Material Safety Data Sheet

Product Name: ATOMIZED ALUMINUM POWDER (SPHERICAL)  ID: 566

*** Section 1 - Chemical Product and Company Identification ***

Chemical Formula: Aluminum, Al
Product Use: Rocket motors, automotive paints, refractories
Other Designations: All non-alloyed spherical aluminum powder

Chemical Name: Aluminum (Al)

Alcoa Inc. Phone: Health and Safety: 1-412-553-4649
201 Isabella Street
Pittsburgh, PA 15212-5858

Manufacturer/Supplier
Alcoa Aluminio SA - Brazil Phone: (+55 35) 3729-5000
Rodovia Pocos de Caldas/Andradas, Km 10
CEP 37701-970
Pocos de Caldas, Minas Gerais Brazil,

Alcoa Inc. Phone: 1-800-331-5370
Rockdale Operations
Market Road 1786
Rockdale, TX 76567

Emergency Information: USA: Chemtrec: 1-800-424-9300 or 1-703-527-3887 Alcoa: 1-412-553-4001
Website: For a current MSDS, refer to Alcoa websites: www.alcoa.com or Internally at my.alcoa.com EHS Community

*** Section 2 - Hazards Identification ***

EMERGENCY OVERVIEW
Solid, finely divided powder. Silvery to gray color. Odorless. Dust or fines dispersed in the air can be explosive. Dust and fines may be readily ignitable. Explosion/fire hazards may be present when (See Sections 5, 7 and 10 for additional information):
* Dust or fines are dispersed in the air.
* Dust or fines are in contact with water.
* Dust or fines are in contact with certain metal oxides (e.g. rust).
Do not use water for spill clean-up. Use natural bristle broom (push type recommended) and non-sparking tools. Avoid all ignition sources. Prohibit smoking.

POTENTIAL HEALTH EFFECTS
The following statements summarize the health effects generally expected in cases of overexposures. User specific situations should be assessed by a qualified individual. Additional health information can be found in Section 11.

Eyes: Can cause mechanical irritation.
Skin: Can cause mechanical irritation.
Ingestion: Can cause irritation.
Inhalation: Can cause irritation of upper respiratory tract.
Carcinogenicity and Reproductive Hazard
Does not present any cancer or reproductive hazards.
Medical Conditions Aggravated By Exposure to Product, Components or Compounds Formed During Processing
Asthma, chronic lung disease, and skin rashes.
*** Section 3 - Composition / Information on Ingredients ***

Complete composition is provided below and may include some components classified as non-hazardous.

<table>
<thead>
<tr>
<th>CAS #</th>
<th>Component</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>7429-90-5</td>
<td>Aluminum</td>
<td>97</td>
</tr>
</tbody>
</table>

*** Section 4 - First Aid Measures ***

**First Aid: Eyes**
Flush eyes with plenty of water or saline for at least 15 minutes. Consult a physician.

**First Aid: Skin**
Wash skin with soap and water for at least 15 minutes. Consult a physician if irritation persists.

**First Aid: Ingestion**
If swallowed, dilute by drinking large amounts of water. Recommend quantities up to 30 mL (~1 oz.) in children and 250 mL (~9 oz.) in adults. Never give anything by mouth to a convulsing or unconscious person. Do **not** induce vomiting. Consult a physician.

**First Aid: Inhalation**
Remove to fresh air. If unconscious or severely injured, check for clear airway, breathing and presence of pulse. Perform CPR if there is no pulse or respiration. Consult a physician.

*** Section 5 - Fire Fighting Measures ***

**Flammable/Combustible Properties**
Dust or fines dispersed in the air can be explosive. Dust and fines may be readily ignitable.

**Fire/Explosion**
May be a potential hazard under the following conditions:
* Dust or fines dispersed in the air can be explosive. Even a minor dust cloud can explode violently. Dust accumulation on the floor, ledges and beams can present a risk of ignition, flame propagation and secondary explosions.
* Dust or fines in contact with water can generate flammable/explosive hydrogen gas. Hydrogen gas could present an explosion hazard in confined or poorly ventilated spaces.
* Dust or fines in contact with certain metal oxides (e.g., rust). A thermite reaction, with considerable heat generation, can be initiated by a weak ignition source.

**Extinguishing Media**
Use gentle surface application of Class D extinguishing agent or dry inert granular material (e.g. sand) to cover and ring the burning material. If possible, isolate the burning material. Allow the fire to burn out. Avoid mixing of the extinguishing agent with the burning material. Do not disturb the material until completely cool.

**Unsuitable Extinguishing Media**
DO **NOT** USE:
* Water.
* Halogenated agents.
* ABC dry chemical agents.
These agents will react with the burning material.

**Fire Fighting Equipment/Instructions**
Fire fighters should wear NIOSH approved, positive pressure, self-contained breathing apparatus and full protective clothing when appropriate.
**Section 6 - Accidental Release Measures**

Small/Large Spill
Avoid all ignition sources around spill. Prohibit smoking. Do not use water for spill clean-up. Avoid dusting of powder to the greatest extent possible. Use natural bristle broom (push type recommended) and non-sparking tools. Recover using non-sparking tools and place in a dry, water-tight, sealed container. After complete cleaning, area may be washed down with large quantities of water.

**Section 7 - Handling and Storage**

Handling/Storage
Product should be kept dry. Avoid generating dust. Prohibit smoking. Storage rooms must be of fire-resistant construction. Do not store powder in same room as other combustible materials.

Requirements for Processes Which Generate Dusts or Fines
Obtain and follow the safety procedures and equipment guides contained in Aluminum Association Bulletin TR-2 and National Fire Protection Association (NFPA) brochures listed in Section 16. Use non-sparking handling equipment. Cover and reseal partially empty containers. Provide grounding and bonding where necessary to prevent accumulation of static charges during dust handling and transfer operations. (See Section 15).

Local ventilation and vacuum systems must be designed to handle explosive dusts. Dry vacuums and electrostatic precipitators must not be used. Dust collection systems must be dedicated to aluminum dust only and should be clearly labeled as such. Do not co-mingle fines of aluminum with fines of iron, iron oxide (rust) or other metal oxides.

Process equipment, storage containers, vessels and buildings should be equipped with explosion/pressure relief valves, panels and windows. Precautions must also be taken to prevent water leakage or seepage which could contact the powder. Refer to NFPA 651.

Avoid all ignition sources. Good housekeeping practices must be maintained. Do not use compressed air to remove settled material from floors, beams or equipment. Do not allow fines or dust to contact water, particularly in enclosed areas.

**Section 8 - Exposure Controls / Personal Protection**

Engineering Controls
Use with adequate explosion-proof ventilation designed to handle particulates to meet the limits listed in Section 8, Exposure Guidelines.

Personal Protective Equipment
Respiratory Protection
Use NIOSH-approved respiratory protection as specified by an Industrial Hygienist or other qualified professional if concentrations exceed the limits listed in Section 8, Exposure Guidelines. Suggested respiratory protection: N95

Eye Protection
Wear safety glasses/goggles to avoid eye contact.

Skin Protection
Wear appropriate gloves to avoid direct skin contact. Wear fire resistant clothing or equivalent full-length fire resistant pants and jackets along with electrically conductive safety shoes or grounding straps. Great caution is required to avoid contact with unprotected electrical devices when wearing conductive safety shoes or grounding straps.

Exposure Guidelines
A: General Product Information
No information available for product.
**Material Safety Data Sheet**

Product Name: ATOMIZED ALUMINUM POWDER (SPHERICAL)  
ID: 566

B: Component Exposure Limits

**Aluminum (7429-90-5)**

<table>
<thead>
<tr>
<th>Standard</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACGIH</td>
<td>10 mg/m3 TWA (metal dust)</td>
</tr>
<tr>
<td>OSHA</td>
<td>15 mg/m3 TWA (total dust); 5 mg/m3 TWA (respirable fraction)</td>
</tr>
</tbody>
</table>

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### **Section 9 - Physical & Chemical Properties**

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical State</td>
<td>Solid, finely divided powder</td>
</tr>
<tr>
<td>Boiling Point</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Melting Point</td>
<td>1195-1215°F (646-657°C)</td>
</tr>
<tr>
<td>Vapor Pressure</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Density</td>
<td>Range: generally 0.8-1.30 g/cm³ (50-81 lb./ft³)</td>
</tr>
<tr>
<td>Odor</td>
<td>Odorless</td>
</tr>
<tr>
<td>Auto Ignition</td>
<td>650°C (layered).</td>
</tr>
<tr>
<td>Appearance</td>
<td>Silvery to gray color</td>
</tr>
<tr>
<td>Solubility in Water</td>
<td>Insoluble</td>
</tr>
<tr>
<td>pH Level</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Octanol-Water Coefficient</td>
<td>Not applicable</td>
</tr>
<tr>
<td>LFL</td>
<td>40 mg/L</td>
</tr>
</tbody>
</table>

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### **Section 10 - Chemical Stability & Reactivity Information**

**Stability**: Stable under normal conditions of use, storage, and transportation as shipped.

**Conditions to Avoid**
- **Water**: Slowly generates flammable/explosive hydrogen gas and heat. Generation rate is greatly increased with smaller particles (e.g., fines and dusts).
- **Heat**: Oxidizes at a rate dependent upon temperature and particle size.
- **Strong oxidizers**: Violent reaction with considerable heat generation. Can react explosively with nitrates (e.g., ammonium nitrate and fertilizers containing nitrate) particularly when heated.
- **Acids and alkalis**: Reacts to generate flammable/explosive hydrogen gas. Generation rate is greatly increased with smaller particles (e.g., fines and dusts).
- **Halogenated compounds**: Many halogenated hydrocarbons, including halogenated fire extinguishing agents, can react violently with finely divided aluminum.
- **Iron oxide (rust) and other metal oxides (e.g., copper and lead oxides)**: A violent thermite reaction generating considerable heat can occur. Reaction with aluminum fines and dusts requires only very weak ignition sources for initiation.
- **Iron powder and water**: An explosive reaction forming hydrogen gas occurs when heated above 1470°F (800°C).

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### **Section 11 - Toxicological Information**

**Health Effects Associated with Individual Ingredients**
- **Aluminum dust, fines and fumes**: Low health risk by inhalation. Generally considered to be biologically inert.

**Acute Toxicity of Ingredients/Formed Compounds**

**A: General Product Information**: No information available for product.

**B: Component Analysis - LD50/LC50**: No LD50/LC50's are available for this product's components.

**C: Formed Compound Toxicity - LD50s/LC50s**: This material has no components listed.

**Carcinogenicity of Ingredients**

**A: Ingredient Carcinogenicity - IARC/NTP**: None of this product's components are listed by IARC or NTP.

**B: Ingredient Carcinogenicity – ACGIH**: None of this product's components are listed by ACGIH.

**Carcinogenicity of Compounds Formed During Processing**

**A: General Product Information**: No new/additional compounds are expected to be formed during processing.
*** Section 12 - Ecological Information ***

Ecotoxicity
A: General Product Information: No information available for product.
B: Component Analysis - Ecotoxicity - Aquatic Toxicity: No ecotoxicity data was found for this product's components.

Environmental Fate
No information available for product.

*** Section 13 - Disposal Considerations ***

Disposal Instructions
Reuse or recycle material whenever possible. Material that cannot be reused may be sent to a metals reclamation facility that is able to handle fines. Waste material that cannot be reclaimed for metal value should be rendered non-reactive prior to disposal in an industrial landfill.

US EPA Waste Number & Descriptions
A: General Product Information
RCRA Status: Not federally regulated in the U.S. if disposed of "as is." Otherwise, characterize in accordance with applicable regulations (40 CFR 261 or state equivalent in the U.S.)

B: Component Waste Numbers
RCRA waste codes other than described under Section A may apply depending on use of product. Refer to 40 CFR 261 or state equivalent in the U.S.

*** Section 14 - Transportation Information ***

Special Transportation

<table>
<thead>
<tr>
<th>Notes:</th>
<th>PSN #1</th>
<th>PSN #2</th>
<th>PSN #3</th>
<th>PSN #4</th>
</tr>
</thead>
<tbody>
<tr>
<td>UN NA Number:</td>
<td>(1)(2)(3)(4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proper Shipping Name:</td>
<td>Not regulated</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hazard Class:</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Packing Group:</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RQ:</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other - Tech Name:</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other - Marine Pollutant:</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other -</td>
<td>MSDS-566 Atomized Aluminum Powder (Spherical)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STCC</td>
<td>33-991-19</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HTS</td>
<td>7603.10.0000</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:
(1) This material was tested by the United States Department of Interior Bureau of Mines in 1991 under UN criteria and found not to meet the definition of a hazard class 4 and does not meet the definition of any other hazard class.
(2) Standard Transportation Commodity Code STCC 33-991-19 Aluminum or Aluminum Alloy Powder, NEC applies and is required for rail shipments.
(3) The import/export HTSUS (Harmonized Tariff Schedule) subheading 7603.10.0000 Aluminum powders of nonlamellar structure applies.
(4) When "Not regulated," enter the proper freight classification, "MSDS Number," and "Product Name" on the shipping paperwork.

Canadian Controlled Products Regulation PIN: Not regulated
*** Section 15 - Regulatory Information ***

US Federal Regulations
A: General Product Information
   All electrical equipment must be suitable for use in hazardous atmospheres involving aluminum powder in accordance with 29 CFR 1910.307. The National Electrical Code, NFPA 70, contains guidelines for determining the type and design of equipment and installation that will meet this requirement.

   In reference to Title VI of the Clean Air Act of 1990, this material does not contain nor was it manufactured using ozone-depleting chemicals.

B: Component Analysis
   This material contains one or more of the following chemicals required to be identified under SARA Section 302 (40 CFR 355 Appendix A), SARA Section 313 (40 CFR 372.65) and/or CERCLA (40 CFR 302.4).
   Aluminum (7429-90-5)
      SARA 313: 1.0 % de minimis concentration (dust or fume only)

SARA 311/312 Physical and Health Hazard Categories:
   Immediate (acute) Health Hazard: No
   Delayed (chronic) Health Hazard: No
   Fire Hazard: No
   Sudden Release of Pressure: Yes (if dust clouds are generated during processing)
   Reactive: No

State Regulations
A: General Product Information
   No information available for product.

B: Component Analysis - State
   The following components appear on one or more of the following state hazardous substances lists:

<table>
<thead>
<tr>
<th>Component</th>
<th>CAS #</th>
<th>CA</th>
<th>FL</th>
<th>MA</th>
<th>MN</th>
<th>NJ</th>
<th>PA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum</td>
<td>7429-90-5</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Other Regulations
A: General Product Information
   Material meets the criteria for inclusion in WHMIS B6.

B: Component Analysis - WHMIS IDL
   The following components are identified under the Canadian Hazardous Products Act Ingredient Disclosure List:

<table>
<thead>
<tr>
<th>Component</th>
<th>CAS #</th>
<th>Minimum Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum</td>
<td>7429-90-5</td>
<td>1 %</td>
</tr>
</tbody>
</table>

C: Component Analysis - Inventory

<table>
<thead>
<tr>
<th>Component</th>
<th>CAS #</th>
<th>TSCA</th>
<th>DSL</th>
<th>EINECS</th>
<th>AUST.</th>
<th>MITI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum</td>
<td>7429-90-5</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

Inventory information
MITY Inventory: Pure metals are not specifically listed by CAS or MITI number on the MITI Inventory. However, the class of compounds for each of these metals is listed.

*** Section 16 - Other Information ***

MSDS History
   Original: December 18, 1985
   Supersedes: May 10, 2004
   Revised: September 11, 2007
Material Safety Data Sheet

Product Name: ATOMIZED ALUMINUM POWDER (SPHERICAL)  ID: 566

MSDS Status
09/11/2007: Reviewed on a periodic basis in accordance with Alcoa policy. Changes in Sections 1, 2, 3, 4, 5, 7, 8, 11, 14 & 15.
05/10/2004: Changes to Sections 1, 3, 14 and 15.

Prepared By
Hazardous Materials Control Committee
Preparer: Stephanie Williams, 412-553-1479/Jon N. Peace, 412-553-2293

MSDS System Number
146311

Other Information
* NFPA 65, Standard for Processing and Finishing of Aluminum  (NFPA phone: 800-344-3555)
* NFPA 651, Standard for Manufacture of Aluminum and Magnesium Powder
* NFPA 70, Standard for National Electrical Code (Electrical Equipment, Grounding and Bonding)
* NFPA 77, Standard for Static Electricity
* Aluminum Association Bulletin TR-2, "Recommendations for Storage and Handling of Aluminum Pigments and Powders"
* Bureau of Mines #6516, Explosibility of Metal Powders (1964)
* Aluminum Association Video, "Safe Handling of Aluminum Powder and Paste".
* Guide to Occupational Exposure Values-2007, Compiled by the American Conference of Governmental Industrial Hygienists (ACGIH).
* Documentation of the Threshold Limit Values and Biological Exposure Indices, Sixth Edition, 1991, Compiled by the American Conference of Governmental Industrial Hygienists, Inc. (ACGIH).

Key-Legend:
ACGIH American Conference of Governmental Industrial Hygienists
AICS Australian Inventory of Chemical Substances
CAS Chemical Abstract Service
CERCLA Comprehensive Environmental Response, Compensation, and Liability Act
CFR Code of Federal Regulations
CPR Cardio-pulmonary Resuscitation
DOT Department of Transportation
DSL Domestic Substances List (Canada)
EC Effective Concentration
ED Effective Dose
EINECS European Inventory of Existing Commercial Chemical Substances
EPA Environmental Protection Act
IARC International Agency for Research on Cancer
LC50 Lethal concentration (50 percent kill)
LCLo Lowest published lethal concentration
LD50 Lethal dose (50 percent kill)
LDLo Lowest published lethal dose
LFL Lower Flammable Limit
MITI Ministry of International Trade & Industry
NFPA National Fire Protection Association
NIOSH National Institute for Occupational Safety and Health
NORM Naturally Occurring Radioactive Materials
NTP National Toxicology Program
OEL Occupational Exposure Limit
OSHA Occupational Safety and Health Administration
PEL Permissible Exposure Limit
PIN Product Identification Number
PSN Proper Shipping Name
RCRA Resource Conservation and Recovery Act
SARA Superfund Amendments and Reauthorization Act
STEL Short Term Exposure Limit
TCLP Toxic Chemicals Leachate Program
TDG Transportation of Dangerous Goods
This is the end of MSDS # 566
WARNING

Physical Hazards: Dust may ignite readily. Explosion potential may be present when (1) dust is dispersed in the air, (2) dust is in contact with certain metal oxides (e.g. rust) or (3) dust is in contact with water or moisture. Reactive with water, acids, oxidizers, and halogenated hydrocarbons.

Health Hazards: Health effects generally expected in cases of overexposures:
EYES: Can cause mechanical irritation.
SKIN: Can cause mechanical irritation.
INGESTION: Can cause irritation.
INHALATION: Can cause irritation of upper respiratory tract.

Precautions: Product should be kept dry. Avoid generating dust. Prohibit smoking. Electrically ground all equipment including drums and containers when in use. Use with adequate explosion-proof ventilation. Use appropriate personal protective equipment (safety glasses/gloves) to avoid contact. Use appropriate NIOSH approved respiratory protection (N95) if concentrations exceed the permissible limits. Take precautionary measures against static discharge. Wear fire retardant pants and jackets with electrically conductive safety shoes or grounding straps.

Accidental Release: DO NOT USE water for spill clean-up. Use natural bristle broom and non-sparking shovel. Avoid dusting of powder to the greatest extent possible.

First Aid: EYES: Flush eyes with plenty of water or saline for at least 15 minutes. Consult a physician. SKIN: Wash with soap and water for at least 15 minutes. Consult a physician if irritation persists. INHALATION: Remove to fresh air. Check for clear airway, breathing, and presence of pulse. Provide CPR for persons without pulse or respirations. Consult a physician. INGESTION: If swallowed, dilute by drinking large amounts of water. Recommend quantities up to 30 mL (~1 oz.) in children and 250 mL (~9 oz.) in adults. Never give anything by mouth to a convulsing or unconscious person. Do not induce vomiting. Consult a physician.

Fire Fighting: Use gentle surface application of Class D extinguishing agent or dry, inert granular material (e.g. sand) to cover and ring the burning powder. Avoid mixing the extinguishing agent with the burning powder. Do not disturb the powder until completely cool. If possible, isolate burning powder. DO NOT USE: water, halogenated agents, or ABC dry chemical agents. These agents will react with the burning material.

For industrial use only. See Alcoa Material Safety Data Sheet No. 566 for more information about use and disposal. Also, see NFPA 651 and Aluminum Association TR-2 for additional safe handling information.

Emergency Phone: (412) 553-4001.

INGREDIENTS: CAS NUMBERS:
Aluminum (7429-90-5)

Alcoa Inc.
201 Isabella Street, Pittsburgh, PA 15212-5858 USA