SAFETY DATA SHEET
according to Regulation (EC) No. 453/2010

Date Issued : 4/11/2012
SDS No : M-1000-320

Vanadium metal pieces

SECTION 1 : Identification of the substance/preparation and of the company/undertaking

1.1. Product identifier
   Product name : Vanadium metal pieces

1.2. Relevant identified uses of the substance or mixture and uses advised against
   Relevant identified uses : Physical vapor deposition of thin films

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

1.4. Emergency telephone number
   24-Hour Emergency Response provided by
   3E Global Incident Response Hotline
   When calling, refer to Kurt J Lesker Company
   Global Response Access Code: 333594
   North America [USA, Canada, Mexico]: 1-866-519-4752
   Mainland China: (+) -86- 4001 2001 74
   Europe: {+}-1-760-476-3961
   Asia Pacific: {+}-1-760-476-3960
   Middle East & Africa: {+}-1-760-476-3959

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture
   Classification according to Directive 67/548/EEC
   Classification according to Regulation (EC) No 1272/2008 [CLP]
   Health : This substance or mixture is not hazardous and is not classified under GHS.

2.2. Label elements
   R&S statement(s) : This material is not classified as hazardous according to Directive 67/548/EEC.

2.3. Other hazards
   Immediate concerns : Negligible fire or explosion hazard in bulk form. Powdered material may form explosive dust-air mixtures.
Vanadium metal pieces

Physical hazards: This substance is not considered hazardous in the form supplied. Dusts at sufficient concentrations can form explosive mixtures with air.

Additional information: The physical and toxicological properties of this material have not been thoroughly investigated.

SECTION 3: Composition / information on ingredients

3.1. Substances

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>CAS</th>
<th>EINECS No.</th>
<th>Wt.%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vanadium</td>
<td>7440-62-2</td>
<td>231-171-1</td>
<td>100</td>
</tr>
</tbody>
</table>

3.2. Mixtures

Not Applicable

SECTION 4: First aid measures

4.1. Description of first aid measures

Following eyes: Immediately flush eyes with plenty of water. Get medical attention, if irritation persists.

Following skin: Wash with soap and water. Get medical attention if irritation develops or persists.

Following ingestion: Rinse mouth. Get medical advice/attention.

Following inhalation: No specific treatment is necessary since this material is not likely to be hazardous by inhalation. If exposed to excessive levels of dusts or fumes, remove to fresh air and get medical attention if cough or other symptoms develop.

4.2. Most important symptoms and effects, both acute and delayed

4.3. Indication of any immediate medical attention and special treatment needed

SECTION 5: Fire fighting measures

5.1. Extinguishing media

Extinguishing media: Use a Class D dry powder extinguisher, dolomite, dry sand, graphite, or soda ash.

5.2. Special hazards arising from the substance or mixture

Explosion hazards: Dusts at sufficient concentrations can form explosive mixtures with air.

5.3. Advice for firefighters

Fire fighting procedures: As in any fire, wear self-contained breathing apparatus pressure-demand, (MSHA/NIOSH approved or equivalent) and full protective gear.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

General procedures: Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Eliminate all ignition sources if safe to do so. Avoid formation of dust. Provide appropriate exhaust ventilation where dust is formed. Avoid breathing (dust, vapor, mist, gas). Practice good
Vanadium metal pieces

chemical hygiene during and after use. Avoid release to the environment.

6.2. Environmental precautions

6.3. Methods and material for containment and cleaning up

Small spill : Clean up spills immediately, observing precautions in Protective Equipment section.

Large spill : Collect spilled material in appropriate container. Spill may be reportable. Consult section 15 for Reportable Quantities.

6.4. Reference to other sections

SECTION 7: Handling and storage

7.1. Precautions for safe handling

General procedures : To avoid risks to human health and the environment, comply with the instructions for use.

Handling : Keep away from heat and flame. Keep container closed when not in use. Remove contaminated clothing and wash before reuse. Wash hands before eating and wash before reuse. Wash thoroughly after handling.

Storage : Keep container closed when not in use. Store in a cool dry place.

7.2. Conditions for safe storage, including any incompatibilities

7.3. Specific end use(s)

SECTION 8: Exposure controls / personal protection

8.1. Control parameters

8.2. Exposure controls

Engineering controls : Use process enclosures, local exhaust ventilation, or other engineering controls to control airborne levels below recommended exposure limits.

Eye/face protection : Wear safety glasses.

Skin protection : Wear protective gloves.

Respiratory protection : Not normally needed. If ventilation is inadequate and this material is handled at elevated temperatures or dusts/fumes/mists are generated a NIOSH/MSHA approved air purifying respirator with a manufacturers approved cartridge or canister may be permissible under certain circumstances where airborne concentrations are expected to exceed exposure limits. Protection provided by air purifying respirators is limited. Use a positive pressure air supplied respirator if there is any potential for an uncontrolled release, exposure levels are not known, or any other circumstances where air purifying respirators may not provide adequate protection.

Work hygienic practices : Practice good chemical hygiene during and after use.

Additional information : There are no established workplace exposure limits for components of this product.

SECTION 9: Physical and chemical properties
Vanadium metal pieces

9.1. Information on basic physical and chemical properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical state</td>
<td>Solid</td>
</tr>
<tr>
<td>Colour</td>
<td>Grey</td>
</tr>
<tr>
<td>Odour</td>
<td>None</td>
</tr>
<tr>
<td>pH</td>
<td>NA = Not Applicable</td>
</tr>
<tr>
<td>Melting temperature</td>
<td>1910°C</td>
</tr>
<tr>
<td>Boiling temperature</td>
<td>3407°C</td>
</tr>
<tr>
<td>Flash point</td>
<td>NA = Not Applicable</td>
</tr>
<tr>
<td>Flammable limits</td>
<td>NA = Not Applicable</td>
</tr>
<tr>
<td>Vapor pressure</td>
<td>NA = Not Applicable</td>
</tr>
<tr>
<td>Vapor density</td>
<td>NA = Not Applicable</td>
</tr>
<tr>
<td>Density</td>
<td>6.0 at 25°C</td>
</tr>
<tr>
<td>Solubility in water</td>
<td>Insoluble</td>
</tr>
<tr>
<td>Auto-ignition temperature</td>
<td>NA = Not Applicable</td>
</tr>
<tr>
<td>Molecular weight</td>
<td>50.9415</td>
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</table>

9.2. Other information

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent volatile</td>
<td>NA = Not Applicable</td>
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</tbody>
</table>

SECTION 10: Stability and reactivity

10.1. Reactivity

<table>
<thead>
<tr>
<th>Stable</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
</tr>
</tbody>
</table>

10.2. Chemical stability

10.3. Possibility of hazardous reactions

<table>
<thead>
<tr>
<th>Hazardous decomposition</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
</tr>
</tbody>
</table>

10.4. Conditions to avoid

10.5. Incompatible materials

<table>
<thead>
<tr>
<th>Incompatible materials</th>
<th>Value</th>
</tr>
</thead>
</table>
|                        | Strong acids, Oxidizing materials, Halogens.

10.6. Hazardous decomposition products

<table>
<thead>
<tr>
<th>Hazardous decomposition products</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Toxic metal fumes</td>
</tr>
</tbody>
</table>

SECTION 11: Toxicological information

11.1. Information on toxicological effects

<table>
<thead>
<tr>
<th>Acute</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dermal LD$_{50}$</td>
<td>Not Available</td>
</tr>
<tr>
<td>Skin absorption</td>
<td>Not Available</td>
</tr>
<tr>
<td>Oral LD$_{50}$</td>
<td>Not Available</td>
</tr>
<tr>
<td>Inhalation LC$_{50}$</td>
<td>Not Available</td>
</tr>
<tr>
<td>Mutagenicity</td>
<td>Not Available</td>
</tr>
<tr>
<td>Reproductive effect</td>
<td>Not Available</td>
</tr>
</tbody>
</table>
## SECTION 12: Ecological information

### 12.1. Toxicity

Aquatic toxicity (acute) : Not Available

### 12.2. Persistence and degradability

Persistence and degradability : Not Available

### 12.3. Bioaccumulative potential

Bioaccumulative potential : Not Available

### 12.4. Mobility in soil

### 12.5. Results of PBT and vPvB assessment

### 12.6. Other adverse effects

## SECTION 13: Disposal considerations

### 13.1. Waste treatment methods

Product disposal : Contact a licensed waste disposal company.

Disposal method : Dispose of according to applicable federal, state, provincial, and local regulations.

Empty container : Follow all MSDS/label precautions even after container is emptied because it may retain product residues.

## SECTION 14: Transport information

### 14.1. UN number

### 14.2. UN proper shipping name

UN proper shipping name : Not Regulated

### 14.3. Transport hazard class(es)

### 14.4. Packing group

### 14.5. Environmental hazards

### 14.6. Special precautions for user

### 14.7. Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code

## SECTION 15: Regulatory information

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

National regulations (Germany)

(WGK) classification : nwg - Not hazardous

### 15.2. Chemical safety assessment

## SECTION 16: Other information

Approved by : EHS DEPT

Prepared by : E Bolton

Information contact : msds@lesker.com

General statements : The physical and toxicological properties of this material have not been thoroughly investigated.
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