SECTION 1. IDENTIFICATION OF THE SUBSTANCE/ PREPARATION AND OF THE COMPANY/ UNDERTAKING

Identification of the substance or preparation

Product Name: Zinc Ingot
Common/ Trade Name: Padaeng SHG (Special High Grade), Jumbo Zinc
Use of the substance/preparation: The largest single use for SHG zinc is coating (galvanizing) steel or iron and other metals. Another major use for zinc is as a constituent in alloys (brass, bronze, and die-casting alloys). Zinc is also used for electroplating, metal spraying, automotive parts, electrical fuses, storage and dry cell batteries, fungicides, nutrition (essential growth element), roofing, gutters, engravers' plates, cable wrappings and organ pipes.

Company/undertaking identification

Manufacturer: Padaeng Industry Public Company limited
CTI Tower, 26th-27th Floor, 191/18-25 Ratchadapisak Road, Klongtoey District, Bangkok, Thailand.

SECTION 2. COMPOSITION/ INFORMATION ON INGREDIENTS

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Approximate Percent by Weight</th>
<th>CAS Number</th>
<th>Approximate Percent by weight (OELs)</th>
<th>LD_{50}/ LC_{50} Species and Route</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zinc</td>
<td>99.995% min</td>
<td>7440-66-6</td>
<td>OSHA PEL</td>
<td>None established</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ACGIH TLV</td>
<td>None established</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>NIOSH REL</td>
<td>None established</td>
</tr>
</tbody>
</table>

No Data
NOTE: OELs for individual jurisdictions may differ from OSHA PELs. Check with local authorities for the applicable OELs in your jurisdiction.

OSHA - Occupational Safety and Health Administration.
ACGIH - American Conference of Governmental Industrial Hygienists.
NIOSH - National Institute for Occupational Safety and Health.
OEL – Occupational Exposure Limit.
PEL – Permissible Exposure Limit.
TLV – Threshold Limit Value.
REL – Recommended Exposure Limit.

NOTE: While there is no established OEL for zinc as such, there are OELs for zinc oxide which may be formed during burning, welding or other fuming processes.

The OSHA PEL final rule limits for zinc oxide dust are 10 mg/m$^3$ (total) and 5 mg/m$^3$ (respirable); the OSHA PEL final rule limit for zinc oxide fume is 5 mg/m$^3$. Note that the OSHA PEL final rule limits are currently non-enforceable due to a court decision. The OSHA PEL transitional limits therefore remain in force at present. They are 15 mg/m$^3$ (total) and 5 mg/m$^3$ (respirable) while the transitional PEL for zinc oxide fume is 5 mg/m$^3$. The ACGIH TLV for zinc oxide is 2 mg/m$^3$ (respirable fraction) with a Short Term Exposure Limit (STEL) of 10 mg/m$^3$ (respirable fraction). The NIOSH REL for zinc oxide (dust or fume) is 5 mg/m$^3$ 10 hr TWA with a 15 mg/m$^3$ ceiling limit (15 minute sample) for zinc oxide dust and a 10 mg/m$^3$ STEL for zinc oxide fume (15 minute sample).

SECTION 3. HAZARDS IDENTIFICATION

Emergency Overview: A lustrous bluish-silver metal that does not burn but may form explosive mixtures if dispersed in air as a fine powder. Contact with acids or alkalis generate flammable hydrogen gas which can accumulate in poorly-ventilated areas. Do NOT use water or foam in fire fighting. Apply dry chemical, sand or special powder extinguishing media. Zinc is relatively n on-toxic and poses little immediate health hazard to personnel or the environment in an emergency situation.
**Potential Health Effects:** Pure zinc dust is relatively non-toxic to humans by inhalation. However, acute over-exposure to zinc oxide fume may cause metal fume fever, characterized by flu-like symptoms such as chills, fever, nausea, and vomiting. Ingestion of soluble salts may cause abdominal irritation resulting in nausea and vomiting. In most cases, dermal exposure to zinc or zinc compounds does not result in any noticeable toxic effects. Zinc is not listed as a carcinogen by OSHA, NTP, IARC, ACGIH or the EU (see Toxicological Information, Section 11).

**Potential Environmental Effects:** In the form in which the product is sold, zinc metal does not represent a significant threat to the environment. However, extended exposure in the aquatic or terrestrial environments may lead to the release of zinc in a bioavailable form. (see Ecological Information, Section 12)

**EU Risk Phrase(s):** Not applicable - zinc is not listed as a dangerous substance.

**SECTION 4. FIRST AID MEASURES**

**Eye Contact:** Do not allow victim to rub eye(s). Let the eye(s) water naturally for a few minutes. If particle/dust does not dislodge, flush with lukewarm, gently flowing water for 5 minutes or until particle/dust is removed, while holding eyelid(s) open. If irritation persists, obtain medical attention. DO NOT attempt to manually remove anything stuck to the eye.

**Skin Contact:** No health effects expected. If irritation does occur, flush with lukewarm, gently flowing water for 5 minutes. If irritation persists, obtain medical advice. Molten Metal: Flush contact area to solidify and cool but do not attempt to remove encrusted material or clothing. Cover burns and seek medical attention immediately.

**Inhalation:** If symptoms are experienced remove source of contamination or move victim to fresh air. Obtain medical advice. NOTE: Metal fume fever may develop 3-10 hours after exposure. If symptoms of metal fume fever (flu-like symptoms) develop, obtain medical attention.
**Ingestion:** If swallowed, no specific intervention is indicated as this material is not likely to be hazardous by ingestion. However, if irritation or discomfort occurs, obtain medical advice.

**SECTION 5. FIRE FIGHTING MEASURES**

**Fire and Explosion Hazards:** Massive metal is not considered a fire or explosion hazard. However, finely divided metallic dust or powder may form flammable or explosive dust clouds when dispersed in the air at high concentrations and exposed to heat, flame, or other ignition sources. Bulk dust in a damp state may heat spontaneously and ignite on exposure to air. Contact with acids and alkali hydroxides results in evolution of hydrogen gas which is potentially explosive. Mixtures with potassium chlorate or ammonium nitrate may explode on impact.

**Extinguishing Media:** Apply dry chemical, dry sand, or special powder extinguishing media. Do NOT use water, carbon dioxide or foam on molten metals. Water may be ineffective for extinguishing a fire but should be used to keep fire-exposed containers cool.

**Fire Fighting:** If possible, move material from fire area and cool material exposed to flame. Apply dry chemical, sand, or special powder extinguishing media. Zinc oxide fumes may evolve in fires. Fire fighters should be fully trained and wear full protective clothing including an approved, self-contained breathing apparatus which supplies a positive air pressure within a full face-piece mask.

**Flashpoint and Method:** Not Applicable.

**Upper and Lower Flammable Limit**

- **Lower Flammable Limit (Zinc Dust):** 500 g/m³;
- **Upper Flammable Limit:** Not Applicable.

**Autoignition Temperature:** Approximately 680°C (dust cloud in air), 460°C (dust layer).
SECTION 6. ACCIDENTAL RELEASE MEASURES

**Procedures for Cleanup:** Solid metal is recyclable. Vacuuming recommended for accumulated metal dust. Molten metal should be allowed to solidify prior to clean-up. Return uncontaminated spilled material to the process if possible. Place contaminated and non-recyclable material in suitable labeled containers for later disposal. Treat or dispose of waste material in accordance with all local, regional and national requirements, as applicable.

**Personal Precautions:** Protective clothing, gloves, and a respirator are recommended for persons responding to an accidental release (see also Section 8). Close-fitting safety goggles may be necessary in some circumstances to prevent eye contact with zinc dust or powder. Where molten metal is involved, wear heat-resistant gloves and suitable clothing for protection from hot-metal splash.

**Environmental Precautions:** Zinc in the metallic form has limited bioavailability and poses no immediate ecological risk. However, contamination of water and soil should be prevented.

SECTION 7. HANDLING AND STORAGE

**Store zinc in a DRY** covered area, separate from incompatible materials. Zinc ingots suspected of containing moisture should be THOROUGHLY DRIED before being added to a molten bath. Ingots may contain cavities that collect moisture. Entrained moisture will expand explosively when immersed in a molten bath. Always practice good personal hygiene. Refrain from eating, drinking, or smoking in work areas. Thoroughly wash hands before eating, drinking, or smoking in appropriate designated areas. No special packaging materials are required.

**EU Safety Phrase(s):** Not applicable - zinc in ingot form is not listed as a dangerous substance.
SECTION 8. EXPOSURE CONTROLS, PERSONAL PROTECTION

Protective Clothing: Gloves and coveralls or other work clothing are recommended to prevent prolonged or repeated direct skin contact when zinc is processed. Eye protection should be worn where fume or dust is generated. Respiratory protection may be required where zinc oxide fume is generated. Where hot or molten metal is handled, heat resistant gloves, face shield, and clothing to protect from hot metal splash should be worn. Safety type boots are recommended.

Ventilation: Use adequate local or general ventilation to maintain the concentration of zinc oxide fumes in the working environment well below recommended occupational exposure limits. Supply sufficient replacement air to make up for air removed by the exhaust system. Where metallic dust particles of zinc metal are being collected and transported by a ventilation system, use a non-sparking, grounded ventilation system separate from other exhaust ventilation systems. Locate dust collectors and fans outdoors if possible and provide dust collectors with explosion vents or blow out panels.

Respirators: Where zinc oxide dust or fumes are generated and cannot be controlled to within acceptable levels, use appropriate NIOSH-approved respiratory protection equipment (a 42CFR84 Class N, R or P-95 particulate filter cartridge).

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

<table>
<thead>
<tr>
<th>Appearance</th>
<th>Odour</th>
<th>Physical State</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bluish-silver lustrous metal</td>
<td>None</td>
<td>Solid</td>
<td>Not Applicable</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vapour Pressure:</th>
<th>Vapour Density:</th>
<th>Boiling Point/Range:</th>
<th>Freezing/Melting Point/Range:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 mm at 487°C</td>
<td>Not Applicable</td>
<td>908°C</td>
<td>420°C</td>
</tr>
<tr>
<td>Negligible at 20°C</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Specific Gravity: 7.1
Evaporation Rate: Not Applicable
Coefficient of Water/Oil Distribution: Not Applicable
Odour Threshold: None

Solubility:
Insoluble in Water

SECTION 10. STABILITY AND REACTIVITY

Stability & Reactivity: Massive metal is stable under normal temperatures and pressures. It slowly becomes covered with a white coating of a hydrated basic zinc carbonate on exposure to moist air. Fine, condensed zinc dust or powder may heat spontaneously and ignite on exposure to air when damp. Zinc metal will react with acids and strong alkalis to generate hydrogen gas. A violent, explosive reaction may occur when powdered zinc is heated with sulphur. Powdered zinc will become incandescent or ignite in the presence of fluorine, chlorine or bromine. Powdered zinc can also react explosively with halogenated hydrocarbons if heated. Mixtures with potassium chlorate or ammonium nitrate may explode on impact.

Incompatibilities: Contact with acids and alkalis will generate highly flammable hydrogen gas. Contact with acidic solutions of arsenic and antimony compounds may evolve highly toxic ARSINE or STIBINE gas. Incompatible with strong oxidizing agents such as chlorine, fluorine, bromine, sodium potassium or barium peroxide, sodium or potassium chlorate, chromium trioxide and fused ammonium nitrate. Also incompatible with elemental sulphur dust, halogenated hydrocarbons or chlorinated solvents and chlorinated rubber.

Hazardous Decomposition Products: High temperature operations such as oxy-acetylene cutting, electric arc welding or overheating a molten bath will generate zinc oxide fume which, on inhalation in sufficient quantity, can produce metal fume fever, a transient influenza-like illness.
SECTION 11. TOXICOLOGICAL INFORMATION

General: Zinc, especially in the metal form, is relatively non-toxic. However, it can react with other materials, such as oxygen or acids, to form compounds that can be potentially toxic. The primary route of exposure would be through the generation and inhalation of zinc oxide fume from welding or burning or overheated melting pots.

Acute:

Skin/Eye: In most cases, dermal exposure to zinc or zinc compounds does not result in any noticeable toxic effects. Zinc metal is not chemically irritating to the eyes.

Inhalation: If excessive quantities of zinc oxide fume are inhaled, it can result in the condition called metal fume fever. The symptoms of metal fume fever will occur within 3 to 10 hours, and include immediate dryness and irritation of the throat, tightness of the chest and coughing, which may later be followed by flu-like symptoms of fever, malaise, perspiration, frontal headache, muscle cramps, low back pain, occasionally blurred vision, nausea, and vomiting. The symptoms are temporary and generally disappear, without medical intervention, within 24 to 48 hours of onset. There are no recognized complications, after affects, or chronic affects that result from this condition.

Ingestion: When ingested in excessive quantities, zinc can irritate the stomach resulting in nausea and vomiting.

Chronic: There is no chronic form of metal fume fever but in rare instances an acute incident may be followed by complaints such as bronchitis or pneumonia. Some workers may develop a short-term immunity (resistance) so that repeated exposure to zinc oxide fumes does not cause metal fume fever. This immunity (resistance) however is quickly lost after short absences from work (weekends or vacations). Workers exposed to finely-divided metallic zinc for up to 35 years revealed no acute or chronic illnesses attributable to zinc. Prolonged or repeated skin contact with zinc dust or powder may cause dryness, irritation and cracking (dermatitis) since zinc is astringent and may tend to draw moisture from the skin. Zinc dust is not listed as a human carcinogen by the Occupational Safety
and Health Administration (OSHA), the National Toxicology Program (NTP), the International Agency for Research on Cancer (IARC), the American Conference of Governmental Industrial Hygienists (ACGIH) or the European Union (EU).

SECTION 12. ECOLOGICAL INFORMATION

Zinc in the metallic form has limited bioavailability and poses no immediate ecological risk. However, its processing or extended exposure in the environment may result in the formation of bioavailable zinc compounds. In aquatic systems, zinc bioaccumulates in both plants and animals. In terrestrial systems, the mobility of zinc in soil is dependent on soil conditions, such as cation exchange capacity, pH, redoxpotential, and chemical species present in the soil. Zinc also bioaccumulates in terrestrial plants, vertebrates, and mammals, with plant uptake from soil dependent on the plant species, soil pH, and soil composition.

SECTION 13. DISPOSAL CONSIDERATIONS

If material cannot be returned to process or salvage, dispose of in accordance with applicable regulations.

SECTION 14. TRANSPORT INFORMATION

PROPER SHIPPING NAME.................................................................Not applicable – not regulated.
U.S. DOT AND TRANSPORT CANADA HAZARD CLASSIFICATION .Not applicable
U.S. DOT AND TRANSPORT CANADA PID..............................................Not applicable
MARINE POLLUTANT ............................................................................No
IMO CLASSIFICATION ...........................................................................Not regulated
SECTION 15. REGULATORY INFORMATION

U.S.

INGREDIENT LISTED ON TSCA INVENTORY .................................................Yes

HAZARDOUS UNDER HAZARD COMMUNICATION STANDARD ..............No

CERCLA SECTION 103 HAZARDOUS SUBSTANCES.................................Zinc...Yes..RQ: 1,000 lb. (454 kg.)*

* reporting not required when diameter of the pieces of solid metal released is equal to or exceeds 100 micrometers (0.004 inches).

EPCRA SECTION 302 EXTREMELY HAZARDOUS SUBSTANCE ..............No

EPCRA SECTION 311/312 HAZARD CATEGORIES .....................................No Hazard Categories Apply

EPCRA SECTION 313 Toxic Release Inventory: ........................................This product does not contain any toxic chemicals subject to the Toxic Release reporting requirements.

However, potential by-products from working with this product - "Zinc (Fume or Dust)" CAS 7440-66-6 are reportable.

CANADIAN:

INGREDIENTS LISTED ON DOMESTIC SUBSTANCES LIST .................Yes

WHMIS CLASSIFICATION: .................................................................Not applicable. Zinc is not a Controlled Product under CPR.

EUROPEAN UNION:

LISTED ON THE EUROPEAN INVENTORY OF EXISTING SUBSTANCES (EINECS) .................................................................Yes

COMMERCIAL CHEMICAL EU CLASSIFICATION: ..........................Not applicable. Zinc in ingot form is not listed as a dangerous substance.
SECTION 16. OTHER INFORMATION

The information in this Material Safety Data Sheet is based on the following references:
- American Conference of Governmental Industrial Hygienists, 2004, Documentation of the Threshold Limit Values and Biological Exposure Indices, Seventh Edition.
- American Conference of Governmental Industrial Hygienists, 2006, Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices.
- American Conference of Governmental Industrial Hygienists, 2005, Guide to Occupational Exposure Values.
- Canadian Centre for Occupational Health and Safety (CCOHS) Hamilton, Ontario, CHEMINFO Record No. 239 – Zinc (Last Revision 2006-01).
- European Economic Community, Commission Directives 91/155/EEC and 67/548/EEC.
- Industry Canada, SOR/88-66, Controlled Products Regulations, as amended.
- National Library of Medicine, National Toxicology Information Program, 2003, Hazardous Substance Data Bank. (on-line version).
- Patty's Toxicology, Fifth Edition, 2001 E. Bingham, B. Cohrssen & CH Powell (Eds.).

----------------------------------------------------------
Prepare by Quality System Management Division, Zinc Refinery, Padaeng Industry PCL.
Revision 00
July 2007