

SECTION 1 - HAZARDOUS INGREDIENTS

<u>Ingredients</u>	<u>CAS #</u>	<u>% (weight)</u>	<u>LC50, ppm (inhalation, rat)</u>	<u>LD50, mg/kg (Oral, rat)</u>
Hafnium	7440-58-6	97-99.8	N/Av	N/Av
Zirconium	7440-67-7	0.05-3.0	N/Av	N/Av

SECTION 2 - PREPARATION INFORMATION

Prepared by: Thermal Dynamics Corporation

Telephone #: 603-298-5711

Preparation date: November 19, 2003

SECTION 3- PRODUCT IDENTIFICATION

Product identifier: Hafnium Metal

Product use: Insert for Air / Nitrogen Electrodes

Supplier name and address:

Thermal Dynamics Corporation
82 Benning Street
West Lebanon, New Hampshire 03784
Telephone: 603-298-5711

Manufacturer name and address:

TELEDYNE WAH CHANG
P.O. Box 460
Albany, OR 97321
Telephone: (541) 926-4211

Emergency Telephone #: CHEMTREC800 424 9300 USA / CANADA
703 527 3887 INTERNATIONAL

HMIS Rating: Health - 0; Flammability - 1; Reactivity - 0

SECTION 4 - PHYSICAL DATA

- **Physical state, odor and appearance:** Solid, similar to stainless steel, no odor.
- **Odor threshold:** N/Av
- **Specific gravity:** 13.3
- **Coefficient of water/oil distribution:** N/Av
- **Vapor pressure (mm Hg @ 20°C):** 0
- **Boiling point:** 4600°C
- **Melting/freezing point:** 2227 +/- 20°C
- **pH:** N/Av
- **Vapor density (Air=1.0):** N/Av
- **Evaporation rate (n-BuAc=1.0):** None
- **Volatiles, %:** None
- **Solubility in water (w/w):** Insoluble

SECTION 5 - FIRE AND EXPLOSION DATA

- **Conditions of flammability:** Solid hafnium will not ignite. Powder of 10 micron size may self-ignite at room temperature. Dust or powder may be ignited when wet. Means of extinction: Small fires can be controlled by smothering with dry salt or Type D dry-powder fire extinguishers. Isolate burning material. It is advisable to allow large fires to burn out, keeping the fire from spreading. Wear reflective heat-resistant suit. Carbon dioxide is NOT effective in extinguishing burning hafnium. Do not spray water on burning fines, chips, powder or sponge, as a violent explosion may result. This hazard increase with finer particles. If a fire starts in a mass of wet metal fines, such as a barrel of damp machining chips, the initial fire may be followed by an explosion and a very high temperature flash radiation. Therefore, when in doubt, personnel should leave the area and not attempt to extinguish the fire. The explosive characteristic of such material is caused by the hydrogen and steam generated by the burning mass.
- **Sensitivity to mechanical impact/static discharge:** Not susceptible to mechanical impact or static discharge under normal conditions.
- **Flash point (Method):** None
- **Lower/upper flammable limits (% by volume):** N/AV
- **Auto-ignition temperature:** Powder may self-ignite at room temperature (see above).
- **Hazardous combustion products:** May produce toxic products such as metal oxides when burning.

SECTION 6 - REACTIVITY DATA

- **Stability:** Stable. Hazardous polymerization will not occur.
- **Incompatible materials:** Hafnium metal is rapidly dissolved by hydrofluoric acid or hydrofluoric-nitric acid mixtures. Above 200°C, hafnium reacts exothermically with fluorine, chlorine, bromine, iodine and with halocarbons, including carbon tetrachloride, carbon tetrafluoride and Freons. Nitryl fluoride, FNO, will initiate a reaction with hafnium metal at room temperature to produce a glowing or white incandescence.
- **Conditions of reactivity:** Contact with incompatibles.
- **Hazardous decomposition products:** Hafnium metal does not decompose. The above reactions with incompatible materials will generate hazardous reaction products such as flammable hydrogen, toxic fumes of nitrogen oxides, or corrosive hafnium halide vapors.

SECTION 7 - TOXICOLOGICAL PROPERTIES

Routes of exposure and acute/chronic effects

- **Exposure limits:** ACGIH-TLV: For hafnium metal, 0.5 mg/m³; for zirconium metal, 5 mg/m³ as Zr.
- **Routes of entry:** Material is not known to be toxic by inhalation, ingestion, skin contact, skin absorption or eye contact.
- **Chronic toxicity:** Hafnium metal has no known toxicity. The metal is completely insoluble in water, saline solutions or body chemicals. Soluble hafnium compounds have been reported to cause liver damage in lab tests on animals. The LD₅₀ of hafnium as the oxychloride was 112 mg/kg for mice, intraperitoneal. A 90 day hafnium chloride feeding study in rats at 1.0% and 0.1% resulted in unspecified liver effects. No industrial disease has been evident with up to 20 years exposure to hafnium compounds.
- **Carcinogenicity:** Neither ingredient is listed by IARC or ACGIH as a carcinogen.
- **Teratogenicity, mutagenicity, other reproductive effects:** None known.
- **Sensitization to material:** Product is not known to cause allergies.
- **Synergistic materials:** None known.

SECTION 8 - FIRST AID

- **Inhalation:** If victim inhales dust, remove victim to fresh air. If breathing difficulty does not improve rapidly, get patient to a doctor.
- **Skin:** Wash skin with mild soap and water. Rinse thoroughly. See a doctor if irritation persists. If cut, use normal first aid for cuts from sharp metal.
- **Eyes:** If dust or particles land in eye, use normal first aid for removing inert foreign object. Get medical help if particle is large or has penetrated eye tissue.
- **Ingestion:** if swallowed, get medical attention.

SECTION 9 - PREVENTIVE MEASURES
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- **Spill, leak or release:** Gather up for reuse or recycling. Avoid creating dust during clean-up.
- **Waste disposal:** Fine non-recyclable scrap should be burned in small quantities under controlled conditions. Consult federal, provincial and local for allowed means of disposal.

*****PROTECTIVE EQUIPMENT*****

- **Respiratory protection:** Wear a NIOSH-approved particulate respirator while conducting operations such as surface grinding which will generate respirable dust.
- **Engineering controls:** Use local ventilation where large amounts of dust are being generated.
- **Protective gloves:** Use gloves to avoid cuts.
- **Eye protection:** Wear goggles or face mask while conducting operations such as surface grinding which will generate flying particles.
- **Other protective equipment:** Wear a reflective heat-resistant suit while burning fine scrap.

*****STORAGE AND HANDLING*****

- **Handling procedures and equipment:** Machining of hafnium may result in fine turnings, chips or dust. Any material with a dimension of less than 1/16 inches or a cross section less than 1/16 X 1/8, if present in any quantity, can be ignited and can sustain combustion. **KEEP AWAY FROM ANY SOURCE OF IGNITION.** Keep fine turnings completely dry, or very wet. If wet, the water content should be more than 25% by weight for maximum safety in handling. Severe explosions can result from ignition of hafnium powder or machining fines containing moisture in the concentration range of 5 to 10%. Do not accumulate large quantities of fines or machining residues. Dispose of these materials daily.
- **Storage requirements:** Store in a cool, dry area.
- **Special shipping information:** None (See Section 10).

SECTION 10 - REGULATION INFORMATION
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(Not meant to be all-inclusive - selected regulations represented)

NOTICE: The information herein is presented in good faith and believed to be accurate as of the effective date shown on this page. However, no warranty, express or implied, is given. Regulatory requirements are subject to change and may differ from one location to another; it is the buyer's responsibility to ensure that its activities comply with federal, provincial or state, and local laws. The following specific information is made for the purpose of complying with numerous federal, provincial or state, and local laws and requirements. See MSDS for health and safety information.

Canadian Regulations:

WHMIS INFORMATION: The solid is not regulated by WHMIS. Hafnium powder is in Class B5 (Flammable Solids) - however, this information does not apply to the material in solid form.

TDG INFORMATION: Not regulated for shipment in solid form. Hafnium powder is classed as Class 4.2 (Spontaneously Combustible) when dry and as Class 4.1 (Flammable Solids) when wet - however, this information does not apply to the material in solid form.

U.S. Regulations:

SARA 313 INFORMATION: This product does not contain any ingredients subject to the reporting requirements of Section 313 of Title III of the Superfund Amendment Reauthorization Act of 1986 and 40 CFR Part 372.

Department of Transportation (DOT): The solid is not hazardous according to DOT criteria. The powder would be classed as Dangerous When Wet.

Additional notes or references:

Abbreviations:

ACGIH: American Conference of Governmental Industrial Hygienists
IARC: International Agency for Research on Cancer
N/Ap: Not applicable
N/Av: Not available
NIOSH: National Institute for Occupational Safety and Health
TCC: Tagliabue Closed Cup
WHMIS: Workplace Hazardous Materials Information System

References:

1. Van Nostrand Reinhold, Dangerous Properties of Industrial Materials, Seventh Edition, N. Irving Sax.
2. Canadian Centre for Occupational Health and Safety. RTECS (Registry of Toxic Effects) and CHEMINFO databases.
3. ACGIH, Threshold Limit Values and Biological Exposure Indices for 2000.
4. International Agency for Research on Cancer Monographs.
5. NIOSH-OSHA Occupational Health Guidelines for Chemical Hazards.
6. Casarett and Doull, Toxicology, Second Edition.