



Material Safety Data Sheet

Section 1. Chemical product and Company Identification

Common name	Gold Bonding Wire	Code	Not available
Supplier	MK ELECTRON CO.,LTD	MSDS#	Not available
Synonym	Au Wire, Bonding Wire, Bumping Wire, Gold Wire	Prepare Date	20 / 12 / 00
Trade name	Not available		
Material Uses	Industrial applications : Bonding, Bumping. (Intergate circuit, TR, LED etc.)	In case of Emergency	Korea & International Tel : (82)031-330-1900 Fax: (82)031-338-6817
Manufacturer	MK ELECTRON CO.,LTD 316-2, Kumeu-ri, Pogok-myun, Yongin-si, Kyunggi-do, 449-810, Korea		

Section 2. Composition and Information on Ingredients

Type of Gold Bonding Wire	Name	CAS#	% by Weight
M (Normal Loop)	Gold	7440-57-5	Min 99.99%
	Beryllium	7440-41-7	0.0003~0.0008%
T(Middle loop wire)	Gold	7440-57-5	Min 99.99%
	Beryllium	7440-41-7	0.0003~0.0008%
	Calcium	7440-70-2	Max 0.0005%
UB(Super long loop wire)	Gold	7440-57-5	Min 99.99%
	Beryllium	7440-41-7	0.0003~0.0008%
	Calcium	7440-70-2	0.0013~0.0018%
R(Alloy High strength wire)	Gold	7440-57-5	Min 99%
	Palladium	7440-05-3	0.9~1.0%
	Beryllium	7440-41-7	0.0003~0.0008%
	Calcium	7440-70-2	0.0004~0.0006%

Section 3. Each elements MSDS of Gold Bonding Wire

Name	CAS#	Attach #
Gold	7440-57-5	MKE-01
Palladium	7440-05-3	MKE-02
Beryllium	7440-41-7	MKE-03
Calcium	7440-70-2	MKE-04

Continued on Next Page

MATERIAL SAFETY DATA SHEET**I. PRODUCT IDENTIFICATION**

Trade Name: Gold
Chemical Nature: Metal
Formula Weight: 196.97

Synonym: Gold Metal
Formula: Au
CAS #: 7440-57-5

II. HAZARDOUS INGREDIENTS

Ingredient: Gold
% Weight: 100

TLV (Units): None Published

III. PHYSICAL DATA

Boiling Point 760 mm Hg: 2970 °C

Melting Point: 1064.76 °C

Specific Gravity: 19.31

Vapor Density: N/A

% Volatiles by Weight: N/A

Solubility in H₂ O: Insoluble/Negligible

Appearance and Odor: Yellow, soft ductile metal, no odor Lump or powder

IV. FIRE AND EXPLOSION HAZARDS DATA

Flash Point (Method used): N/A

Autoignition Temperature: N/A

Flammable Limits: Upper: N/A

Extinguishing Media: None

Special Fire Fighting Procedures: None

Unusual Fire & Explosion Hazards: None

V. HEALTH HAZARD DATA

Effects of Over Exposure: As a solid no known adverse effects

Carcinogenicity: None identified

Reproductive Effects: None

Immediate (Acute) Health Hazard: Yes

Delayed (Chronic) Health Hazard: No

Effects of Overexposure:

Inhalation: Coughing sneezing, difficulty breathing, bronchitis, pneumoconiosis and pulmonary fibrosis may occur. A nuisance dust.

Dermal/Eye Contact: Dermal: Mechanical irritation, dermatitis possible. Contact of gold with the skin may cause an allergic reaction.

Skin Contact: May cause irritation and allergic reaction.

Ingestion: No adverse effects expected.

Other: An equivocal tumorigenic agent.

Medical Conditions Generally Aggravated by Exposure: Respiratory disorders. May aggravate existing dermatitis or other skin ailments.

EMERGENCY AND FIRST AID PROCEDURES:

EYES: Flush eyes with lukewarm water for 15 minutes. If irritation persists contact a physician.

SKIN: Wash Thoroughly. If irritation persists contact a physician.

INHALATION: Remove to Fresh Air, contact Physician.

INGESTION: If large quantities are ingested, contact Physician.

Continued on Next Page

VI. REACTIVITY DATA

Stability: Generally considered stable.

Incompatibility (Material to Avoid): Gold plus ammonia may produce fulminate-like compounds that explode when dried. Finely divided gold and strong hydrogen peroxide solution may explode.

Hazardous Decomposition Products: Toxic fumes under fire conditions.

Hazardous Polymerization: Is not expected to occur.

VII. SPILL OR LEAK PROCEDURES

Steps to be Taken in Case Material is Released or Spilled: Vacuum or scoop the material into a container for reclamation or disposal.

Waste Disposal Method: In accordance with Local, State and Federal Regulations. Has reclaim value as scrap.

VIII. SPECIAL PROTECTION INFORMATION

Respiratory Protection: If dust, NIOSH approved Schedule 21 or C resp.

Ventilation: Recommended where dusting may occur.

Eye Protection: Safety Glasses

Protective Gloves: For Extended use of powder
Other Protective Equipment: None

IX. SPECIAL PRECAUTIONS

Other Handling and Storage Conditions: Avoid and control operations which create dusting. Wash thoroughly after handling. Keep container closed. Avoid contact with eyes and skin.

US Federal Regulations: SARA 311 and 312 Hazard Categories

Fire Hazard: No Reactivity Hazard: No Sudden Release of Pressure: No

The information in this MSDS should be provided to all who will use, handle, store, transport or otherwise be exposed to this product. This MSDS has been prepared for the guidance of plant engineering, operations, and management and for persons working with or handling this product. The information presented in the MSDS is premised upon proper handling and anticipated uses and is for the material without chemical additions/alterations. We believe this information to be reliable and up-to-date as of the date of publication, but make no warranty that it is.

Prepared by: S Dierks

Dated: March 1994

Continued on Next Page

MATERIAL SAFETY DATA SHEET**I. PRODUCT IDENTIFICATION**

Trade Name: Palladium
Formula: Pd

Chemical Nature: Metallic Element
CAS #: 7440-05-3

II. HAZARDOUS INGREDIENTS

<u>%</u>	<u>PEL</u>	<u>TLV</u>
100	Not established	Not established

III. PHYSICAL DATA

Boiling Point: 3980 °C

Freezing/Melting Point: 1552 °C

Specific Gravity (H₂ O = 1): 12.02

Solubility in H₂ O: Insoluble

Appearance and Odor: Bright metallic solid, odorless.

Vapor Pressure: Essentially 0

IV. FIRE AND EXPLOSION HAZARDS DATA

Flash Point (Method used): N/A

Autoignition Temperature: Not Established

Flammable Limits in Air: Lower: N/A Upper: N/A

Extinguishing Media: Flammable in powdered form. Do not use water, Co₂ or halogenated extinguishers. Use dry chemical extinguishing agents, dry and or dry ground dolomite.

Special Fire Fighting Procedures: No special firefighting procedures needed. Use normal procedures which include wearing NIOSH/MSHA approved self-contained breathing apparatus, flame and chemical resistant protective clothing, hat, gloves and boots. If without risk remove material from fire area.

Unusual Fire & Explosion Hazard: As finely divided dust, may explode. Can catalyze oxidation and ignition of hydrogen flammable gases, organic liquids. Palladium dust is a fire and explosion hazard. Flammable Solid.

V. HEALTH HAZARD INFORMATION

Effects of Exposure: Acute:

Ingestion: None known. Poorly absorbed by the body when ingested.

Skin Contact: Powder or dust may cause skin irritation. May be a skin sensitizer.

Eye Contact: Powder or dust may cause eye irritation.

Inhalation: Powder or dust may cause irritation.

Chronic: None known.

Medical Conditions, if any, Aggravated by the Chemical: None known.

Most Likely Routes of Entry: Ingestion.

Carcinogenicity: NTP: No

IARC: No

OSHA: No

EPA: No

Continued on Next Page

Other: In the laboratory, palladium appears to bind many cell components, blocks the actions of a number of enzymes and interferes with the use of energy by nerves and muscles. Palladium also induces lung malfunction and produces abnormal fetuses. Lethal intravenous doses cause appetite loss, hemolysis, renal deposition and bone marrow damage.

EMERGENCY AND FIRST AID PROCEDURES:

EYES: Immediately flush eyes, including under eyelids, with large amounts of water for at least 15 minutes. Call a physician.

SKIN: Remove contaminated clothing, flood skin with large amounts of water. If irritation persists seek medical attention.

INHALATION: No specific information available, one should obtain medical attention.

INGESTION: No data available but one should obtain medical attention.

VI. REACTIVITY DATA

Stability: Stable

Incompatibility (Material to Avoid): Explosive reaction with hydrogen + hydrogen peroxide. Reaction with formic acid or sodium tetrahydridoborate releases explosive hydrogen gas. Violent reaction with isopropyl alcohol, OF 2 S. Under the proper conditions it undergoes hazardous reactions with aluminum, arsenic, carbon, methanol, ozonides and sulfur.

Hazardous Decomposition Products: Palladium oxide.

Hazardous Polymerization: Will not Occur.

Other: Palladium absorbs a considerable amount of hydrogen.

VII. SPILL OR LEAK PROCEDURES

Steps to be Taken in Case Material is Released or Spilled: Wearing full protective equipment, cover spill with dry sand or ver-miculite. Mix well and carefully transfer to a container.

Waste Disposal Method: Dispose of according to local, state, and federal regulations.

VIII. SPECIAL PROTECTION INFORMATION

Respiratory Protection (Specify Type): Wear NIOSH/MSHA approved high efficiency particle respirator.

Ventilation: Laboratory fume hood.

Protective Gloves: Rubber.

Eye Protection: ANSI approved safety goggles.

IX. SPECIAL PRECAUTIONS

Other Handling and Storage Conditions: Keep container tightly closed. Store in a cool, dry, well-ventilated area. Wash thoroughly after use.

Other Precautions: Lab coat and apron, flame and chemical resistant coveralls, eyewash capable of sustained flushing, safety drench shower and hygienic facilities for washing.

Prepared by: S. Dierks

Dated: October 1995

Continued on Next Page

MATERIAL SAFETY DATA SHEET**I. PRODUCT IDENTIFICATION**

Trade Name: Beryllium
 Formula: Be
 Synonyms: Beryllium Metal, Metallic Beryllium, Beryllium Metal Powder, Metallic Beryllium Powder.

Chemical Family: Metallic Element
 CAS #: 7440-41-7

II. HAZARDOUS INGREDIENTS

TLV (Units): Beryllium .002 mg/m³
 Occupational Standards and References: NIOSH RTECS#: DS1750000

<u>Component</u>	<u>PEL</u>	<u>Ceiling</u>	<u>Peak</u>	<u>TLV/TLV-STEL</u>
Beryllium	0.002	0.005	0.002	N/A

* All concentrations are as elemental Beryllium in milligrams Per Cubic Meter of Air.

III. PHYSICAL DATA

Atomic Number: 4
 Evaporation Rate: N/A
 Melting Point (°C): 1289
 % Volatiles by Weight: None
 Physical State: Solid Shape/Powder

Atomic Weight: 9.01
 Boiling Point 760 mm Hg: 2970 °C
 Density (g/cc): 1.85
 Solubility in H₂ O: None
 Color and Odor: Grey metallic, odorless

IV. FIRE AND EXPLOSION HAZARDS DATA

Flash Point (Method used): Non-combustible as a solid. Ignition occurred as a powder layer consisting of 1.0 to 5.0 micron particles between 540 °C and 700 °C. Coarser beryllium powder able to pass through a 74 micron sieve did not ignite like testing. Explosive limits: Not applicable to solids. As a cloud of 1.0 micron diameter powder ignition occurred at 910 °C. Beryllium powder greater than or equal to 2 microns in diameter did not ignite under like conditions. Regardless of powder size tested beryllium did not ignite as a cloud in a spark apparatus.

Extinguishing Media: As a solid, use extinguishing media appropriate to the surrounding fire. Do not use water or carbon dioxide to extinguish beryllium powder fires. As a powder, extinguish by smothering using a Class D fire extinguisher, dry sand, graphite powder, or sodium chloride.

Special Fire Fighting Procedures: None.

Unusual Fire & Explosion: Do not use water to extinguish fires around operations involving molten metal due to the potential for steam explosions. In addition, water may disassociate when in contact with burning beryllium powder or chips releasing flammable hydrogen gas which could burn and result in an explosion. Ventilation duct work which has accumulated a fine coating of beryllium dust on its internal surface poses a potentially serious fire hazard. Extinguishing using Class D fire extinguisher media and shut down or isolate the affected portion of the ventilation system. Because of this potential risk, sources of ignition such as flame, spark, etc. must not be allowed to enter the ventilation duct work. Also, duct work must be made of non-combustible material.

Special Fire Fighting Procedures: If this material becomes airborne as a respirable particulate during a fire situation, pressure-demand self-contained breathing apparatus must be worn by firefighters or any other persons potentially exposed to the metal fumes.

Beryllium powder will ignite at approximately 1200 °F. The powder is not explosive. Smother powder fires with dry sand, graphite powder or sodium chloride. Do not use water or carbon dioxide. Wear self-contained breathing apparatus to protect against airborne beryllium.

Continued on Next Page

V. HEALTH HAZARD INFORMATION

Primary Routes of Exposure: Inhalation: An exposure to airborne beryllium in excess of the occupational standard can occur during routine handling, material transfer, chemical processing or further processing of powdered material and when machining, melting, casting, gross handling, picking, welding, grinding, sanding, polishing, milling, crushing, or otherwise abrading the surface of solid beryllium in a manner which generates finely divided particles.

Machining operations conducted under a flood of liquid coolant usually require local exhaust ventilation. The cycling through a machine of liquid lubricant/coolant containing finely divided beryllium in suspension can result in the concentration building to a point where the particulate may become airborne during use. A filter, centrifuge, or settling chamber can be installed in-line if necessary. The potential for exposures also may occur during repair or maintenance activities on contaminated equipment such as: furnace rebuilding, maintenance or repair of air cleaning equipment, structural renovation, welding, etc.

Ingestion: There are no known cases of illness resulting from ingestion of beryllium. Ingestion can occur from hand, clothing, food, and drink contact with metal dust, fume, or powder during hand to mouth activities such as eating, drinking, smoking, nail biting, etc. This product is not intended for internal consumption. As a standard hygiene practice, hands should be washed before eating or smoking.

Skin: This product is in an insoluble form and does not pose a potential for an allergic dermal response or skin absorption and can be safely handled with bare hands. Skin abrasion may cause irritation.

Eyes: Injury to the eyes can result from particulate irritation or mechanical injury to the cornea or conjunctiva by dust or particulate. Exposure may result from direct contact with airborne particulate (chips, dust, or powder) contact to the eye by contaminated hands or clothing.

Effects of Exposure:

Acute (immediate or near-term health effects): This product is insoluble and does not cause acute health effects.

Chronic (long-term health effects): Overexposure to airborne beryllium particulate may cause a serious lung disease, in certain sensitive individuals, called chronic beryllium disease (chronic berylliosis). Chronic beryllium disease is a condition in which the tissues of the lungs become inflamed, restricting the exchange of oxygen between the lungs and the bloodstream. Symptoms may include cough, chest pain, shortness of breath, weight loss, weakness, and fatigue. Long term effects may include loss of lung function, fibrosis, or subsequent secondary effects on the heart with eventual permanent impairment.

Carcinogenic references: Hazard communication regulations of the U.S. Occupational Safety & Health Administration require that caution labels for materials listed as potential carcinogens in either the International Agency for Cancer Research Monograph Series or the National Toxicology Program Annual Report on carcinogens must contain a cancer warning. Beryllium has also been so listed based principally on animal tests and therefore this material bears a label identifying it as a potential cancer hazard.

Medical Conditions Aggravated by Exposure: Persons with impaired pulmonary function, airway diseases, or conditions such as asthma, emphysema, chronic bronchitis, etc. may incur further impairment if excessive concentrations of dust or fume are inhaled. If prior damage or disease to the neurologic (nervous), circulatory, hematologic (blood), or urinary (kidney) system has occurred, proper screening or examinations should be conducted on individuals who may be exposed to further risk where handling and use of this material may cause excessive exposure.

EMERGENCY AND FIRST AID PROCEDURES:

EYES: Dust or powder should be flushed from the eyes with copious amounts of clean water. If irritation persists obtain medical help. Contact lenses should not be worn when working with metal dusts and powders because the contact lens must be removed to provide adequate treatment.

Continued on Next Page

SKIN: Skin cuts and abrasions can be treated by standards first aid. Skin contamination with dust or powder can be removed by washing with soap and water. If irritation persists obtain medical help. Accidental implantation of this material beneath the skin requires it to be removed to prevent infection or development of a corn-like lesion.

INGESTION: Swallowing metal powder or dust can be treated by having the affected person drink large quantities of water and attempting to induce vomiting if conscious. Obtain medical help.

INHALATION: Breathing difficulty caused by inhalation of dust or fume requires immediate removal to fresh air. Although no cases in which a person stopped breathing as a result of exposure are known, if breathing has stopped, perform artificial respiration and obtain medical help.

VI. REACTIVITY DATA

General Reactivity: This material is stable.

Incompatibility (Material to Avoid): Avoid contact with mineral acids and oxidizing agents which may generate hydrogen gas. Hydrogen gas can be an explosion hazard.

Hazardous Decomposition Products: Melting and gross handling or powdering operations can emit airborne dusts or fumes.

Hazardous Polymerization: Will not Occur

*Oxidation will form on solid shapes when moist. Beryllium with acids may generate hydrogen.

VII. SPILL AND LEAK PROCEDURES

Steps to Be Taken in Case Material Is Released or Spilled: In solid form this material poses no health or environmental risk. If this material is in powder or dust form, establish a restricted entry zone based on the severity of the spill. Persons entering the restricted zone must wear adequate respiratory protection and protective clothing appropriate for the severity of the spill. Cleanup should be conducted with a vacuum system utilizing a high efficiency particulate air filtration system followed by wet cleaning methods. Special care must be taken when changing filters on HEPA vacuum cleaners when used to clean up potentially toxic materials. Caution should be taken to minimize airborne generation of powder or dust and avoid contamination of air and water. Depending upon the quantity of material released, fine powder or dust spills to the environment may require reporting the National Response Center at (800) 424-8802 as well as the State Emergency Response Commission and Local Emergency Planning Committee.

Solid Waste Management: The U.S. Environmental Protection Agency has classified beryllium dust (P015) as a hazardous waste under the Resource Conservation and Recovery Act (RCRA). In section 40 CFR 261.33 (e) of RCRA, beryllium dust is considered hazardous when it is in the form of a "discarded commercial chemical product, off-specification species, container residue and spill residue, thereof." It is our understanding this designation only applies to commercially pure products or manufacturing intermediates in which beryllium is the "sole active ingredient." Due to the limited scope of this definition, we believe the only form of beryllium to which it applies is waste metallic beryllium dust in the form of commercially pure metallic beryllium powder. Beryllium scrap, chips, and powder are normally recycled. In cases where this is not justified, we recommend any off-specification metallic beryllium dust or powder be sealed within two plastic bags and then placed within a DOT container approved for flammable solids. The outer container must be labeled with the appropriate EPA hazardous waste label(s) and shipped under a uniform hazardous waste manifest and hazardous waste container label, also be followed when disposing of dust collector filters contaminated with metallic beryllium dust.

Continued on Next Page

Ambient Air Emissions: Beryllium users involving outplant emissions are subject to the National Emission Standard for Beryllium as promulgated by EPA (40 CFR 61, Subpart C). The National Emission Standard for Beryllium is 0.01 micrograms/m³ (30 day average) in ambient air for those production facilities which have been qualified to be regulated through ambient air monitoring. Other facilities must meet a 10 gram per 24-hour total site emission limit. Most process air emission sources exhausting outside a production building will require an air permit from a local and/or air pollution control agency. The use of air cleaning equipment may be necessary to achieve the desired level of control. Tempered makeup air should be provided to prevent excessive negative pressure in a building. Direct recycling of cleaned process exhaust air is not recommended. Plant exhausts should be located so as not to re-enter the plant through makeup air or other inlets. Regular maintenance, inspection and monitoring of air cleaning equipment operating parameters is important to ensure adequate efficiency is maintained.

Wastewater: Wastewater regulations can vary considerably. Contact your local and state governments to determine what conditions apply.

Toxic Substances Control Act: Beryllium (CAS # 7440-41-7) is listed on the TSCA Chemical Substance Inventory of Existing Chemical Substances.

VIII. SPECIAL PROTECTION INFORMATION

Respiratory Protection: When potential exposures are above the occupational limits, approved respirators must be used as specified by an Industrial Hygienist or other qualified professional. Respirator users should be medically evaluated to determine if they are physically capable of wearing a respirator. Quantitative and/or qualitative fit testing and respirator training must be satisfactorily completed by all personnel prior to respirator use in an environment where concentrations of airborne fumes or dusts may exceed the occupational standards. Users of any style respirator must be clean shaven on those areas of the face where the respirator seal contacts the face. Exposure to unknown concentrations of fumes or dusts requires the wearing of a pressure-demand self-contained breathing apparatus. Pressure-demand airline respirators are recommended for jobs with high potential exposures such as changing bags in a baghouse air cleaning device.

Housekeeping: Vacuum or wet cleaning methods are recommended for dust removal. Be certain to de-energize electrical systems as necessary before beginning wet cleaning. Vacuum cleaners with high efficiency particulate air (HEPA) filters are the recommended type. The use of compressed air to remove dusts should be avoided as such an activity can result in unnecessary short-term elevated exposures to dusts.

Ventilation and Engineering Controls: Whenever possible the use of local exhaust ventilation or other engineering controls is the preferred method of controlling exposure to airborne dust and fume to meet established occupational exposure limits. Where utilized, pickups on flexible ventilation lines should be positioned as close to the source of airborne contamination as possible. Disruption of the airflow in the area of a local exhaust inlet, such as by a man cooling fan, should be avoided. Ventilation equipment should be checked regularly to ensure it is functioning properly. Ventilation training is recommended for all users. Powders should be stored and transported in tightly sealed containers and must only be handled under controlled ventilated conditions.

Protective Gloves: Wear gloves to prevent metal cuts and skin abrasions particularly during handling.

Eye Protection: Wear safety glasses, goggles, face shield, or welders helmet when risk of eye injury is present particularly during melting, casting, machining, grinding, welding, powder handling, etc.

Maintenance: During repair or maintenance activities the potential exists for exposures to beryllium in excess of the occupational standard. Under these circumstances, protecting workers can require the use of specific work practices or procedures involving the combined use of ventilation, wet methods, respiratory protection, decontamination, special protective clothing, and when necessary, restricted work zones.

Continued on Next Page

Welding: In accordance with OSHA regulation 29 CFR 1910.252 welding of beryllium is regulated as follows: Welding or cutting indoors, outdoors, or in confined spaces involving beryllium-containing base or filler metals shall be done using local exhaust ventilation and airline respirators unless atmospheric tests under the most adverse conditions have established that the workers' exposure is within the acceptable concentrations defined by 29 CFR 1910.1000. In all cases, workers in the immediate vicinity of the welding or cutting operations shall be protected as necessary by local exhaust ventilation or airline respirators. Please note: Metallic beryllium is not normally welded. Satisfactory welds are only achieved using electron beam welding.

Other Protective Equipment: No protective equipment or clothing is required when handling solid forms. Protective clothing such as fire retardant clothing, and molten metal splash resistant garments (ie: coats, hats, hoods, pants, shoes, gloves) should be worn as necessary to protect from accidental molten metal splash. Protective overgarment or work clothing should be worn by persons who may become contaminated with dusts, fumes, or powders. Contaminated work clothing and overgarment should be managed in such a manner so as to prevent secondary exposure to persons such as laundry operators and to prevent contamination to personal clothing. Never use compressed air to clean work clothing.

Environmental Surveillance: Exposure to beryllium should be determined by having air samples taken in the employee breathing zone, work area, and department. The frequency and type of air sampling should be as specified by an Industrial Hygienist or other qualified professional. Air sample results should be made available to employees.

Medical Surveillance: Periodic lung function tests, chest x-rays, and physical examinations should be used to monitor the potential effects of dust or fume exposure.

IX. SPECIAL PRECAUTIONS

Packaging and Labeling Requirements: The following requirements of the U.S. Dept. of Transportation apply only to beryllium metal powder or dust, not to solid shapes. UN2926 Note: Must be marked on shipping papers and on the outside of the shipping container.

Shipping Name: RQ Flammable Solid, Poisonous, N.O.S. (Beryllium Metal Powder) Note: Must be marked on shipping papers and on the outside of the shipping container.

Hazard Class: Beryllium metal powder and dust are classified as Flammable Solid and Class B Poison. Note: Hazard class must be included on shipping papers.

Label(s) Required: Flammable Solid and Poison (For Beryllium Metal Powder or Dust Only). Note: Place on the outside of the shipping container.

Reportable Quantity: 10 lbs. (4.54). The RQ is limited to particles having a diameter less than 100 micrometers.

DOT Specification Container: Suitable for Flammable Solids. Recommended double overpack when shipping powder.

Other: Emergency response information is provided within this MSDS. This information must be included, in some form, with the shipping papers.

Prepared by: S. Dierks

Dated: November 1992

Continued on Next Page

MATERIAL SAFETY DATA SHEET**I. PRODUCT IDENTIFICATION**

Trade Name: Calcium Metal
 Chemical Nature: Alkaline Earth Metal
 CAS #: 7440-70-2

Synonym: Calcium
 Formula: Ca

II. HAZARDOUS INGREDIENTS

TLV (Units): No Published Data Percent: 60-100
 HMIS Rating: Health: 1 Reactivity: 2 Flammability: 1 Other: F
 EPA Hazard: Health: 1 Fire: 1 Reactive: 1 Pressure: 0 Delayed Health: 0

III. PHYSICAL DATA

Boiling Point 760 mm Hg: 2,718°F Specific Gravity: 1.5
 Vapor Density: N/A% Volatiles by Weight: 0
 Solubility in H₂O: Reacts Violently with Water
 Appearance and Odor: Gray Metallic Solid, No odor, except when it reacts with water to produce hydrogen.

IV. FIRE AND EXPLOSION HAZARDS DATA

Flash Point (Method used): N/A Autoignition Temperature: N/A
 Flammable Limits: Upper: N/A Lower: N/A

Extinguishing Media: Do not use water, foam, or halogenated hydrocarbons such as Halon or carbon tetrachloride to extinguish fire. Use only graphite powder, soda ash, powdered sodium chloride, or an appropriate metal-fire-extinguishing dry powder, such as Met-L-X. For large fires, withdraw from the area and let the fire burn.

Special Fire Fighting: Fire fighters should wear self-contained breathing apparatus (SCBA) with full face piece operated in the pressure-demand or positive pressure mode. Fire fighters should move containers from the fire area if this can be done without risk. Do not use water or foam. Use dry powders only.

Unusual Fire & Explosion: Core material is a flammable solid. It is extremely dangerous when wet. Keep it dry. This material forms Calcium Hydroxide and hydrogen gas (explosion hazard) when wet. This material forms CaO (quicklime) when it burns. It reacts with wet extinguishing agents (ie. Water, halogens, and possibly carbon dioxide).

V. HEALTH HAZARD INFORMATION

Exposure Limit Descriptions:
 CEIL: Ceiling Exposure Limit: 15 Minutes PEL: Permissible Exposure Limit: 8 hr TWA
 REL: Recommended Exposure Limit: 8 hr TWA STEL: Short Term Exposure Limit: 15 minutes
 TLV: Threshold Limit Value: 8 hr TWA

This material will react with water or moisture causing heat. If this material contacts moisture in the eyes, on the skin, or in the respiratory tract, severe corrosive irritation may result.

Continued on Next Page

Acute Health Effects:

Inhalation: Inhalation of dust, or fume may cause respiratory irritation, cough, difficulty in breathing, and chemical pneumonitis.

Skin Contact: Contact with skin will cause irritation and possible corrosion damage.

Eye Contact: Substance is severely irritating to the eyes and may injure eye tissue if not promptly removed.

Ingestion: May cause irritation or burns to the mouth, throat, and stomach if swallowed. May cause vomiting.

Medical Conditions Aggravated by Exposure: Pre-existing chronic respiratory, skin or eye diseases.

Symptoms:

Inhalation: Severe irritation of the respiratory tract.

Skin Contact: Severe irritation.

Eye Contact: Severe irritation.

Ingestion: Severe irritation of throat and stomach.

Primary Routes of Exposure: Inhalation, ingestion, skin contact, eye contact.

Target Organs: Eyes, skin, and respiratory tract.

Carcinogenicity: IARC: No

OSHA: No

NTP: No

ACGIH: No

EMERGENCY AND FIRST AID PROCEDURES:

INHALATION: Remove to fresh air. If breathing is difficult, give oxygen. Seek immediate medical attention.

SKIN: Remove contaminated material immediately with a dry cloth. Wash with large amounts of water for at least 15 minutes.

EYE: Immediately flush eyes with running water for 15 minutes. Lift upper and lower eyelids occasionally. Get immediate medical attention.

INGESTION: If swallowed, and victim is conscious, give larger amounts of water to dilute the alkali. Do not induce vomiting.

Never give anything by mouth to an unconscious person.

NOTE TO PHYSICIAN: All treatments should be based on observed signs and symptoms of distress in the patient. Consideration should be given to the possibility that overexposure to materials other than this product may have occurred.

VI. REACTIVITY DATA

Stability: Unstable when in contact with water or acids.

Incompatibility (Material to Avoid): Water, Alkali-Metal Hydroxides and Carbonates

Hazardous Decomposition Products: Hydrogen, Calcium Hydroxide, Calcium Oxide

Hazardous Polymerization: Will not occur

VII. SPILL OR LEAK PROCEDURES

Steps to Be Taken in Case Material is Released or Spilled: Do not touch spilled material. Wear protective apparel. Do not smoke or place flame or ignition sources near a spilled area. Do not allow water to touch spilled material or to get inside containers. Use a cover (plastic sheet) to prevent water or rain from dissolving spilled material or to prevent water or rain from dissolving spilled material or to prevent its spreading. Isolate hazard area and keep nonessential personnel away from spill or leak site. Shovel small dry spills into a dry container and cover it tightly. Move containers away from spill to a safe area. Take up small spills with sand or an absorbent material and contain it as described above. Dike the flow of large calcium metal and water spills with soil, sandbags, or concrete. Keep the waste from entering drains or open sewers. Wear full protective gear.

Waste Disposal Method: Recycle or dispose in sealed containers according to Local State and Federal regulations.

Continued on Next Page

VIII. SPECIAL PROTECTION INFORMATION

Respiratory Protection (Specify Type): This material does not have established exposure limits. Wear a positive pressure air-supplied respirator in situations where there may be a potential for airborne exposure.

Ventilation: Provide adequate exhaust ventilation to meet exposure limit requirements. An exhaust filter system may be required to avoid environmental contamination.

Protective Gloves: Impervious gloves

Eye Protection: Goggles or face shields

Other Protective Equipment: Wear rubber apron or other impervious clothing to prevent contact with skin.

IX. SPECIAL PRECAUTIONS

Other Handling and Storage Conditions: Store in sealed containers away from water, acids, or organic materials. Protect containers against physical damage. Material will generate heat upon contacting water. Avoid damaging container.

X. TRANSPORTATION INFORMATION

DOT Class: Flammable Solid

DOT Shipping Name: Calcium Metal

DOT Label: Flammable Solid, Dangerous when wet

Packing Group: II

UN Number: UN1401

Additional DOT Requirements: Keep cold and dry. Segregation is the same as for flammable solids, label Dangerous When Wet.

IMO Class: 4.3

IMO Label: Dangerous When Wet

The data and recommendations presented herein are based upon a review of ESPI files, published MSDS's, and standard toxicological reference sources. ESPI makes no guarantee or warranty, either express or implied as to the accuracy or completeness of these data and recommendations.

Issued By: S. Dierks

Date: July 1996