gas)</td>
</tr>
<tr>
<td>Upper/lower flammability or explosive limits</td>
</tr>
<tr>
<td>Vapor pressure</td>
</tr>
<tr>
<td>Vapor density</td>
</tr>
<tr>
<td>Relative density</td>
</tr>
<tr>
<td>Bulk density</td>
</tr>
<tr>
<td>Solubility(ies)</td>
</tr>
<tr>
<td>Partition coefficient</td>
</tr>
<tr>
<td>Auto-ignition temperature</td>
</tr>
<tr>
<td>Decomposition Temperature</td>
</tr>
<tr>
<td>Viscosity</td>
</tr>
<tr>
<td>Molecular weight</td>
</tr>
</tbody>
</table>

10. Stability and reactivity

Reactivity  There are no known reactivity hazards associated with this product.

Stability  Stable at normal ambient temperatures and when used as recommended. Stable under the prescribed storage conditions.
**Vanadium Oxide (V2O5, pieces)**

<table>
<thead>
<tr>
<th>Possibility of hazardous reactions</th>
<th>No potentially hazardous reactions known.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conditions to avoid</td>
<td>There are no known conditions that are likely to result in a hazardous situation.</td>
</tr>
<tr>
<td>Materials to avoid</td>
<td>No specific material or group of materials is likely to react with the product to produce a hazardous situation.</td>
</tr>
<tr>
<td>Hazardous decomposition products</td>
<td>Does not decompose when used and stored as recommended. Thermal decomposition or combustion products may include the following substances: Toxic gases or vapors.</td>
</tr>
</tbody>
</table>

### 11. Toxicological information

#### Information on toxicological effects

<table>
<thead>
<tr>
<th>Acute toxicity - oral</th>
<th>Notes (oral LD₅₀)</th>
<th>Acute Tox. 4 - H302 Harmful if swallowed.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ATE oral (mg/kg)</td>
<td>500.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Acute toxicity - dermal</th>
<th>Notes (dermal LD₅₀)</th>
<th>Based on available data the classification criteria are not met.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Acute toxicity - inhalation</th>
<th>Notes (inhalation LD₅₀)</th>
<th>Acute Tox. 4 - H332 Harmful if inhaled.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ATE inhalation (dusts/mists mg/l)</td>
<td>1.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Skin corrosion/irritation</th>
<th>Based on available data the classification criteria are not met.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animal data</td>
<td></td>
</tr>
<tr>
<td>Serious eye damage/irritation</td>
<td>Based on available data the classification criteria are not met.</td>
</tr>
<tr>
<td>Respiratory sensitization</td>
<td>Based on available data the classification criteria are not met.</td>
</tr>
<tr>
<td>Skin sensitization</td>
<td>Based on available data the classification criteria are not met.</td>
</tr>
<tr>
<td>Germ cell mutagenicity</td>
<td>Suspected of causing genetic defects.</td>
</tr>
<tr>
<td>Genotoxicity - in vitro</td>
<td></td>
</tr>
<tr>
<td>Carcinogenicity</td>
<td>Based on available data the classification criteria are not met.</td>
</tr>
<tr>
<td>IARC carcinogenicity</td>
<td>None of the ingredients are listed or exempt.</td>
</tr>
<tr>
<td>Reproductive toxicity</td>
<td></td>
</tr>
<tr>
<td>Reproductive toxicity - fertility</td>
<td>Suspected of damaging fertility.</td>
</tr>
<tr>
<td>Reproductive toxicity - development</td>
<td>Suspected of damaging the unborn child.</td>
</tr>
</tbody>
</table>

### Specific target organ toxicity - single exposure

<table>
<thead>
<tr>
<th>STOT - single exposure</th>
<th>STOT SE 3 - H335 May cause respiratory irritation.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target organs</td>
<td>Respiratory system, lungs</td>
</tr>
</tbody>
</table>

### Specific target organ toxicity - repeated exposure
# Vanadium Oxide (V2O5, pieces)

**STOT - repeated exposure**
- STOT RE 1 - H372 Causes damage to organs through prolonged or repeated exposure.

**Aspiration hazard**
- Not relevant. Solid.

**General information**
- Avoid contact during pregnancy/while nursing. May cause genetic defects. The severity of the symptoms described will vary dependent on the concentration and the length of exposure.

**Inhalation**
- A single exposure may cause the following adverse effects: Headache, Exhaustion and weakness.

**Ingestion**
- May cause discomfort if swallowed. Stomach pain, Nausea, vomiting.

**Skin Contact**
- Prolonged contact may cause dryness of the skin.

**Eye contact**
- No specific symptoms known.

**Route of entry**
- Ingestion Inhalation Skin and/or eye contact

**Target Organs**
- Respiratory system, lungs

## 12. Ecological Information

### Toxicity
- Aquatic Chronic 2 - H411 Toxic to aquatic life with long lasting effects.

### Persistence and degradability
- The degradability of the product is not known.

### Bioaccumulative potential
- No data available on bioaccumulation.

### Partition coefficient
- Not applicable.

### Mobility in soil
- No data available.

### Other adverse effects
- None known.

## 13. Disposal considerations

### Waste treatment methods

#### General information
- The generation of waste should be minimized or avoided wherever possible. Reuse or recycle products wherever possible. This material and its container must be disposed of in a safe way. When handling waste, the safety precautions applying to handling of the product should be considered. Care should be taken when handling emptied containers that have not been thoroughly cleaned or rinsed out. Empty containers or liners may retain some product residues and hence be potentially hazardous.

#### Disposal methods
- Dispose of surplus products and those that cannot be recycled via a licensed waste disposal contractor. Waste, residues, empty containers, discarded work clothes and contaminated cleaning materials should be collected in designated containers, labeled with their contents. Incineration or landfill should only be considered when recycling is not feasible.

## 14. Transport information
Vanadium Oxide (V2O5, pieces)

General
The product is not covered by international regulations on the transport of dangerous goods (IMDG, IATA, DoT).

UN Number
Not applicable.

UN proper shipping name
Not applicable.

Transport hazard class(es)
No transport warning sign required.

Packing group
Not applicable.

Environmental hazards
Environmentally Hazardous Substance
No.

Special precautions for user
Based on available knowledge of this material, it has been determined to be non-hazardous and will not pose a risk to persons or the environment in its provided form. However, any cutting, welding, melting, grinding, or use for deposition will produce dust, fume, or particulates containing component elements of this material. Exposure to these components may present significant health hazards. Note: Fine particulate may be a combustible dust which, when dispersed in air, may present an explosion hazard.

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

15. Regulatory information

US Federal Regulations

SARA Section 302 Extremely Hazardous Substances Tier II Threshold Planning Quantities
None of the ingredients are listed or exempt.

CERCLA/Superfund, Hazardous Substances/Reportable Quantities (EPA)
None of the ingredients are listed or exempt.

SARA Extremely Hazardous Substances EPCRA Reportable Quantities
None of the ingredients are listed or exempt.

SARA 313 Emission Reporting
None of the ingredients are listed or exempt.

CAA Accidental Release Prevention
None of the ingredients are listed or exempt.

FDA - Essential Chemical
None of the ingredients are listed or exempt.

FDA - Precursor Chemical
None of the ingredients are listed or exempt.
Vanadium Oxide (V2O5, pieces)

SARA (311/312) Hazard Categories
None of the ingredients are listed or exempt.

OSHA Highly Hazardous Chemicals
None of the ingredients are listed or exempt.

US State Regulations
California Proposition 65 Carcinogens and Reproductive Toxins
None of the ingredients are listed or exempt.

California Air Toxics "Hot Spots" (A-I)
None of the ingredients are listed or exempt.

California Air Toxics "Hot Spots" (A-II)
None of the ingredients are listed or exempt.

California Directors List of Hazardous Substances
None of the ingredients are listed or exempt.

Massachusetts "Right To Know" List
None of the ingredients are listed or exempt.

Rhode Island "Right To Know" List
None of the ingredients are listed or exempt.

Minnesota "Right To Know" List
None of the ingredients are listed or exempt.

New Jersey "Right To Know" List
None of the ingredients are listed or exempt.

Pennsylvania "Right To Know" List
None of the ingredients are listed or exempt.

Inventories
US - TSCA
None of the ingredients are listed or exempt.

US - TSCA 12(b) Export Notification
None of the ingredients are listed or exempt.

16. Other information

Training advice
Only trained personnel should use this material.

Revision comments
NOTE: Lines within the margin indicate significant changes from the previous revision.

Issued by
HS&E Manager.

Revision date
3/16/2017

Revision
5

Supersedes date
12/28/2015

SDS No.
4659

SDS status
Approved.
Vanadium Oxide (V2O5, pieces)

Hazard statements in full

H302 Harmful if swallowed.
H332 Harmful if inhaled.
H335 May cause respiratory irritation.
H341 Suspected of causing genetic defects.
H361 Suspected of damaging fertility or the unborn child.
H372 Causes damage to organs through prolonged or repeated exposure.
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End of SDS