

## Praxair Material Safety Data Sheet

(See section 15, under TSCA, for important restrictions on product use.)

### 1. Chemical Product and Company Identification

<b>Product Name:</b> Water-reactive solid, corrosive, n.o.s. (tetrakis(dimethylamino)hafnium) (MSDS No. P-6280-B)		<b>Trade Name:</b> Praxair® TDMAH	
<b>Chemical Name:</b> Tetrakis(dimethylamino)hafnium		<b>Synonyms:</b> Tetrakis(dimethylamido)hafnium, hafnium(IV) dimethylamide, TDMAH	
<b>Formula:</b> [(CH <sub>3</sub> ) <sub>2</sub> N] <sub>4</sub> Hf, C <sub>8</sub> H <sub>24</sub> HfN <sub>4</sub>		<b>Chemical Family:</b> Metal amide complex	
<b>Telephone:</b>	<b>Emergencies:</b> 1-800-645-4633* <b>CHEMTREC:</b> 1-800-424-9300* <b>Routine:</b> 1-800-PRAXAIR	<b>Company Name:</b> Praxair, Inc. 39 Old Ridgebury Road Danbury, CT 06810-5113	

\* Call emergency numbers 24 hours a day only for spills, leaks, fire, exposure, or accidents involving this product. For routine information, contact your supplier, Praxair sales representative, or call 1-800-PRAXAIR (1-800-772-9247).

### 2. Composition/Information on Ingredients

See section 16 for important information about mixtures.

INGREDIENT	CAS NUMBER	CONCENTRATION	OSHA PEL	ACGIH TLV-TWA (2004)
Tetrakis(dimethylamino)hafnium	19782-68-4*	>99%**	None currently established.***	0.5 mg/m <sup>3</sup> ****

\* The Chemical Abstract Service has deleted the duplicate CAS number 19962-11-9.

\*\* The symbol > means "greater than"; the symbol <, "less than."

\*\*\* The OSHA PEL for hafnium is 0.5 mg/m<sup>3</sup>.

\*\*\*\* Hafnium and compounds, as Hf

### 3. Hazards Identification

#### EMERGENCY OVERVIEW

**WARNING! Water-reactive, corrosive, flammable solid**

**May cause liver damage.**

**May cause mild to severe eye irritation.**

**May irritate the skin, respiratory tract, and mucous membranes.**

**Reacts with water to form toxic, flammable, corrosive by-products.**

**Self-contained breathing apparatus and protective clothing**

**must be worn by rescue workers.**

**Odor: Slight amine**

**THRESHOLD LIMIT VALUE:** TLV-TWA, 0.5 mg/m<sup>3</sup> (ACGIH, 2004). TLV-TWAs should be used as a guide in the control of health hazards and not as fine lines between safe and dangerous concentrations.

**EFFECTS OF A SINGLE (ACUTE) OVEREXPOSURE:**

**INHALATION**—Liquid or vapor may irritate the respiratory tract to an unknown degree, but severe respiratory irritation may result in respiratory inflammation, edema, and chemical pneumonitis. May cause coughing, wheezing, laryngitis, shortness of breath, headache, nausea, and vomiting. Reaction with moisture produces hafnium oxide powder and may generate potentially harmful organic vapors.

**SKIN CONTACT**—The liquid and vapor may irritate the skin.

**SWALLOWING**—Hafnium compounds may be fatal if ingested. Can cause liver damage. Ingestion may be extremely irritating to the mouth and throat and cause perforation of esophagus and stomach. May cause gastrointestinal distress, nausea, vomiting, and headache.

**EYE CONTACT**—Liquid or vapor may result in permanent damage and loss of vision, depending on severity of exposure.

**EFFECTS OF REPEATED (CHRONIC) OVEREXPOSURE:** Repeated or prolonged exposure of the skin may cause dermatitis (inflammation of the skin). With prolonged or repeated exposure, harmful amounts may be absorbed through the skin.

**OTHER EFFECTS OF OVEREXPOSURE:** Zirconium impurity may cause allergic rash.

**MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE:** The skin irritating properties of tetrakis(dimethylamino)hafnium may aggravate an existing dermatitis. Respiratory irritation may aggravate an existing asthma or other upper respiratory or pulmonary disease. Ingestion may aggravate digestive tract ailments.

**SIGNIFICANT LABORATORY DATA WITH POSSIBLE RELEVANCE TO HUMAN HEALTH HAZARD EVALUATION:** None known.

**CARCINOGENICITY:** Tetrakis(dimethylamino)hafnium is not listed by NTP, OSHA, or IARC.

#### 4. First Aid Measures

**INHALATION:** Immediately remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, qualified personnel may give oxygen. Closely monitor the victim for wheezing, coughing, or pain. Call a physician.

**SKIN CONTACT:** Remove contaminated clothing and shoes, and wash exposed areas with soap and plenty of water. Wash contaminated clothing prior to reuse; discard shoes. Seek medical attention if discomfort persists.

**SWALLOWING:** Get immediate medical attention. If victim is conscious, wash out mouth with water. Keep victim calm. Do not induce vomiting unless directed to do so by medical personnel.

**EYE CONTACT:** Immediately flush eyes thoroughly with water for at least 15 minutes. Hold the eyelids open and away from the eyeballs to ensure that all surfaces are flushed thoroughly. See a physician, preferably an ophthalmologist, immediately.

**NOTES TO PHYSICIAN:** *There is no specific antidote. Treatment of overexposure should be directed at the control of symptoms and the clinical condition of the patient.*

*Exposure to zirconium, present as an impurity at <1%, has caused granulomatous lesions of probable allergic epitheloid origin in susceptible individuals.*

### 5. Fire Fighting Measures

<b>FLASH POINT</b> (test method): ASTM D 3278	109°F (43°C)
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<b>AUTOIGNITION TEMPERATURE:</b>	Not available
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<b>FLAMMABLE LIMITS IN AIR</b> , % by volume:	<b>LOWER:</b> Not available	<b>UPPER:</b> Not available
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**EXTINGUISHING MEDIA:** Use dry chemical powder. Do NOT use water or water based foams.

**SPECIAL FIRE FIGHTING PROCEDURES: WARNING! Water-reactive solid, corrosive, flammable.** May emit toxic, corrosive, or flammable fumes and vapors on reaction with water or upon thermal decomposition. Evacuate all personnel from danger area. Use self-contained breathing apparatus and protective clothing. Remove ignition sources if without risk. Move containers away from fire area if without risk. If this material is on fire, extinguish flames with the recommended media. On-site fire brigades must comply with OSHA 29 CFR 1910.156.

**UNUSUAL FIRE AND EXPLOSION HAZARDS:** Heat of fire may cause container to burst. This material may emit toxic and corrosive fumes when heated. Reacts with water and moisture in the air.

**HAZARDOUS COMBUSTION PRODUCTS:** CO, CO<sub>2</sub>, dimethylamine, hafnium oxide, zirconium oxide, and organic fumes.

### 6. Accidental Release Measures

**STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED: WARNING! Water-reactive solid, corrosive, flammable.** Evacuate all personnel from danger area. Use self-contained breathing apparatus and protective clothing where needed. Remove all sources of ignition if without risk. Shut off flow if without risk. Reacts with water and moisture in the air. Ventilate area or move container to a well-ventilated area.

**WASTE DISPOSAL METHOD:** Avoid contact with water. Prevent waste from contaminating the surrounding environment. Keep personnel away. Small spills can be mixed with vermiculite, dry sand, or earth; swept up; and placed into chemical waste containers for later disposal. Discard any product, residue, disposable container, or liner in an environmentally acceptable manner, in full compliance with federal, state, and local regulations. If necessary, call your local supplier for assistance.

### 7. Handling and Storage

**PRECAUTIONS TO BE TAKEN IN STORAGE:** Store in a dry area away from direct sunlight. Store under an inert atmosphere of nitrogen or argon. Do not store with flammables or strong oxidizers. Store away from water or moisture. Store only in the DOT-approved container in which product was received. Keep containers tightly closed; never store tetrakis(dimethylamino)hafnium in open containers. Store full and empty containers separately. Use a first-in, first-out inventory system to prevent storing full containers for long periods.

**PRECAUTIONS TO BE TAKEN IN HANDLING:** Protect containers from damage. For other precautions in using this product, see section 16.

## 8. Exposure Controls/Personal Protection

### VENTILATION/ENGINEERING CONTROLS:

**LOCAL EXHAUST**—Inadequate; see SPECIAL.

**MECHANICAL (general)**—Inadequate; see SPECIAL.

**SPECIAL**—Use only in a closed system. This material is air- and moisture-sensitive. It should be maintained under a dry, inert atmosphere and used in an enclosed device such as a glove box.

**OTHER**—See SPECIAL.

**RESPIRATORY PROTECTION:** Respirators must be acceptable to MSHA and NIOSH. Respiratory protection must conform to OSHA rules as specified in 29 CFR 1910.134.

**SKIN PROTECTION:** Wear work gloves when handling containers; rubber where contact with product may occur.

**EYE PROTECTION:** Wear safety glasses when handling containers. Select eye protection in accordance with OSHA 29 CFR 1910.133.

**OTHER PROTECTIVE EQUIPMENT:** Protective clothing where needed. Select in accordance with OSHA 29 CFR 1910.132 and 1910.133.

## 9. Physical and Chemical Properties

**MOLECULAR WEIGHT:** 354.80 g/mol

**SOLUBILITY IN WATER:** Reacts with water.

**BOILING POINT** at 0.1 mm Hg (0.00193 psi): 135°F (57°C)

**MELTING POINT:** 84°F (29°C)

**APPEARANCE, ODOR, AND STATE:** Pale yellow solid with low melting point, slight amine odor.

## 10. Stability and Reactivity

**STABILITY:**  Unstable  Stable

**INCOMPATIBILITY (materials to avoid):** Water, moisture, air, strong oxidizers, halogens, acids, bases, protic solvents

**HAZARDOUS DECOMPOSITION PRODUCTS:** Thermal decomposition or burning may produce CO, CO<sub>2</sub>, dimethylamine, hafnium oxide, organic fumes, and zirconium oxide.

**HAZARDOUS POLYMERIZATION:**  May Occur  Will Not Occur

**CONDITIONS TO AVOID:** Contact with water or moisture

## 11. Toxicological Information

See section 3.

## 12. Ecological Information

Tetrakis(dimethylamino)hafnium does not contain any Class I or Class II ozone-depleting chemicals. Tetrakis(dimethylamino)hafnium is not listed as a marine pollutant by DOT.

### 13. Disposal Considerations

**WASTE DISPOSAL METHOD:** Do not attempt to dispose of residual or unused quantities. Return cylinder to supplier.

### 14. Transport Information

**DOT/IMO SHIPPING NAME:** Water-reactive solid, corrosive, n.o.s.  
(tetrakis(dimethylamino)hafnium)

HAZARD CLASS:	PACKING GROUP:	IDENTIFICATION NUMBER:	PRODUCT RQ:
4.3	I	UN 3131	None

**SHIPPING LABEL(s):** DANGEROUS WHEN WET, CORROSIVE

**PLACARD (when required):** DANGEROUS WHEN WET

### 15. Regulatory Information

The following selected regulatory requirements may apply to this product. Not all such requirements are identified. Users of this product are solely responsible for compliance with all applicable federal, state, and local regulations.

#### U.S. FEDERAL REGULATIONS:

##### EPA (ENVIRONMENTAL PROTECTION AGENCY)

**CERCLA:** COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT OF 1980 (40 CFR Parts 117 and 302):

**Reportable Quantity (RQ):** None

##### SARA: SUPERFUND AMENDMENT AND REAUTHORIZATION ACT:

**SECTIONS 302/304:** Require emergency planning based on Threshold Planning Quantity (TPQ) and release reporting based on Reportable Quantities (RQ) of Extremely Hazardous Substances (EHS) (40 CFR Part 355):

**Threshold Planning Quantity (TPQ):** None

**EHS RQ (40 CFR 355):** None

**SECTIONS 311/312:** Require submission of MSDSs and reporting of chemical inventories with identification of EPA hazard categories. The hazard categories for this product are as follows:

**IMMEDIATE:** Yes

**PRESSURE:** No

**DELAYED:** Yes

**REACTIVITY:** No

**FIRE:** No

**SECTION 313:** Requires submission of annual reports of release of toxic chemicals that appear in 40 CFR Part 372.

Tetrakis(dimethylamino)hafnium does not require reporting under Section 313.

**40 CFR 68: RISK MANAGEMENT PROGRAM FOR CHEMICAL ACCIDENTAL RELEASE PREVENTION:** Requires development and implementation of risk management programs at facilities that manufacture, use, store, or otherwise handle regulated substances in quantities that exceed specified thresholds.

Tetrakis(dimethylamino)hafnium is not listed as a regulated substance.

**TSCA:** TOXIC SUBSTANCES CONTROL ACT: Tetrakis(dimethylamino)hafnium is not listed on the TSCA inventory.

**CAUTION:** This material is supplied under a “Low Volume Exemption” (40 CFR 723) of the Toxic Substances Control Act. As such, its use is restricted to the formation of thin-film precursors for microelectronic devices.

**OSHA:** OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION:

**29 CFR 1910.119:** PROCESS SAFETY MANAGEMENT OF HIGHLY HAZARDOUS CHEMICALS: Requires facilities to develop a process safety management program based on Threshold Quantities (TQ) of highly hazardous chemicals.

Tetrakis(dimethylamino)hafnium is not listed in Appendix A as a highly hazardous chemical.

#### STATE REGULATIONS:

**CALIFORNIA:** Tetrakis(dimethylamino)hafnium is not listed by California under the SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT OF 1986 (Proposition 65).

**PENNSYLVANIA:** Tetrakis(dimethylamino)hafnium is subject to the PENNSYLVANIA WORKER AND COMMUNITY RIGHT-TO-KNOW ACT (35 P.S. Sections 7301-7320).

### 16. Other Information

Be sure to read and understand all labels and instructions supplied with all containers of this product.

**OTHER HAZARDOUS CONDITIONS OF HANDLING, STORAGE, AND USE:** *Water-reactive solid, corrosive, flammable.* Do not breathe vapor. Use only with adequate ventilation or respiratory protection. (See section 8.) Do not get liquid, vapor, or solid material in eyes, on skin, or on clothing. (See section 3.) Have safety showers and eyewash fountains immediately available. *Reacts with water and moisture.* Store and use as instructed in section 7. Reaction with moisture in sealed container could build pressure and create an explosion hazard. *Use only with compatible materials and equipment.* Keep away from alcohols, oxidizing agents, and flammables. *Do not eat, drink, or smoke in areas where this material is stored or used.* After working with this product, wash face and hands thoroughly with soap and water before eating drinking, smoking, applying cosmetics, or using the toilet.

**MIXTURES:** When you mix two or more chemicals, you can create additional, unexpected hazards. Obtain and evaluate the safety information for each component before you produce the mixture. Consult an industrial hygienist or other trained person when you evaluate the end product. Remember, gases and liquids have properties that can cause serious injury or death.

#### HAZARD RATING SYSTEMS:

##### NFPA RATINGS:

HEALTH = 3  
FLAMMABILITY = 2  
INSTABILITY = 2  
SPECIAL = ~~W~~

##### HMIS RATINGS:

HEALTH = 3  
FLAMMABILITY = 2  
PHYSICAL HAZARD = 2

*NOTE: The hazards of this material have not been fully investigated.*

Praxair asks users of this product to study this MSDS and become aware of product hazards and safety information. To promote safe use of this product, a user should (1) notify employees, agents, and contractors of the information in this MSDS and of any other known product hazards and safety information, (2) furnish this information to each purchaser of the product, and (3) ask each purchaser to notify its employees and customers of the product hazards and safety information.

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The opinions expressed herein are those of qualified experts within Praxair, Inc. We believe that the information contained herein is current as of the date of this Material Safety Data Sheet. Since the use of this information and the conditions of use of the product are not within the control of Praxair, Inc., it is the user's obligation to determine the conditions of safe use of the product.

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