



MATERIAL SAFETY DATA SHEET

Prepared to U.S. OSHA, CMA, ANSI, Canadian WHMIS Standards and European Directives

PART I What is the material and what do I need to know in an emergency?

1. PRODUCT IDENTIFICATION

TRADE NAME (AS LABELED): **BRASS**
CHEMICAL NAME/CLASS: METAL ALLOY
PRODUCT USE: Printing Operations
MANUFACTURER'S NAME: **REVERE GRAPHICS WORLDWIDE**
ADDRESS: 5 Boundary Street
 Plymouth, MA 02360
EMERGENCY PHONE: (800) 424-9300 (**CHEMTREC**)
BUSINESS PHONE: (508) 746-1000
DATE OF PREPARATION: January 10, 2003
DATE OF REVISION: September 8, 2004

2. COMPOSITION and INFORMATION ON INGREDIENTS

| CHEMICAL NAME | CAS # | EINECS # | % w/w | EXPOSURE LIMITS IN AIR | | | | | |
|---|-----------|-----------|----------|---------------------------------|---------------------------|---------------------------------|---------------------------|------------------------------------|---|
| | | | | ACGIH | | OSHA | | NIOSH IDLH mg/m ³ | OTHER mg/m ³ |
| | | | | TLV mg/m ³ | STEL mg/m ³ | PEL mg/m ³ | STEL mg/m ³ | | |
| Lead Exposure limits are for lead and inorganic compounds, as pB | 7439-92-1 | 231-100-4 | < 2 | 0.05 | | 0.05 (see 29 CFR 1910.1025) | NE | 100 | NIOSH REL: TWA = < 0.1 (blood Pb < 0.06 mg/100 g whole blood) DFG MAKs TWA = 0.1 (inhalable fraction) PEAK = 8 MAK 15 min., average value, 1-hr interval DFG MAK Pregnancy Risk Classification: B Carcinogen: EPA-B2, IARC-2B, TLV-A3 |
| Zinc Exposure limits are for zinc oxide, fume | 7440-66-6 | 231-175-3 | 5.0-40.0 | 5 | 10 | 5 | NE | 500 | NIOSH REL: TWA = 5 DFG MAK (fume): TWA = 0.1 (Respirable fraction) PEAK = 1 MAK 15 min., average value, 1-hr interval Carcinogen: EPA-D (fume) |
| Copper Exposure limits are for copper fume and dust | 7440-50-8 | 231-159-6 | 68.0-96. | 0.2 (fume) 1 (dusts & mists) | NE | 0.1 (fume) 1 (dusts & mists) | NE | 100 | NIOSH RELS: TWA = (fume): 0.1; (dusts & mists): 1 Carcinogen (copper dusts & mists): EPA-D |

NE = Not Established

See Section 16 for Definitions of Terms Used.

NOTE: All Canadian WHMIS, and European Community required information is included. It is located in appropriate sections based on the ANSI Z400.1-1998 format. This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

3. HAZARD IDENTIFICATION

EC LABELING AND CLASSIFICATION: This product does not meet the definition of any hazard class as defined by the European Community Council Directive 67/548/EEC or subsequent Directives.

EC CLASSIFICATION: Not applicable. **EC RISK PHRASES:** Not applicable. **EC SAFETY PHRASES:** Not applicable.

EMERGENCY OVERVIEW: This odorless product is a solid brass alloy plate. **Health Hazards:** There are no immediate health hazards associated with this product. If highly heated, fumes from the product may also cause metal fume fever. **Fire Hazards:** This product is not flammable. If heated to decomposition this product can produce irritating vapors and toxic gases (e.g., metal oxides, metal fumes). **Reactivity Hazards:** This product is not reactive. **Environmental Hazards:** Due to the form of this product, it is not expected that damage to the environment can occur if released. **Emergency Considerations:** In the event of fire or spill, adequate precautions must be taken for surrounding materials. Emergency responders must wear personal protective equipment suitable for the situation to which they are responding.

SYMPTOMS OF OVER-EXPOSURE BY ROUTE OF EXPOSURE: The most significant routes of over-exposure for this product are by skin or eye contact. The following paragraphs describe symptoms of exposure by route of exposure.

INHALATION: Inhalation is not anticipated to be a significant route of overexposure to the plates. Inhalation of large amounts of particulates generated by this product during metal processing operations may be physically irritating and cause deposits of dust in nasal passages. Inhalation of dusts and fumes of Copper and Zinc (the main components of this product) can cause metal fume fever. Initial symptoms of metal fume fever can include a metallic or sweet taste in the mouth, dryness or irritation of the throat, and coughing. Later symptoms (after 4-48 hours) can include sweating, shivering, headache, fever, chills, thirstiness, muscle aches, nausea, vomiting, weakness, and tiredness. Chronic over-exposure to Copper dust may cause tiredness, stuffiness, diarrhea and vomiting.

CONTACT WITH SKIN or EYES: Contact of the plate form of this product with the skin is not anticipated to be irritating. Contact with the plate form of this product or metal dust generated during routing can be physically damaging and irritating to the eye (i.e., foreign object). Rare cases of allergic contact dermatitis have been reported in people working with copper dust.

SKIN ABSORPTION: Skin absorption is not known to be a significant route of over-exposure for any component of this product.

INGESTION: Ingestion is not anticipated to be a likely route of occupational exposure for this product. If particulates, generated during routing operations, are ingested (i.e., through poor hygiene practices), nausea, vomiting, diarrhea, and abdominal cramps can occur.

INJECTION: Injection of this product is not anticipated to be a significant route of exposure. In the unlikely event that a splinter of the alloy penetrates the skin, a slow-healing, gaseous bleb may be produced.

HEALTH EFFECTS OR RISKS FROM EXPOSURE: An Explanation in **Law Terms**. Over-exposure from this product is very unlikely when used for its designed purpose.

ACUTE: Inhalation of large amounts of particulates generated by this product during metal processing operations may result in irritation. Inhalation of dusts and fumes of Copper and Zinc (components of this product) can cause metal fume fever. Contact with the plate form of this product or metal dust generated during routing can be physically damaging and irritating to the eye (i.e., foreign object).

CHRONIC: Rare cases of allergic contact dermatitis have been reported in people working with copper dust. This product contains trace amounts of Lead, which is a possible carcinogen and reproductive hazard.

TARGET ORGANS: ACUTE: None under normal circumstances of use and handling. Skin, eyes, and respiratory system in situations in which fumes or dusts are generated. CHRONIC: Skin (from Photoresist).

PART II *What should I do if a hazardous situation occurs?*

4. FIRST-AID MEASURES

Victims of chemical exposure must be taken for medical attention if any adverse effect occurs. Remove or cover gross contamination to avoid exposure to rescuers. Rescuers should be taken for medical attention, if necessary. Take copy of label and MSDS to health professional with victim.



HAZARDOUS MATERIAL IDENTIFICATION SYSTEM

| | | |
|----------------------|--------|---|
| HEALTH HAZARD | (BLUE) | 0 |
|----------------------|--------|---|

| | | |
|----------------------------|-------|---|
| FLAMMABILITY HAZARD | (RED) | 0 |
|----------------------------|-------|---|

| | | |
|------------------------|----------|---|
| PHYSICAL HAZARD | (YELLOW) | 0 |
|------------------------|----------|---|

PROTECTIVE EQUIPMENT

| EYES | RESPIRATORY | HANDS | BODY |
|---|---------------|---|---------------|
|  | See Section 8 |  | See Section 8 |

For Routine Industrial Use and Handling Applications

See Section 16 for Definition of Ratings

4. FIRST-AID MEASURES (Continued)

SKIN EXPOSURE: In the event that skin contact leads to irritation, rinse the area thoroughly with water. The contaminated individuals must seek medical attention if any adverse effect persists.

EYE EXPOSURE: If particulates generated by this product during metal processing operations enter the eyes, open victim's eyes while under gently running water. Use sufficient force to open eyelids. Have victim "roll" eyes. Minimum flushing is for 15 minutes. Victim must seek immediate medical attention.

INHALATION: If particulates generated by this product during metal processing operations are inhaled, remove victim to fresh air. Seek medical attention if adverse effect continues after removal to fresh air.

INGESTION: If particulates generated by this product during metal processing operations are swallowed, CALL PHYSICIAN OR POISON CONTROL CENTER FOR MOST CURRENT INFORMATION. If professional advice is not available, do not induce vomiting. Victim should drink milk, egg whites, or large quantities of water. Never induce vomiting or give diluents (milk or water) to someone who is unconscious, having convulsions, or unable to swallow.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Acute or chronic respiratory conditions, skin disorder, central nervous system conditions, or disorders involving the "Target Organs" (see Section 3, "Hazard Identification") may be aggravated by overexposure to this product.

RECOMMENDATIONS TO PHYSICIANS: Treat symptoms and eliminate overexposure.

5. FIRE-FIGHTING MEASURES

FLASH POINT: Not applicable.

AUTOIGNITION TEMPERATURE: Not applicable.

FLAMMABLE LIMITS (in air by volume, %): Lower: Not applicable.
Upper: Not applicable.

FIRE EXTINGUISHING MATERIALS: Use fire extinguishing materials appropriate for surrounding fire.

Water Spray: No

Carbon Dioxide: Yes

Foam: Yes

Dry Chemical: Yes

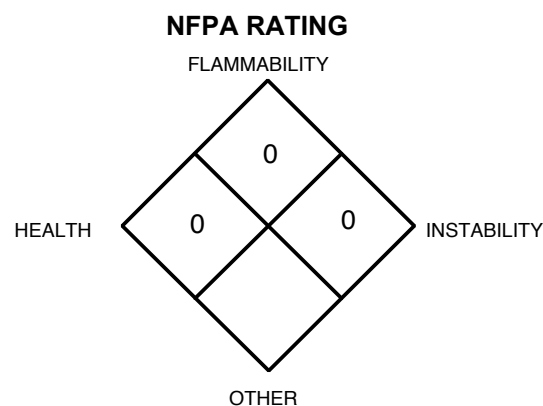
Halon: Yes

Other: Any "ABC" Class

UNUSUAL FIRE AND EXPLOSION HAZARDS: This product is not flammable. When involved in a fire, this product may decompose and produce irritating fumes and toxic gases including copper, lead and zinc oxides, metal fumes.

Explosion Sensitivity to Mechanical Impact: Not sensitive.

Explosion Sensitivity to Static Discharge: Not sensitive.



**See Section 16 for
Definition of Ratings**

SPECIAL FIRE-FIGHTING PROCEDURES: Incipient fire responders should wear eye protection. Structural firefighters must wear Self-Contained Breathing Apparatus and full protective equipment. If possible, prevent runoff water from entering storm drains, bodies of water, or other environmentally sensitive areas.

6. ACCIDENTAL RELEASE MEASURES

SPILL AND LEAK RESPONSE: Pick-up plates carefully, avoiding cuts. Place in a suitable container and seal if appropriate. Dispose of or recycle in accordance with U.S. Federal, State, and local hazardous waste disposal regulation, those of Canada and its Provinces, and those of EC Member States see Section 13, Disposal Considerations).

PART III *How can I prevent hazardous situations from occurring?*

7. HANDLING and STORAGE

WORK AND HYGIENE PRACTICES: As with all chemicals, avoid getting this product ON YOU or IN YOU. Wash thoroughly after using this product. Do not eat, drink, smoke, or apply cosmetics while handling this product. Avoid breathing dusts of this product. If necessary, periodically wipe-down area of product use to prevent accumulation of dusts. Remove contaminated clothing immediately.

STORAGE AND HANDLING PRACTICES: All employees who handle this product should be trained to handle it safely. Avoid breathing particulates generated by this product during metal processing or other operations. Use in a well-ventilated location. Packages of this product must be properly labeled. No special precautions are necessary when handling these plates, except to protect the surfaces from mechanical damage. Avoid accumulation of shavings or powder produced when working with these plates. Store packages in a cool, dry location. Storage in an atmosphere that is wet, moist, or highly humid may lead to corrosion of this product. Store away from incompatible materials (see Section 10, Stability and Reactivity)

PROTECTIVE PRACTICES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT: Follow practices indicated in Section 6 (Accidental Release Measures). Make certain that application equipment is locked and tagged-out safely if

necessary. Collect all rinsates and dispose of according to applicable U.S. Federal, State, or local procedures, or the applicable standards of Canada and its Provinces and EC Member States.

8. EXPOSURE CONTROLS - PERSONAL PROTECTION

VENTILATION AND ENGINEERING CONTROLS: Use with adequate ventilation to ensure exposure levels are maintained below the limits provided in Section 2 (Composition and Information on Ingredients). Prudent practice is to ensure eyewash/safety shower stations are available near areas where this product is used.

INTERNATIONAL OCCUPATIONAL EXPOSURE LIMITS: The following international exposure limits are currently in force for some of the components of this product.

COPPER:

Arab Republic of Egypt: TWA = 0.1 mg/m³ (fume), JAN 1993
 Australia :TWA = 0.2 mg/m³ (fume), JAN 1993
 Australia :TWA = 1 mg/m³ (dust), JAN 1993
 Austria: MAK = 1 mg/m³, JAN 1999
 Austria: MAK = 0.1 mg/m³ (fume), JAN 1999
 Belgium: TWA = 0.2 mg/m³ (fume), JAN 1993
 Belgium: TWA = 1 mg/m³ (dust), JAN 1993
 Denmark: TWA = 0.1 mg/m³, JAN 1999
 Finland: TWA = 0.2 mg/m³ (fume), JAN 1999
 Finland: TWA = 1 mg/m³ (dust), JAN 1999
 France: VME (fume) = 0.2 mg/m³, JAN 1999
 France: VME (dust) = 1 mg/m³, JAN 1999
 France: VME = 1 mg/m³, STEL 2 mg/m³ (dust), JAN 1993
 Germany: MAK = 0.1 mg/m³ (fume), JAN 1999
 Germany: MAK = 1 mg/m³ (dust), JAN 1999
 Hungary: TWA = 0.2 mg/m³, STEL 0.4 mg/m³ (dust), JAN 1993
 India: TWA = 0.2 mg/m³ (fume), JAN 1993
 The Netherlands: MAC-TGG = 1 mg/m³ (dust), JAN 1999

COPPER (continued):

The Netherlands: MAC-TGG = 1 mg/m³ (dust), JAN 1993
 Norway: TWA = 0.05 mg(Co)/m³, JAN 1999
 Norway: TWA = 0.1 mg/m³, fume, JAN 1999
 The Philippines: TWA = 1.0 mg/m³ (fume), JAN 1993
 Poland: MAC(TWA) fume = 0.1 mg/m³, MAC(STEL) fume 0.3 mg/m³, JAN 1999
 Poland: MAC(TWA) MAC(TWA) dust = 1 mg/m³, MAC(STEL) dust 2 mg/m³, JAN 1999
 Russia :STEL = 0.5 ppm (1 mg/m³) (dust), JAN 1993
 Sweden: NGV = 0.2 mg/m³ (resp. dust), JAN 1999
 Sweden: NGV = 1 mg/m³ (total dust), JAN 1999
 Switzerland: MAK-W = 0.1 mg/m³, KZG-W 0.2 mg/m³ (fume), JAN 1999
 Switzerland: MAK-W = 1 mg/m³, KZG-W 1 mg/m³, JAN 1999
 Thailand: TWA = 0.1 mg/m³ (fume), JAN 1993
 Thailand: TWA = 1 mg/m³, JAN 1993

COPPER (continued):

United Kingdom: TWA = 0.2 mg/m³, fume, SEP 2000
 United Kingdom: TWA = 1 mg/m³, STEL 2 mg/m³, dusts and mists as Cu, SEP 2000
 United Kingdom: TWA = 1 mg(W)/m³, STEL 3 mg(W)/m³, SEP 2000
 In Argentina, Bulgaria, Colombia, Jordan, Korea, New Zealand, Singapore, Vietnam check ACGIH TLV

LEAD:

Austria: MAK 0.1 mg/m³, JAN 1999
 Denmark: TWA = 0.1 mg/m³, JAN 1999
 Germany: MAK = 0.1 mg/m³, JAN 1999
 Japan OEL = 0.1 mg/m³, JAN 1999
 Norway: TWA = 0.05 mg/m³, JAN 1999
 Poland: MAC(TWA) = 0.05 mg/m³, JAN 1999
 Sweden: TWA = 0.05 mg/m³ (resp. dust), JAN 1999
 Sweden: TWA = 0.1 mg/m³ (total dust), JAN 1999
 Switzerland: MAK-W = 0.1 mg/m³, JAN 1999
ZINC:
 ARAB Republic of Egypt: TWA = 0.1 mg/m³, JAN 1993

The following information on appropriate Personal Protective Equipment is provided to assist employers in complying with OSHA regulations found in 29 CFR Subpart I (beginning at 1910.132) or equivalent standard of Canada, or standards of EC member states (including EN 149 for respiratory PPE, and EN 166 for face/eye protection). Please reference applicable regulations and standards for relevant details.

RESPIRATORY PROTECTION: Maintain airborne contaminant concentrations below guidelines listed in Section 2 (Composition and Information on Ingredients) if applicable. If necessary, use only respiratory protection authorized in the U.S. Federal OSHA Respiratory Protection Standard (29 CFR 1910.134), equivalent U.S. State standards, Canadian CSA Standard Z94.4-93, the European Standard EN149, or EC member states. Oxygen levels below 19.5% are considered IDLH by OSHA. In such atmospheres, use of a full-facepiece pressure/demand SCBA or a full facepiece, supplied air respirator with auxiliary self-contained air supply is required under U.S. Federal OSHA's Respiratory Protection Standard (1910.134-1998) or the regulations of various U.S. States, Canada, or EC Member States. Air-purifying respirators with dust/mist/fume filters are recommended if operations may produce dusts from this product. If use of this product results in the generation of dusts, the following NIOSH Respiratory Equipment Guidelines may be applicable. The following are NIOSH respiratory protective equipment guidelines for Copper Dust, Mists and Fume and Lead and are presented as the component of greatest percentage in the plates is Copper and Lead is the toxic component.

COPPER (DUSTS & MISTS, METAL FUME)

CONCENTRATION

RESPIRATORY PROTECTION

Up to 5 mg/m³:

Any Dust and Mist Respirator.

Up to 10 mg/m³:

Any Dust and Mist Respirator except single-use and quarter-mask respirators, or any Supplied-Air Respirator (SAR).

Up to 25 mg/m³:

Any SAR operated in a continuous-flow mode, or any Powered, Air-Purifying Respirator (PAPR) with a dust and mist filter.

Up to 50 mg/m³:

Any Air-Purifying, Full-Facepiece Respirator with a high-efficiency particulate filter, or any PAPR with a tight-fitting facepiece and a high-efficiency particulate filter, or Self-Contained Breathing Apparatus with a full facepiece, or any SAR with a full facepiece.

Up to 100 mg/m³:

Any SAR that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

Emergency or Planned Entry into Unknown Concentrations or IDLH Conditions: Any SCBA that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode, or any SAR that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary SCBA operated in pressure-demand or other positive-pressure mode.

Escape:

Any Air-Purifying, Full-Facepiece Respirator with a high-efficiency particulate filter, or any appropriate escape-type, SCBA.

8. EXPOSURE CONTROLS - PERSONAL PROTECTION (Continued)

RESPIRATORY PROTECTION (continued): NIOSH Respiratory Guidelines (continued):

LEAD

CONCENTRATION

Up to 0.5 mg/m³

Up to 1.25 mg/m³:

Up to 2.5 mg/m³:

Up to 50 mg/m³:

Up to 100 mg/m³

Emergency or Planned

Escape:

RESPIRATORY PROTECTION

Any Air-Purifying Respirator with a high-efficiency particulate filter, or any Supplied-Air Respirator (SAR).

Any SAR operated in a continuous-flow mode, or any Powered, Air-Purifying Respirator with a high-efficiency particulate filter.

Any Air-Purifying, Full-Facepiece Respirator with a high-efficiency particulate filter, or any SAR that has a tight-fitting facepiece and is operated in a continuous-flow mode, or any PAPR with a tight-fitting facepiece and a high-efficiency particulate filter, or any Self-contained breathing apparatus with a full facepiece, or any SAR with a full facepiece.

Any SAR operated in a pressure-demand or other positive-pressure mode.

Any SAR that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

Entry into Unknown Concentrations or IDLH Conditions: Any SCBA that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode, or any SAR that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary SCBA operated in pressure-demand or other positive-pressure mode.

Any Air-Purifying, Full-Facepiece Respirator with a high-efficiency particulate filter, or any appropriate escape-type, SCBA.

EYE PROTECTION: Safety glasses. If necessary, refer to U.S. OSHA 29 CFR 1910.133, Canadian Standards, and the European Standard EN166.

HAND PROTECTION: Use mechanically-resistant gloves when handling this product. If necessary, refer to U.S. OSHA 29 CFR 1910.138, the appropriate Standards of Canada, or appropriate Standards of the EC.

BODY PROTECTION: Use body protection appropriate for task (e.g. lab coat, overalls). If necessary, refer to appropriate Standards of Canada. If a hazard of injury to the feet exists due to falling objects, rolling objects, where objects may pierce the soles of the feet or where employee's feet may be exposed to electrical hazards, use foot protection, as described in U.S. OSHA 29 CFR 1910.136.

9. PHYSICAL and CHEMICAL PROPERTIES

VAPOR DENSITY (air = 1): Not applicable.

SPECIFIC GRAVITY (water = 1): 8.75

SOLUBILITY IN WATER: Insoluble.

VAPOR PRESSURE, mm Hg @20 C: Not applicable.

ODOR THRESHOLD (recognition): Not applicable.

COEFFICIENT OF OIL/WATER DISTRIBUTION (PARTITION COEFFICIENT): Not applicable.

APPEARANCE AND COLOR: Flat metal plate.

HOW TO DETECT THIS SUBSTANCE (warning properties): The plate shape is characteristic.

EVAPORATION RATE (n-BuAc=1): Not applicable.

MELTING POINT or RANGE: 1880 C (3416 F) [zinc]

BOILING POINT: Not applicable.

pH: Not applicable.

10. STABILITY and REACTIVITY

STABILITY: Stable.

DECOMPOSITION PRODUCTS: Copper, lead and zinc oxides, other metal oxides, metal fumes.

MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: Strong acids, strong caustics.

HAZARDOUS POLYMERIZATION: Will not occur.

CONDITIONS TO AVOID: Fire, extremely high temperatures, contact with incompatible materials.

PART IV *Is there any other useful information about this material?*

11. TOXICOLOGICAL INFORMATION

TOXICITY DATA: The specific toxicology data available for components greater than 1% in concentration are as follows.

LEAD:

TDLo (Oral-Woman) 450 mg/kg/6 years
Peripheral Nerve and Sensation: flaccid paralysis without anesthesia (usually neuromuscular blockage); Behavioral: hallucinations, distorted perceptions, muscle weakness

LEAD (continued):

LDLo (Oral-Human) 155 mg/kg
TCLo (Inhalation-Human) 271 mg/m³
TCLo (Inhalation-Human) 10 µg/m³:
Gastrointestinal: gastritis; Liver: other changes
TCLo (Inhalation-Human) 9.9 mg/m³/122 days-
intermittent: Related to Chronic Data: death

LEAD (continued):

TCLo (Inhalation-Human) 0.011 mg/m³/26 weeks-
intermittent: Brain and Coverings: other
degenerative changes
TCLo (Inhalation-Man) 0.03 mg/m³/1 year-
intermittent: Endocrine: changes in luteinizing
hormone; Biochemical: Metabolism (Intermediary):
porphyrin including bile pigments

11. TOXICOLOGICAL INFORMATION (Continued)

TOXICITY DATA (continued):**LEAD (continued):**

TCLo (Inhalation-Man) 0.03 mg/m³/5 years-intermittent: Endocrine: androgenic

TCLo (Inhalation-Man) 0.109 mg/m³/5 years-intermittent: Reproductive: Paternal Effects: spermatogenesis (incl. genetic material, sperm morphology, motility, and count)

TCLo (Inhalation-Rat) 10 mg/m³/24 hours: female 1-21 day(s) after conception: Reproductive: Effects on Embryo or Fetus: fetotoxicity (except death, e.g., stunted fetus); Specific Developmental Abnormalities: blood and lymphatic systems (including spleen and marrow)

TCLo (Inhalation-Rat) 3 mg/m³/24 hours: female 1-21 day(s) after conception: Reproductive: Effects on Newborn: biochemical and metabolic

TCLo (Inhalation-Guinea Pig) 20 mg/m³/6 hours/30 days-intermittent: Immunological including Allergic: uncharacterized

TCLo (Inhalation-Guinea Pig) 200 µg/m³/6 hours/26 weeks-intermittent: Immunological including Allergic: uncharacterized

TDLo (Oral-Rat) 1050 µg/kg/30 weeks-intermittent: Brain and Coverings: other degenerative changes; Behavioral: alteration of classical conditioning; Nutritional and Gross Metabolic: changes in metals, not otherwise specified

TDLo (Oral-Rat) 790 mg/kg multi-generations: Reproductive: Effects on Embryo or Fetus: fetotoxicity (except death, e.g., stunted fetus), fetal death

TDLo (Oral-Rat) 1140 mg/kg: female 14 day(s) pre-mating-21 day(s) post-birth: Reproductive Effects on Newborn: behavioral

TDLo (Oral-Rat) 520 mg/kg female 7-22 day(s) after conception lactating female 10 day(s) post-birth: Reproductive: Effects on Newborn: biochemical and metabolic

TDLo (Oral-Rat) 1100 mg/kg: female 1-22 day(s) after conception: Reproductive: Specific Developmental Abnormalities: blood and lymphatic systems (including spleen and marrow); Effects on Newborn: growth statistics (e.g., reduced weight gain)

TDLo (Oral-Rat) 93.6 mg/kg/30 days-continuous: Kidney, Ureter, Bladder: other changes; Blood other changes; Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: other Enzymes

TDLo (Oral-Mouse) 4099.2 mg/kg/8 weeks-intermittent: Endocrine: changes in endocrine weight (unspecified)

TDLo (Oral-Mouse) 10,248 mg/kg/20 weeks-intermittent: Endocrine: other changes; Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: other Enzymes

LEAD (continued):

TDLo (Oral-Mouse) 6879 mg/kg/5 weeks-continuous: Blood: pigmented or nucleated red blood cells, other changes, changes in other cell count (unspecified)

TDLo (Oral-Mouse) 1120 mg/kg: multi-generations: Reproductive: Effects on Embryo or Fetus: fetotoxicity (except death, e.g., stunted fetus), fetal death

TDLo (Oral-Mouse) 6300 mg/kg: female 1-21 day(s) after conception: Reproductive: Fertility: female fertility index (e.g. # females pregnant per # sperm positive females; # females pregnant per # females mated), pre-implantation mortality (e.g. reduction in number of implants per female; total number of implants per corpora lutea)

TDLo (Oral-Mouse) 300 mg/kg: female 1-2 day(s) after conception: Reproductive: Fertility: other measures of fertility

TDLo (Oral-Mouse) 4800 mg/kg: female 1-16 day(s) after conception: Reproductive: Effects on Embryo or Fetus: cytological changes (including somatic cell genetic material)

TDLo (Oral-Mouse) 4099.2 mg/kg: male 56 day(s) pre-mating: Reproductive: Paternal Effects: testes, epididymis, sperm duct, other effects on male

TDLo (Oral-Mammal-domestic) 662 mg/kg: female 1-21 week(s) after conception: Reproductive: Effects on Newborn: behavioral

TDLo (Oral-Mammal-domestic) 814 mg/kg: female 5 week(s) pre-mating female 1-21 week(s) after conception: Reproductive: Effects on Newborn: behavioral

TDLo (Oral-Mammal-species unspecified) 2118 mg/kg lactating female 15 day(s) post-birth: Reproductive: Effects on Embryo or Fetus: fetotoxicity (except death, e.g., stunted fetus), fetal death

TDLo (Oral-Non-mammalian species) 582 mg/kg/30 days-continuous: Endocrine androgenic, estrogenic; Related to Chronic Data: changes in ovarian weight

TDLo (Unreported-Rat) 0.012 mg/kg/10 days-intermittent: Reproductive: Paternal Effects: spermatogenesis (incl. genetic material, sperm morphology, motility, and count), testes, epididymis, sperm duct

TDLo (Unreported-Rat) 0.012 mg/kg/10 days-intermittent: Endocrine: effect on menstrual cycle; Reproductive: Maternal Effects: ovaries, fallopian tubes

TDLo (Unreported-Horse, Donkey) 120 mg/kg/days-intermittent: Peripheral Nerve and Sensation - flaccid paralysis without anesthesia (usually neuromuscular blockage); Lungs, Thorax, or Respiration: respiratory depression; Related to Chronic Data: death

LDLo (Intraperitoneal-Rat) 1 gm/kg

LEAD (continued):

LDLo (Oral-Pigeon) 160 mg/kg

Cytogenetic Analysis (Unreported-Human) 50 µg/m³

Cytogenetic Analysis (Inhalation-Rat) 23 µg/m³/16 weeks

Cytogenetic Analysis (Oral-Monkey) 42 mg/kg/30 weeks

COPPER:

LD₅₀ (Intraperitoneal-Mouse) 3500 µg/kg

TDLo (Oral-Human) 120 µg/kg: Gastrointestinal: nausea or vomiting

TDLo (Oral-Rat) 152 mg/kg female 22 week(s) pre-mating: Reproductive: Effects on Embryo or Fetus: fetotoxicity (except death, e.g., stunted fetus); Specific Developmental Abnormalities: Central Nervous System

TDLo (Oral-Rat) 1520 µg/kg: female 22 week(s) pre-mating: Reproductive: Specific Developmental Abnormalities: musculoskeletal system

TDLo (Oral-Rat) 1210 µg/kg: female 35 week(s) pre-mating: Reproductive: Fertility: pre-implantation mortality (e.g. reduction in number of implants per female; total number of implants per corpora lutea), post-implantation mortality (e.g. dead and/or resorbed implants per total number of implants)

TDLo (Oral-Rabbit) 3 gm/kg/60 days-continuous: Cardiac: other changes; Liver: hepatitis (hepatocellular necrosis), zonal; Related to Chronic Data: death

TDLo (Intravenous-Rabbit) 75 mg/kg/2 days-intermittent: Liver: other changes; Related to Chronic Data: death

TDLo (Intraperitoneal-Rat) 100 mg/kg: Tumorigenic: equivocal tumorigenic agent by RTECS criteria Lungs, Thorax, or Respiration: fibrosis, focal (pneumoconiosis), tumors

LDLo (Subcutaneous-Rabbit) 375 mg/kg: Liver: hepatitis (hepatocellular necrosis), zonal; Liver: other changes; Kidney, Ureter, Bladder: other changes

TDLo (Intrauterine-Rat) 250 µg/kg: female 1 day(s) pre-mating: Reproductive: Maternal Effects: uterus, cervix, vagina; Fertility: female fertility index (e.g. # females pregnant per # sperm positive females; # females pregnant per # females mated)

ZINC:

Standard Draize Test (Skin-Human) 300 µg/3 days-intermittent: Mild

TCLo (Inhalation-Human) 124 mg/m³/50 minutes: Lungs, Thorax, or Respiration: cough, dyspnea Skin and Appendages: sweating

LDLo (Oral-Duck) 388 mg/kg: Autonomic Nervous System: other (direct) para-symphomimetic; Behavioral: ataxia; Blood changes in leukocyte (WBC) count

SUSPECTED CANCER AGENT: The components of this product are listed by agencies tracking the carcinogenic potential of chemical compounds, as follows:

COPPER: EPA-D (Not Classifiable as to Human Carcinogenicity)

LEAD: ACGIH-TLV-A3 (Confirmed Animal Carcinogen with Unknown Relevance to Humans); EPA-B2 (Probable Human Carcinogen-Sufficient Evidence from Animal Studies; Inadequate Evidence or no Data from Epidemiologic Studies); IARC-2B (Possibly Carcinogenic to Humans); MAK-3B (Substances for Which in vitro tests or Animal Studies Have Yielded Evidence of Carcinogenic Effects that is Not Sufficient for Classification of the Substance in One of the Other Categories. Further Studies are Required Before a Final Classification Can Be Made.)

ZINC: EPA-D (Not Classifiable as to Human Carcinogenicity)

The other components of this product are not found on the following lists: FEDERAL, OSHA Z LIST, NTP, IARC and CAL/OSHA and therefore are neither considered to be nor suspected to be cancer-causing agents by these agencies.

11. TOXICOLOGICAL INFORMATION (Continued)

IRRITANCY OF PRODUCT: Fumes or dusts from this product may be irritating to contaminated skin, eyes and respiratory system.

SENSITIZATION TO THE PRODUCT: Repeated contact with the Photoresist may result in skin sensitization reaction (e.g. dermatitis, skin rash) in susceptible individuals. Rare cases of allergic contact dermatitis have been reported in people working with copper dust.

REPRODUCTIVE TOXICITY INFORMATION: Listed below is information concerning the effects of this product and their components on the human reproductive system.

Mutagenicity: Lead is considered mutagenic, based on positive results obtained in tests using somatic and germ cells of animals exposed by relevant routes of exposure. Several studies have reported positive results (chromosomal aberrations) in the white blood cells of workers with low to moderate inorganic Lead exposure. Other studies have shown no increase in chromosomal aberrations in workers with similar exposures.

Embryotoxicity: Inorganic Lead exposure during pregnancy has historically been associated with significant harmful effects on pregnancy, including increased miscarriages and stillbirths. Many of these historical reports involved exposure to very high levels of Lead, as well as other environmental, social and lifestyle characteristics which may have caused or contributed to the observed effects. Lead exposure which has not also caused significant toxicity in the mother has not been clearly associated with teratogenic or embryotoxic effects. Several non-occupational studies indicate that low to moderate exposure to Lead during pregnancy and in early childhood, can produce harmful effects on neuro-behavioral development and IQ, a measure of intelligence. Reduced birth weight and shorter pregnancy may also be related to low level lead exposure. However, this literature is inconsistent and no firm conclusions can be drawn. There is no relevant animal information available for elemental Lead.

Teratogenicity: Components of this product are not reported to cause teratogenic effects in humans. Studies on test animals exposed to relatively high doses of the Copper and Lead components of this product indicate adverse teratogenic effects.

Reproductive Toxicity: Significant harmful effects have been reported in the male reproductive system following low to moderate Lead exposures. Harmful effects on the female reproductive system have not been clearly demonstrated following low to moderate inorganic Lead exposure. Harmful reproductive effects have been reported in both men and women following high level exposures. Studies on test animals exposed to relatively high doses of the Copper component of this product indicate adverse reproductive effects.

*A **mutagen** is a chemical which causes permanent changes to genetic material (DNA) such that the changes will propagate through generational lines. An **embryotoxin** is a chemical which causes damage to a developing embryo (i.e. within the first eight weeks of pregnancy in humans), but the damage does not propagate across generational lines. A **teratogen** is a chemical which causes damage to a developing fetus, but the damage does not propagate across generational lines. A **reproductive toxin** is any substance which interferes in any way with the reproductive process.*

BIOLOGICAL EXPOSURE INDICES: There are Biological Exposure Indices (BEIs) determined for the Lead component of this product, as follows.

| CHEMICAL DETERMINANT | SAMPLING TIME | BEI |
|-----------------------|---------------|--------------|
| LEAD Lead in blood | Not critical | 30 µg/100 mL |

12. ECOLOGICAL INFORMATION

ENVIRONMENTAL STABILITY: The components of this product are metals and resins and are expected to persist in the environment for an extended period of time. The components will react with water and air to form a variety of metal oxide compounds. The following environmental data are available for the components of this product.

COPPER:

Terrestrial Fate: The fate of Copper with respect to its leachability in purely organic spruce forest soils was studied. Appreciable mobilization of Copper occurred only with prolonged leaching at pH 2.8. Therefore, it does not appear likely that acidic rainfall will result in significant mobilization of Copper from organic soils unless the pH of rainfall decreases to < 3. Estimated that approx 50% of Copper in the top few centimeters of these soils was organically bound, approx 18% was in the hydroxy carbonate form, approx 7% was in the adsorbed state, approximately 11% was bound by other anions and 6% was irreversibly adsorbed. Only 3% of the Copper was extractable with water at pH 4.5; hence only 3% was mobile at this pH. In urbanized areas the effects of land clearing, profile disruption and increased acid rainfall may increase copper mobilization in these soils.

LEAD: Insoluble in water. Biological Half-Life for lead in bones of humans is 10 years. Lead was absorbed (by fresh water fished crab) through the gills, and distributed to the haemolymph to hepatopancreas, muscle, and exoskeleton. Lead bioaccumulated over the course of the study showed a high degree of organ specificity.

ZINC: Insoluble in water. Biological Half-Life for humans 162-500 days. The Bioconcentration Factor in edible portions of *Crassostrea virginica*, adult oyster is 16,700 (total zinc).

EFFECT OF MATERIAL ON PLANTS or ANIMALS: The metal components of this product occur naturally in the. Under normal circumstances, this product is not expected to cause adverse effects on plant or animal life.

12. ECOLOGICAL INFORMATION (Continued)

EFFECT OF CHEMICAL ON AQUATIC LIFE: Under normal circumstances, this product is not expected to cause adverse effects on aquatic life. Low chronic aquatic limits indicate a high chronic hazard, it may be concentrated to toxic levels in food chain. The following aquatic toxicity data are available for the components:

COPPER:

LC₅₀ (fathead minnows) = 0.14 ppm in hard water

LC₅₀ (bluegill) = 0.02 ppm in soft water

LC₅₀ (brook trout) = 0.09 ppm in soft water

LEAD:

LC₅₀ (Japanese quail) =, males, females, 14 days old, oral (5-day ad libitum in diet) = 5,000 ppm. At 1,000, 2236, and 5000 ppm onset of toxic symptoms began at 7 days and remitted at 11-12 days

Concentration for fresh and salt water fish, 0.1

Lobster die with 20 days when kept in lead-lined tanks.

LC₅₀ (brook trout) = 0.13 ppm

LC₅₀ (rainbow trout) = 0.43 ppm

ZINC: Zinc poisoning causes inflamed gills in fish. Laboratory studies of Atlantic salmon, rainbow trout, carp, and goldfish have shown avoidance reactions by these fish to zinc in water. The sensitivity of fish to zinc varies with species, age, and the condition of fish, as well as they characteristics of the water. Some acclimatization to the presence of zinc is possible, and survivors from batches of fish exposed to dissolved zinc are less susceptible to additional toxic concentrations than fish not previously exposed. It has also been observed that the effects of zinc poisoning may not become apparent immediately, so that fish removed from zinc-contaminated to zinc-free water (after 4-6 hour exposure) may die within 48 hours.

13. DISPOSAL CONSIDERATIONS

PREPARING WASTES FOR DISPOSAL: Waste disposal must be in accordance with appropriate U.S. Federal, State, and local regulations, or those of Canada and its Provinces. This product, if unaltered by use, may be disposed of by treatment at a permitted facility or as advised by your local solid waste regulatory authority.

EPA WASTE NUMBER: Waste of this product should be analyzed for Toxicity Characteristic Leaching Procedure chemicals, as follows: D008 (Lead), Regulated Level: 5.0 mg/L.

14. TRANSPORTATION INFORMATION

THIS PRODUCT IS NOT HAZARDOUS AS DEFINED BY 49 CFR 172.101 BY THE U.S. DEPARTMENT OF TRANSPORTATION.

PROPER SHIPPING NAME: Not Regulated

HAZARD CLASS NUMBER and DESCRIPTION: Not Applicable

UN IDENTIFICATION NUMBER: Not Applicable

PACKING GROUP: Not Applicable

DOT LABEL(S) REQUIRED: Not Applicable

EMERGENCY RESPONSE GUIDE NUMBER: Not Applicable

NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER, 2000: Not applicable.

MARINE POLLUTANT: No component of this product is designated as a marine pollutant by the Department of Transportation (49 CFR 172.101, Appendix B).

TRANSPORT CANADA TRANSPORTATION OF DANGEROUS GOODS REGULATIONS: This product is not considered as Dangerous Goods.

INTERNATIONAL AIR TRANSPORT ASSOCIATION SHIPPING INFORMATION (IATA): This product is not considered as dangerous goods, per rules of IATA.

INTERNATIONAL MARITIME ORGANIZATION SHIPPING INFORMATION (IMO): This product is not considered as dangerous goods, per rules of the International Maritime Organization.

EUROPEAN AGREEMENT CONCERNING THE INTERNATIONAL CARRIAGE OF DANGEROUS GOODS BY ROAD (ADR): This product is not considered by the Economic Commission for Europe to be dangerous goods.

15. REGULATORY INFORMATION

ADDITIONAL U.S. REGULATIONS:

U.S. SARA REPORTING REQUIREMENTS: The components of this product are subject to the reporting requirements of Sections 302, 304 and 313 of Title III of the Superfund Amendments and Reauthorization Act, as follows:

| CHEMICAL NAME | SARA 302 (40 CFR 355, Appendix A) | SARA 304 (40 CFR Table 302.4) | SARA 313 (40 CFR 372.65) |
|-----------------------|--------------------------------------|----------------------------------|-----------------------------|
| Copper (fume or dust) | No | No | Yes |
| Lead | No | No | Yes |
| Zinc (fume or dust) | No | No | Yes |

U.S. SARA THRESHOLD PLANNING QUANTITY: Not applicable.

U.S. CERCLA REPORTABLE QUANTITY (RQ): Copper = 5000 lb (2270); Lead = 10 lb (4.54 kg); Zinc = 1,000 lb (454 kg); (for metal particles under 100 micrometers in diameter).

U.S. TSCA INVENTORY STATUS: All components of this product are on the TSCA Inventory.

OTHER U.S. FEDERAL REGULATIONS: If necessary for large-scale operations in which excessive airborne dusts are generated, refer to the OSHA Lead Standard (29 CFR 1910.1025).

15. REGULATORY INFORMATION (Continued)

ADDITIONAL U.S. REGULATIONS (continued):

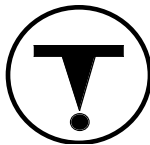
CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65): The Lead component of this product is on the California Proposition 65 Lists. Toluene is present in the photoresist. Toluene is listed on the California Proposition 65 Lists. **WARNING:** This product contains a chemical known to the State of California to cause cancer, birth defects or other reproductive harm.

LABELING: CAUTION! PARTICULATES GENERATED FROM THIS PRODUCT MAY CAUSE SKIN AND EYE IRRITATION. PROLONGED SKIN CONTACT WITH DUSTS MAY CAUSE ALLERGIC SKIN REACTIONS. Do not get particulates on skin or in eyes. Avoid prolonged skin contact. Avoid breathing dust or particulates generated by this product. Wear gloves and goggles, as appropriate. **FIRST-AID:** In case of contact, immediately flush skin or eyes with plenty of water if irritation occurs. If dusts are inhaled, remove to fresh air. If particulates are ingested, do not induce vomiting. Get medical attention if any adverse effect occurs. **IN CASE OF FIRE:** Use water fog, dry chemical, CO₂, or "alcohol" foam. **IN CASE OF SPILL:** Pick-up or sweep-up product. Place in a suitable container and seal. Consult Material Safety Data Sheet for additional information.

ADDITIONAL CANADIAN REGULATIONS:

CANADIAN DSL/NDL INVENTORY STATUS: The components of this product are on the DSL Inventory.

CANADIAN WHMIS CLASSIFICATION and SYMBOLS: **CLASS D2B:** Materials Causing Other Toxic Effects (for Photoresist Layer)



EUROPEAN ECONOMIC COMMUNITY INFORMATION:

EUROPEAN ECONOMIC COMMUNITY INFORMATION FOR PRODUCT:

EC LABELING AND CLASSIFICATION: This product does not meet the definition of any hazard class as defined by the European Economic Community Guidelines.

EUROPEAN COMMUNITY ANNEX II HAZARD SYMBOLS: Not applicable.

EUROPEAN ECONOMIC COMMUNITY INFORMATION FOR CONSTITUENTS: The following information is available for primary constituents in the components of this product.

Copper:

An official classification for this substance has not been published in Commission Directives 93/72/EEC or 94/69EC.

Lead:

An official classification for this substance has not been published in Commission Directives 93/72/EEC or 94/69EC.

Zinc:

NOTE: This constituent is present as part of a solid metal alloy. The information provided below pertains to Zinc in powder form only.

EC CLASSIFICATION: Highly Flammable [F; R10]

EC RISK PHRASES: Flammable. Contact with water liberates extremely flammable gases. [R: 10-15]

EC SAFETY PHRASES: Keep out of the reach of children. (*This safety phrase can be omitted from the label when the substance or preparation is sold for industrial use only*). Keep container tightly closed and dry. In case of fire, use appropriate fire extinguishing media. [S: (2-) *7/8-43]

16. OTHER INFORMATION

PREPARED BY:

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DATE OF PRINTING:

January 13, 2005

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DEFINITIONS OF TERMS

A large number of abbreviations and acronyms appear on a MSDS. Some of these which are commonly used include the following:

CAS #: This is the Chemical Abstract Service Number that uniquely identifies each constituent.

EXPOSURE LIMITS IN AIR:

CEILING LEVEL: The concentration that shall not be exceeded during any part of the working exposure.

LOQ: Limit of Quantitation.

MAK: Federal Republic of Germany Maximum Concentration Values in the workplace.

EXPOSURE LIMITS IN AIR (continued):

NE: Not Established. When no exposure guidelines are established, an entry of NE is made for reference.

NIC: Notice of Intended Charge.

NIOSH CEILING: The exposure that shall not be exceeded during any part of the workday. If instantaneous monitoring is not feasible, the ceiling shall be assumed as a 15-minute TWA exposure (unless otherwise specified) that shall not be exceeded at any time during a workday.

DEFINITIONS OF TERMS (Continued)

EXPOSURE LIMITS IN AIR (continued):

NIOSH RELs: NIOSH's Recommended Exposure Limits.

PEL-Permissible Exposure Limit: OSHA's Permissible Exposure Limits. This exposure value means exactly the same as a TLV, except that it is enforceable by OSHA.

PEL-Permissible Exposure Limit (continued): The OSHA Permissible Exposure Limits are based in the 1989 PELs and the June, 1993 Air Contaminants Rule (Federal Register: 58:35338-35351 and 58:40191). Both the current PELs and the vacated PELs are indicated. The phrase, "Vacated 1989 PEL," is placed next to the PEL that was vacated by Court Order.

SKIN: Used when there is a danger of cutaneous absorption.

STEL-Short Term Exposure Limit: Short Term Exposure Limit, usually a 15-minute time-weighted average (TWA) exposure that should not be exceeded at any time during a workday, even if the 8-hr TWA is within the TLV-TWA, PEL-TWA or REL-TWA.

TLV-Threshold Limit Value: An airborne concentration of a substance that represents conditions under which it is generally believed that nearly all workers may be repeatedly exposed without adverse effect. The duration must be considered, including the 8-hour.

TWA-Time Weighted Average: Time Weighted Average exposure concentration for a conventional 8-hr (TLV, PEL) or up to a 10-hr (REL) workday and a 40-hr workweek. **IDLH-Immediately Dangerous to Life and Health:** This level represents a concentration from which one can escape within 30-minutes without suffering escape-preventing or permanent injury.

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM HAZARD RATINGS: This rating system was developed by the National Paint and Coating Association and has been adopted by industry to identify the degree of chemical hazards.

HEALTH HAZARD:

0 (Minimal Hazard): No significant health risk, irritation of skin or eyes not anticipated. *Skin Irritation:* Essentially non-irritating. PII or Draize = "0". *Eye Irritation:* Essentially non-irritating, or minimal effects which clear in < 24 hours [e.g. mechanical irritation]. Draize = "0". *Oral Toxicity LD₅₀ Rat:* < 5000 mg/kg. *Dermal Toxicity LD₅₀ Rat or Rabbit:* < 2000 mg/kg. *Inhalation Toxicity 4-hrs LC₅₀ Rat:* < 20 mg/L; **1 (Slight Hazard)** Minor reversible injury may occur; slightly or mildly irritating. *Skin Irritation:* Slightly or mildly irritating. *Eye Irritation:* Slightly or mildly irritating. *Oral Toxicity LD₅₀ Rat:* > 500-5000 mg/kg. *Dermal Toxicity LD₅₀ Rat or Rabbit:* > 1000-2000 mg/kg. *Inhalation Toxicity LC₅₀ 4-hrs Rat:* > 2-20 mg/L; **2 (Moderate Hazard):** Temporary or transitory injury may occur. *Skin Irritation:* Moderately irritating; primary irritant; sensitizer. PII or Draize > 0, < 5. *Eye Irritation:* Moderately to severely irritating and/or corrosive; reversible corneal opacity; corneal involvement or irritation clearing in 8-21 days. Draize > 0, ≤ 25. *Oral Toxicity LD₅₀ Rat:* > 50-500 mg/kg. *Dermal Toxicity LD₅₀ Rat or Rabbit:* > 200-1000 mg/kg. *Inhalation Toxicity LC₅₀ 4-hrs Rat:* > 0.5-2 mg/L; **2 (Moderate Hazard):** Temporary or transitory injury may occur. *Skin Irritation:* Moderately irritating; primary irritant; sensitizer. PII or Draize > 0, < 5. *Eye Irritation:* Moderately to severely irritating and/or corrosive; reversible corneal opacity; corneal involvement or irritation clearing in 8-21 days. Draize > 0, ≤ 25. *Oral Toxicity LD₅₀ Rat:* > 50-500 mg/kg. *Dermal Toxicity LD₅₀ Rat or Rabbit:* > 200-1000 mg/kg. *Inhalation Toxicity LC₅₀ 4-hrs Rat:* > 0.5-2 mg/L; **3 (Serious Hazard):** Major injury likely unless prompt action is taken and medical treatment is given; high level of toxicity; corrosive. *Skin Irritation:* Severely irritating and/or corrosive; may destroy dermal tissue, cause skin burns, dermal necrosis. PII or Draize > 5-8 with destruction of tissue. *Eye Irritation:* Corrosive, irreversible destruction of ocular tissue; corneal involvement or irritation persisting for more than 21 days. Draize > 80 with effects irreversible in 21 days. *Oral Toxicity LD₅₀ Rat:* > 1-50 mg/kg. *Dermal Toxicity LD₅₀ Rat or Rabbit:* > 20-200 mg/kg. *Inhalation Toxicity LC₅₀ 4-hrs Rat:* > 0.05-0.5 mg/L; **4 (Severe Hazard)** Life-threatening; major or permanent damage may result from single or repeated exposure. *Skin Irritation:* Not appropriate. Do not rate as a "4", based on skin irritation alone. *Eye Irritation:* Not appropriate. Do not rate as a "4", based on eye irritation alone. *Oral Toxicity LD₅₀ Rat:* ≤ 1 mg/kg. *Dermal Toxicity LD₅₀ Rat or Rabbit:* ≤ 20 mg/kg. *Inhalation Toxicity LC₅₀ 4-hrs Rat:* ≤ 0.05 mg/L.

FLAMMABILITY HAZARD:

0 (Minimal Hazard): Materials that will not burn in air when exposure to a temperature of 815.5 C [1500 F] for a period of 5 minutes.; **1 (Slight Hazard):** Materials that must be pre-heated before ignition can occur. Material require considerable pre-heating, under all ambient temperature conditions before ignition and combustion can occur.

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM HAZARD RATINGS (continued):**FLAMMABILITY HAZARD (continued)**

1 (continued): Including: Materials that will burn in air when exposed to a temperature of 815.5 C (1500 F) for a period of 5 minutes or less; Liquids, solids and semisolids having a flash point at or above 93.3 C [200 F] (e.g. OSHA Class IIIB, or; Most ordinary combustible materials [e.g. wood, paper, etc.]; **2 (Moderate Hazard):** Materials that must be moderately heated or exposed to relatively high ambient temperatures before ignition can occur. Materials in this degree would not, under normal conditions, form hazardous atmospheres in air, but under high ambient temperatures or moderate heating may release vapor in sufficient quantities to produce hazardous atmospheres in air, Including: Liquids having a flash-point at or above 37.8 C [100 F] Solid materials in the form of course dusts that may burn rapidly but that generally do not form explosive atmospheres; Solid materials in a fibrous or shredded form that may burn rapidly and create flash fire hazards (e.g. cotton, sisal, hemp; Solids and semisolids that readily give off flammable vapors.); **3 (Serious Hazard):** Liquids and solids that can be ignited under almost all ambient temperature conditions. Materials in this degree produce hazardous atmospheres with air under almost all ambient temperatures, or, unaffected by ambient temperatures, are readily ignited under almost all conditions, including: Liquids having a flash point below 22.8 C [73 F] and having a boiling point at or above 38 C [100 F] and below 37.8 C [100 F] [e.g. OSHA Class IB and IC]; Materials that on account of their physical form or environmental conditions can form explosive mixtures with air and are readily dispersed in air [e.g., dusts of combustibles, mists or droplets of flammable liquids]; Materials that burn extremely rapidly, usually by reason of self-contained oxygen [e.g. dry nitrocellulose and many organic peroxides]; **4 (Severe Hazard):** Materials that will rapidly or completely vaporize at atmospheric pressure and normal ambient temperature or that are readily dispersed in air, and which will burn readily, including: Flammable gases; Flammable cryogenic materials; Any liquid or gaseous material that is liquid while under pressure and has a flash point below 22.8 C [73 F] and a boiling point below 37.8 C [100 F] [e.g. OSHA Class IA; Material that ignite spontaneously when exposed to air at a temperature of 54.4 C [130 F] or below [e.g. pyrophoric].

PHYSICAL HAZARD:

0 (Water Reactivity): Materials that do not react with water. *Organic Peroxides:* Materials that are normally stable, even under fire conditions and will not react with water. *Explosives:* Substances that are Non-Explosive. *Unstable Compressed Gases:* No Rating. *Pyrophorics:* No Rating. *Oxidizers:* No "0" rating allowed. *Unstable Reactives:* Substances that will not polymerize, decompose, condense or self-react.; **1 (Water Reactivity):** Materials that change or decompose upon exposure to moisture. *Organic Peroxides:* Materials that are normally stable, but can become unstable at high temperatures and pressures. These materials may react with water, but will not release energy. *Explosives:* Division 1.5 & 1.6 substances that are very insensitive explosives or that do not have a mass explosion hazard. *Compressed Gases:* Pressure below OSHA definition. *Pyrophorics:* No Rating. *Oxidizers:* Packaging Group III; *Solids:* any material that in either concentration tested, exhibits a mean burning time less than or equal to the mean burning time of a 3:7 potassium bromate/cellulose mixture and the criteria for Packing Group I and II are not met. *Liquids:* any material that exhibits a mean pressure rise time less than or equal to the pressure rise time of a 1:1 nitric acid (65%)/cellulose mixture and the criteria for Packing Group I and II are not met. *Unstable Reactives:* Substances that may decompose, condense or self-react, but only under conditions of high temperature and/or pressure and have little or no potential to cause significant heat generation or explosive hazard. Substances that readily undergo hazardous polymerization in the absence of inhibitors.; **2 (Water Reactivity):** Materials that may react violently with water. *Organic Peroxides:* Materials that, in themselves, are normally unstable and will readily undergo violent chemical change, but will not detonate. These materials may also react violently with water. *Explosives:* Division 1.4 – Explosive substances where the explosive effect are largely confined to the package and no projection of fragments of appreciable size or range are expected. An external fire must not cause virtually instantaneous explosion of almost the entire contents of the package. *Compressed Gases:* Pressurized and meet OSHA definition but < 514.7 psi absolute at 21.1 C (70 F) [500 psig]. *Pyrophorics:* No Rating. *Oxidizers:* Packaging Group II *Solids:* any material that, either in concentration tested, exhibits a mean burning time of less than or equal to the mean burning time of a 2:3 potassium bromate/cellulose mixture and the criteria for Packing Group I are not met

DEFINITIONS OF TERMS (Continued)

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM HAZARD RATINGS (continued):

PHYSICAL HAZARD (continued):

3 (continued): . **Liquids:** any material that exhibits a mean pressure rise time less than or equal to the pressure rise of a 1:1 aqueous sodium chlorate solution (40%) cellulose mixture and the criteria for Packing Group I are not met. **Unstable Reactives:** Substances that may polymerize, decompose, condense, or self-react at ambient temperature and/or pressure, but have a low potential for significant heat generation or explosion. Substances that readily form peroxides upon exposure to air or oxygen at room temperature); **3 (Water Reactivity):** Materials that may form explosive reactions with water. **Organic Peroxides:** Materials that are capable of detonation or explosive reaction, but require a strong initiating source, or must be heated under confinement before initiation; or materials that react explosively with water. **Explosives:** Division 1.2—Explosive substances that have a fire hazard and either a minor blast hazard or a minor projection hazard or both, but do not have a mass explosion hazard. **Compressed Gases:** Pressure \geq 514.7 psi absolute at 21.1 C (70 F) [500 psig]. **Pyrophorics:** No Rating. **Oxidizers:** Packing Group I **Solids:** any material that, in either concentration tested, exhibits a mean burning time less than the mean burning time of a 3:2 potassium bromate/cellulose mixture. **Liquids:** Any material that spontaneously ignites when mixed with cellulose in a 1:1 ratio, or which exhibits a mean pressure rise time less than the pressure rise time of a 1:1 perchloric acid (50%) cellulose mixture. **Unstable Reactives:** Substances that may polymerize, decompose, condense or self-react at ambient temperature and/or pressure and have a moderate potential to cause significant heat generation or explosion.); **4 (Water Reactivity):** Materials that react explosively with water without requiring heat or confinement. **Organic Peroxides:** Materials that are readily capable of detonation or explosive decomposition at normal temperature and pressures. **Explosives:** Division 1.1 & 1.2-explosive substances that have a mass explosion hazard or have a projection hazard. A mass explosion is one that affects almost the entire load instantaneously. **Compressed Gases:** No Rating. **Pyrophorics:** Add to the definition of Flammability "4". **Oxidizers:** No "4" rating. **Unstable Reactives:** Substances that may polymerize, decompose, condense or self-react at ambient temperature and/or pressure and have a high potential to cause significant heat generation or explosion.)

NATIONAL FIRE PROTECTION ASSOCIATION HAZARD RATINGS:

HEALTH HAZARD: **0** (material that on exposure under fire conditions would offer no hazard beyond that of ordinary combustible materials); **1** (materials that on exposure under fire conditions could cause irritation or minor residual injury); **2** (materials that on intense or continued exposure under fire conditions could cause temporary incapacitation or possible residual injury); **3** (materials that can on short exposure could cause serious temporary or residual injury); **4** (materials that under very short exposure could cause death or major residual injury).

FLAMMABILITY HAZARD: **0** Materials that will not burn under typical fire conditions, including intrinsically noncombustible materials such as concrete, stone, and sand. **1** Materials that must be preheated before ignition can occur. Materials in this degree require considerable preheating, under all ambient temperature conditions, before ignition and combustion can occur. **2** Materials that must be moderately heated or exposed to relatively high ambient temperatures before ignition can occur. Materials in this degree would not under normal conditions form hazardous atmospheres with air, but under high ambient temperatures or under moderate heating could release vapor in sufficient quantities to produce hazardous atmospheres with air. **3** Liquids and solids that can be ignited under almost all ambient temperature conditions. Materials in this degree produce hazardous atmospheres with air under almost all ambient temperatures or, though unaffected by ambient temperatures, are readily ignited under almost all conditions. **4** Materials that will rapidly or completely vaporize at atmospheric pressure and normal ambient temperature or that are readily dispersed in air and will burn readily.

NATIONAL FIRE PROTECTION ASSOCIATION HAZARD RATINGS (continued):

INSTABILITY HAZARD: **0** Materials that in themselves are normally stable, even under fire conditions. **1** Materials that in themselves are normally stable, but that can become unstable at elevated temperatures and pressures. **2** Materials that readily undergo violent chemical change at elevated temperatures and pressures. **3** Materials that in themselves are capable of detonation or explosive decomposition or explosive reaction, but that require a strong initiating source or that must be heated under confinement before initiation. **4** Materials that in themselves are readily capable of detonation or explosive decomposition or explosive reaction at normal temperatures and pressures.

FLAMMABILITY LIMITS IN AIR: Much of the information related to fire and explosion is derived from the National Fire Protection Association (NFPA). **Flash Point** - Minimum temperature at which a liquid gives off sufficient vapors to form an ignitable mixture with air. **Autoignition Temperature:** The minimum temperature required to initiate combustion in air with no other source of ignition. **LEL** - the lowest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source. **UEL** - the highest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source.

TOXICOLOGICAL INFORMATION:

Human and Animal Toxicology: Possible health hazards as derived from human data, animal studies, or from the results of studies with similar compounds are presented. Definitions of some terms used in this section are **LD₅₀** - Lethal Dose (solids & liquids) which kills 50% of the exposed animals; **LC₅₀** - Lethal Concentration (gases) which kills 50% of the exposed animals; **ppm** concentration expressed in parts of material per million parts of air or water; **mg/m³** concentration expressed in weight of substance per volume of air; **mg/kg** quantity of material, by weight, administered to a test subject, based on their body weight in kg. Other measures of toxicity include **TDLo**, the lowest dose to cause a symptom and **TCLo** the lowest concentration to cause a symptom; **TDo**, **LDLo**, and **LDo**, or **TC**, **TCo**, **LCLo**, and **LCo**, the lowest dose (or concentration) to cause lethal or toxic effects. **Cancer Information:** The sources are: **IARC** - the International Agency for Research on Cancer; **NTP** - the National Toxicology Program, **RTECS** - the Registry of Toxic Effects of Chemical Substances, **OSHA** and **CAL/OSHA**. IARC and NTP rate chemicals on a scale of decreasing potential to cause human cancer with rankings from 1 to 4. Subrankings (2A, 2B, etc.) are also used. **Other Information:** **BEI** - ACGIH Biological Exposure Indices, represent the levels of determinants which are most likely to be observed in specimens collected from a healthy worker who has been exposed to chemicals to the same extent as a worker with inhalation exposure to the TLV.

ECOLOGICAL INFORMATION:

EC is the effect concentration in water. **BCF** = Bioconcentration Factor, which is used to determine if a substance will concentrate in lifeforms which consume contaminated plant or animal matter. **TL_m** = median threshold limit; Coefficient of Oil/Water Distribution is represented by **log K_{ow}** or **log K_{oc}** and is used to assess a substance's behavior in the environment.

REGULATORY INFORMATION:

U.S. and CANADA:

This section explains the impact of various laws and regulations on the material. **ACGIH:** American Conference of Governmental Industrial Hygienists, a professional association which establishes exposure limits. **EPA** is the U.S. Environmental Protection Agency. **NIOSH** is the National Institute of Occupational Safety and Health, which is the research arm of the U.S. Occupational Safety and Health Administration (**OSHA**). **WHMIS** is the Canadian Workplace Hazardous Materials Information System. **DOT** and **TC** are the U.S. Department of Transportation and the Transport Canada, respectively. Superfund Amendments and Reauthorization Act (**SARA**); the Canadian Domestic/Non-Domestic Substances List (**DSL/NDL**); the U.S. Toxic Substance Control Act (**TSCA**); Marine Pollutant status according to the **DOT**; the Comprehensive Environmental Response, Compensation, and Liability Act (**CERCLA** or **Superfund**); and various state regulations. This section also includes information on the precautionary warnings which appear on the material's package label. **OSHA** - U.S. Occupational Safety and Health Administration.