Material Safety Data Sheet

Section I - Product Information

Manufacturer: APC International, Ltd.
P.O. Box 180, Duck Run
Mackeivy, Pennsylvania
17750, USA

Telephone: +1-570-726-6961
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Chemical Name: Lead Zirconate Titanate; Lead-Titanium-Zirconium-Oxide (Pb(Ti,Zr)O3)
CAS Registry Number: 12626-81-2

Product or Trade Name: PZT; PZT Powder; PZT Ceramics; Piezoceramic Components; Elements; Crystals
Applies to: APC-840; APC-841; APC-850; APC-855; APC-880

Flammability: 0 Reactivity: 1 Health: 2/3 (ceramic/powder)

Section II - Hazardous Constituents

<table>
<thead>
<tr>
<th>Material/Component</th>
<th>CAS Number</th>
<th>Weight %</th>
<th>OSHA PEL TWA(mg/m3)</th>
<th>ACGIH/TLV TWA(mg/m3)</th>
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</thead>
<tbody>
<tr>
<td>Lead Oxide</td>
<td>1317-36-8</td>
<td>50-70</td>
<td>0.05</td>
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<td>Zirconium Oxide</td>
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<tr>
<td>Titanium Oxide</td>
<td>13463-67-7</td>
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<td>10</td>
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<tr>
<td>Niobium Oxide</td>
<td>1313-96-8</td>
<td>0-10</td>
<td>0.3</td>
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<tr>
<td>Strontium Oxide</td>
<td>1314-11-0</td>
<td>0-5</td>
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<tr>
<td>Barium Oxide</td>
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<td>Magnesium Oxide</td>
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<td>Nickel Oxide</td>
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<td>Iron Oxide</td>
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<td>Manganese Oxide</td>
<td>1313-13-9</td>
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<td>Silver</td>
<td>7440-22-4</td>
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</table>

This product is considered a lead compound. Please refer to the Code of Federal Regulations CFR-29-1910.1025 (Lead Standard for industrial workers)
Section III - Physical Data

Boiling Point (@ S.P.): n/a           Bulk Powder Density: ~ 2.0 g/cc
Melting Point: >1350 °C          Fired Density: 7.6-8.1 g/cc
Vapor Pressure (mm Hg): n/a       Solubility in water (g/L): 0.05
% Volatiles by volume: n/a        Evaporation Rate: n/a
                                                Molecular Weight: 321.0-332.7
Appearance / Odor: Odorless / Shades of Yellow, Tan, Red, Brown, Green, and Black.

Section IV - Fire and Explosion Hazard Data

LEL: n/a                           UEL: n/a
Flash Point: n/a                   Autoignition Temp.: n/a
Flammable Limits: n/a              Extinguishing Media: Water (Fog or Flood), CO2, Dry Chemical

Special Fire-fighting Procedures: Wear full body protective clothing, full face piece and NIOSH or
                                  MSHA approved positive pressure self-contained breathing apparatus.

Unusual Fire/Explosion Hazards: Fumes, vapor and/or dust may occur and are considered toxic
                                  and a respiratory irritant. May react with strong oxidizers.

Section V - Reactivity Data

Stability: Powder-- Stable to 125 °C
           Fired Product - Stable to 800 °C
Incompatibilities: Strong oxidizers, acids, or bases may produce heat on contact with water or steam.

Decomposition Products:
Powder - Temperatures exceeding 125 °C will result in decomposition of organic binders
        which, while non-hazardous, could be considered an irritant and should be adequately exhausted.
Powder & Ceramics - Elevated temperatures (>800 °C) may produce lead fumes or vapors

Section VI - Health Hazard Information

Routes of Exposure

Inhalation: Inhalation of dust or fumes may cause respiratory irritation
Ingestion: Resulting from hand to mouth contact or ingestion of dust
Skin Contact: Contact with skin may cause irritation and lead to contact ingestion
Skin Absorption: n/a
Eye Contact: May cause irritation

APC-PZT-MSDS-REV 0
**Effects of Overexposure**

**Acute Overexposure:** Exposure to elevated levels of airborne or ingested lead may produce symptoms of anemia, insomnia, weakness, constipation, nausea, abdominal pain, vomiting, and neuritis. Extreme overexposure may lead to convulsions, stupor, coma, and encephalopathy.

**Chronic Overexposure:** Chronic exposure to airborne and ingested lead may produce symptoms of persistent fatigue, sleep disturbance, headaches, aching bones and muscles, constipation, abdominal pain, and loss of appetite. Excessive overexposure may affect the circulatory, nervous, and digestive systems. If chronic exposure is left untreated, neuromuscular dysfunction and possible paralysis may occur. Women of childbearing age should avoid exposure to lead and its inorganic compounds due to the pre-natal effects. Lead can cause potential injury to a developing fetus and have possible effects on reproduction.

**Emergency and First Aid Procedures**

**Inhalation:** Remove from area of exposure. Contact physician or Poison Control Center immediately.

**Ingestion:** Induce vomiting in conscious victim. Contact physician or Poison Control Center immediately.

**Skin:** Wash thoroughly with soap and water. Use a special soap formulated for use with heavy metals if available.

**Eye:** Flush eyes with copious quantities of water. Seek immediate medical attention.

**Section VII - Personal Protective Equipment (PPE) Recommendations**

**Respiratory Protection:** A NIOSH/MSHA approved dust/fume respirator shall be worn when airborne exposure may exceed OSHA Permissible Exposure Limits (PEL's).

**Protective Gloves:** Recommended Nitrile gloves for handling powder, not required for handling devices.

**Eye Protection:** Safety glasses and or face shield is recommended for protection against exposure to dust.

**Protective Clothing:** If lead PEL is exceeded, protective clothing should be provided in accordance with OSHA 29-CFR 1910.1025.

**Ventilation:** Sufficient mechanical ventilation (engineering control, general and or local exhaust) shall be provided to maintain exposure below permissible air concentrations.
Section VIII - Spill or Leak Procedures

In the event of a spill or accidental release:

Avoid inhalation of dust or fumes. Gloves, goggles, and respirators should be worn during clean-up. Small spills should be vacuumed using a HEPA filtered vacuum. Do not dry sweep or use compressed air.

Method of Waste Disposal:

Waste shall be collected, either powder or components, and disposed of in accordance with local, state, and federal regulations. Waste may also, under certain circumstances, be recycled in accordance with local, state and federal regulations.

Neutralizing Materials:

n/a

Section IX - Special Precautions and Hygiene Practices

General Good Hygiene Practices:

Food and drink should not be consumed in areas of use. Tobacco products and cosmetics should not be used in areas of use. Always wash hands thoroughly after handling products, if possible, with a specially formulated soap designed for use with heavy metals. Avoid wearing clothing home from the workplace if handling powders. Store products far away from all foods and feeds.

General Precautions:

Do not reuse containers. Containers may retain product residues, especially if powder. All labeled precautions must be observed. This product is intended for industrial use only. Keep away from children.

General Handling and Storage:

Store product (powder or components) in a dry area. Avoid contact with acids and bases.