

LTS RESEARCH LABORATORIES, INC.  
MATERIAL SAFETY DATA SHEET  
COPPER INDIUM SELENIDE

GENERAL

MANUFACTURER/SUPPLIER: LTS RESEARCH LABORATORIES, INC.

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COMPANY'S CITY: ORANGEBURG  
COMPANY'S STATE: NEW YORK  
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DATE MSDS PREPARED: 02/03/05  
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1. PRODUCT IDENTIFICATION

PRODUCT NAME: COPPER-INDIUM-SELENIUM ALLOY  
CHEMICAL FORMULA:  $\text{CuInSe}$ ,  $\text{CuInSe}_2$   
CHEMICAL FAMILY: METAL FAMILY  
CAS NUMBER: 7440-50-8 / 7440-74-6 / 7782-49-2  
MOLECULAR WEIGHT: 336.28 G/MOL

2. PHYSICAL AND CHEMICAL CHARACTERISTICS

BOILING POINT 760MM HG: N/A  
MELTING POINT: N/A  
VAPOR PRESSURE: N/A  
VAPOR DENSITY: N/A  
DENSITY: 8.64  
% VOLATILES BY WEIGHT: N/A  
SOLUBILITY IN WATER: INSOLUBLE  
APPEARANCE: REDDISH, SILVERY WHITE, ODORLESS

3. HAZARD IDENTIFICATION

HAZARDOUS COMPONENTS %  
COPPER SELENIDE 0-100 %  
OSHA/PEL: 1 MG/M<sup>3</sup> (COPPER)  
ACGIH/TLV: 1 MG/M<sup>3</sup> (COPPER)  
INDIUM 0-100 %  
ACGIH/TLV: 0.1 MG/M<sup>3</sup>

4. FIRE FIGHTING MEASURES

FLASH POINT: N/A  
AUTOIGNITION TEMPERATURE (COPPER SELENIDE) : 700 °C (CLOUD)  
FLAMMABILITY:  
LOWER: N/A  
UPPER: N/A

EXTINGUISHING MEDIA: CARBON DIOXIDE, FOAM OR DRY CHEMICAL. DO NOT USE WATER.

SPECIAL FIRE FIGHTING PROCEDURE: FIREFIGHTERS MUST WEAR FULL FACE SELF-CONTAINED BREATHING APPARATUS WITH FULL PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES. FUMES FROM FIRE ARE HAZARDOUS. ISOLATE RUNOFF TO PREVENT ENVIRONMENTAL POLLUTION.

UNUSUAL FIRE AND EXPLOSION  
HAZARDS:

MAY IGNITE ON CONTACT WITH CHLORINE, CHLORINE TRIFLUORIDE, FLUORINE AND HYDRAZINIUM NITRATE. MAY REACT VIOLENTLY WITH C<sub>2</sub>H<sub>2</sub>, BROMATES, CHLORATES, IODATES, (CL<sub>2</sub>-OF<sub>2</sub>), DIMETHYL SULFOXIDE + TRICHLOROACETIC ACID, ETHYLENE OXIDE, H<sub>2</sub>O<sub>2</sub>, HYDRAZINE MONONITRATE, HYDROZOIC ACID, H<sub>2</sub>S+AIR, PB(N<sub>3</sub>)<sub>2</sub>, K<sub>2</sub>O<sub>2</sub>, NAN<sub>3</sub>, NA<sub>2</sub>O<sub>2</sub>, AND SULFURIC ACID. MAY HAVE POTENTIALLY EXPLOSIVE REACTION WITH ACETYLENIC COMPOUNDS, 3-BROMOPROPYNE, ETHYLENE OXIDE, LEAD AZIDE, AMMONIUM, NITRATE. POWDERS BELOW 50 MICRON SIZE RANGE ARE NOT EASILY IGNITED BY SPARKS AND ARE WEAKLY EXPLOSIVE IN AIR.

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5. REACTIVITY DATA

STABILITY: STABLE  
CONDITION TO AVOID: NONE  
MATERIALS TO AVOID: 1-BROMO-2-PROPYNE; ACETYLENIC COMPOUNDS; 3-BROMOPROPYNE; ETHYLENE OXIDE; LEAD AZIDE; AMMONIUM NITRATE; CHLORINE; CHLORINE TRIFLUORIDE, FLUORINE; HYDRAZINIUM NITRATE; C<sub>2</sub>H<sub>2</sub>; BROMATES, CHLORATES, IODATES; (CL<sub>2</sub>+OF<sub>2</sub>); DIMETHYL SULFOXIDE + TRICHLOROACETIC ACID; H<sub>2</sub>O<sub>2</sub>; HYDRAZINE MONONITRATE; HYDREZOIC ACID; H<sub>2</sub>S+AIR; PB(N<sub>3</sub>)<sub>2</sub>; K<sub>2</sub>O<sub>2</sub>; NAN<sub>3</sub>; NA<sub>2</sub>O<sub>2</sub>; AND SULFURIC ACID. AVOID ACIDS, OXIDIZING AGENTS AND SULFUR.  
HAZARDOUS DECOMP. PRODUCTS: METAL OXIDE FUME, OXIDES OF CU ACID  
HAZARDOUS POLYMERIZATION: NOT OCCUR

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6. HEALTH HAZARD DATA

EFFECTS OF EXPOSURE:  
COPPER COMPOUNDS: IN ANIMALS, INHALATION OF COPPER DUST HAS CAUSED HEMOLYSIS OF THE RED BLOOD CELLS, DEPOSITION OF HEMOFUSCIN IN THE LIVER AND PANCREAS, AND INJURY TO THE LUNG CELLS, INJECTION OF THE DUST HAS CAUSED CIRRHOSIS OF THE LIVER AND PANCREAS, AND A CONDITION CLOSELY RESEMBLING HEMOCHROMATOSIS OR BRONZED DIABETES.  
INDIUM: TO THE BEST OF OUR KNOWLEDGE THE ACUTE AND CHRONIC TOXICITY OF INDIUM IS NOT FULLY KNOWN. EXPOSURE TO INDIUM COMPOUNDS MAY CAUSE PAIN IN THE JOINTS AND BONES, TOOTH DECAY, NERVOUS AND GASTROINTESTINAL DISORDERS, HEART PAIN AND GENERAL DEBILITY. EXPERIMENTS WITH ANIMALS ALSO INDICATE THAT INDIUM MAY CAUSE REDUCED FOOD AND WATER CONSUMPTION WITH WEIGHT LOSS, PULMONARY EDEMA, PNEUMONIA, BLOOD, LIVER AND KIDNEY DAMAGE, LEG PARALYSIS AND DAMAGE TO THE BRAIN, HEART, ADRENALS AND SPLEEN.  
SELENIUM: TO THE BEST OF OUR KNOWLEDGE THE CHEMICAL, PHYSICAL AND TOXICOLOGICAL PROPERTIES OF SELENIUM HAVE NOT BEEN THOROUGHLY INVESTIGATED AND RECORDED. SELENIUM IN SMALL AMOUNTS IS ESSENTIAL FOR NORMAL GROWTH OF SOME ANIMALS. DEFICIENCY OR EXCESS IS ASSOCIATED WITH SERIOUS DISEASE IN LIVESTOCK. ELEMENTAL SELENIUM HAS LOW ACUTE SYSTEMIC TOXICITY, BUT DUST OR FUMES CAN CAUSE SERIOUS IRRITATION OF THE RESPIRATORY TRACT. IT IS A SUSPECTED CARCINOGEN OF THE LIVER AND THYROID. INORGANIC SELENIUM COMPOUNDS CAN CAUSE DERMATITIS. GARLIC ODOR OF BREATH IS A COMMON

SYMPTOM. PALLOR, NERVOUSNESS, DEPRESSION, DIGESTIVE DISTURBANCES HAVE BEEN REPORTED IN CASES OF CHRONIC EXPOSURE. SELENIUM COMPOUNDS ARE COMMON AIR CONTAMINANTS. (SAX, DANGEROUS PROPERTIES OF INDUSTRIAL MATERIALS)  
SELENIUM MAY CAUSE AMYOTROPHIC LATERAL SCLEROSIS, BRONCHIAL IRRITATION, GASTROINTESTINAL DISTRESS, NASOPHARYNGEAL IRRITATION, GARLIC ODOR ON BREATH AND SWEAT, METALLIC TASTE, PALLOR, IRRITABILITY, EXCESSIVE FATIGUE, LOSS OF FINGERNAILS AND HAIR, PULMONARY EDEMA, ANEMIA AND WEIGHT LOSS.

ACUTE EFFECT:

INHALATION:

COPPER COMPOUNDS:

MAY CAUSE A METALLIC TASTE IN THE MOUTH, CONGESTION OF NASAL MUCOUS MEMBRANES, IRRITATION TO THE RESPIRATORY TRACT.

INDIUM:

DUST OR POWDER MAY CAUSE IRRITATION TO THE RESPIRATORY SYSTEM.

SELENIUM:

INHALATION OF SELENIUM DUST OR FUME CAN CAUSE IRRITATION, METALLIC TASTE AND A GARLIC-ODOR TO THE BREATH, BRONCHITIS FEVER..

SKIN:

COPPER COMPOUNDS:

MAY CAUSE IRRITATION.

INDIUM:

DUST OR POWDER MAY BE IRRITATING TO SKIN AND MUCOUS MEMBRANES.

SELENIUM

IRRITANT. REPEATED SKIN CONTACT CAN CAUSE DERMATITIS.

EYES:

COPPER COMPOUNDS:

MAY CAUSE IRRITATION TO THE CONJUNCTIVA.

INDIUM:

DUST OR POWDER MAY IRRITATE EYES

SELENIUM:

IRRITANT.  $SeO_2$  IN THE EYE CAN CAUSE A PINK ALLERGIC-TYPE REACTION.

INGESTION:

COPPER COMPOUNDS:

POISON MAY BE INTRAPERITONEAL ROUTE. MAY CAUSE ACUTE COPPER TOXICITY.

INDIUM:

NO TOXIC EFFECTS KNOWN.

SELENIUM:

MAY CAUSE PALLOR, WEAKNESS, G.I. TRACT DISTURBANCES AND NERVOUSNESS, NAUSEA, VOMITING, SKIN DISCOLORATION, LOSS OF NAILS

CHRONIC EFFECT:

COPPER COMPOUNDS:

MAY CAUSE ULCERATION AND PERFORATION OF THE NASAL SEPTUM AND PHARYNGEAL CONGESTION. MAY CAUSE IRRITATION TO THE GASTROINTESTINAL TRACT AND CHRONIC COPPER TOXICITY. MAY CAUSE DAMAGE TO THE NERVOUS SYSTEM. MAY CAUSE DERMATITIS.

INDIUM:

EXPOSURE TO INDIUM COMPOUNDS MAY CAUSE PAIN IN THE JOINTS AND BONES TOOTH DECAY, NERVOUS AND GASTROINTESTINAL DISORDERS, HEART PAIN AND GENERAL DEBILITY.

ROUTES OF ENTRY:

INHALATION, SKIN, EYES AND INGESTION.

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE:

PRE-EXISTING RESPIRATORY, GASTRIC DISORDERS AND AN INCREASED RISK FOR INDIVIDUALS WITH WILSON'S DISEASE. SUBCUTANEOUS AND INTRAVENOUS INJECTION OF INDIUM IONS ARE HIGHLY TOXIC, CONCENTRATING IN THE LIVER AND KIDNEYS.

TOXICITY DATA:	N/A
TARGET ORGAN:	MAY AFFECT THE RESPIRATORY SYSTEMS, SKIN, LIVER CENTRAL NERVOUS SYSTEMS AND KIDNEYS.
CARCINOGENICITY	
NTP:	NOT LISTED
IARC:	NOT LISTED
ACGIH:	NOT LISTED

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#### 7. EMERGENCY AND FIRST AID PROCEDURE

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EYES:	FLUSH WITH PLENTY OF WATER FOR ATLEAST 15 MINUTES. SEEK MEDICAL ATTENTION IF IRRITATION PERSISTS.
SKIN:	WASH SKIN WITH SOAP & WATER. SEEK MEDICAL ATTENTION IF IRRITATION PERSISTS.
INHALATION:	REMOVE PERSON TO FRESH AIR. IF REQUIRED, PROVIDE ARTIFICIAL RESPIRATION. KEEP PATIENT WARM. SEEK MEDICAL ATTENTION.
INGESTION:	GIVE MILK OR WATER, INDUCE VOMITING. SEEK MEDICAL HELP. NEVER INDUCE VOMITING OR GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON.

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#### 8. SPILL OR LEAK PROCEDURE

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STEPS TO BE TAKEN IF MATERIAL RELEASED OR SPILLED:	SCOOP OR VACUUM UP SPILL USING A HIGH EFFICIENCY PARTICULATE ABSOLUTE (HEPA) AIR FILTER AND PLACE IN A CLOSED CONTAINER FOR PROPER DISPOSAL. TAKE CARE NOT TO RAISE DUST. PROVIDE VENTILATION. SPRINKLE MODERATELY WITH DAMP SAND AND COLLECT FOR DISPOSAL AVOIDING DUST CLOUDS AS MUCH AS POSSIBLE.
RESPIRATORY PROTECTION (SPECIFY TYPE):	PARTICLE MASK.
VENTILATION:	USE LOCAL EXHAUST UNDER DUSTING CONDITIONS TO MAINTAIN CONCENTRATION AT LOW EXPOSURE LEVELS.
PROTECTIVE GLOVES:	RECOMMENDED
EYE/FACE PROTECTION:	SAFETY GLASSES
OTHER PROTECTIVE EQUIPMENT: CONTAMINATION	PROTECTIVE GEAR SUITABLE TO PREVENT
WASTE DISPOSAL METHOD: REGULATIONS .	DISPOSE AS PER LOCAL, STATE AND FEDERAL

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#### 9. HANDLING AND STORAGE CONDITIONS

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HANDLING AND STORAGE:	STORE POWDERS IN TIGHTLY SEALED CONTAINERS IN DRY, COOL PLACE. DO NOT STORE TOGETHER WITH OXIDIZING AND ACIDIC MATERIALS. INDIUM IN SOLID FORM CAN BE HANDLED WITHOUT ANY SPECIAL PRECAUTIONS. BE SURE SOLID MATERIAL IS DRY BEFORE ADDING TO MOLTEN MATERIAL. AVOID MAKING DUST.
OTHER PRECAUTIONS:	IMPLEMENT ENGINEERING AND WORK PRACTICE CONTROLS TO REDUCE AND MAINTAIN CONCENTRATION OF EXPOSURE. USE GOOD HOUSEKEEPING AND SANITATION PRACTICES. DO NOT USE TOBACCO OR FOOD IN WORK AREA. WASH THOROUGHLY BEFORE EATING OR SMOKING. DO NOT BLOW DUST OFF CLOTHING OR SKIN WITH COMPRESSED AIR. MAINTAIN EYEWASH CAPABLE OF SUSTAINED FLUSHING, SAFETY DRENCH SHOWER AND FACILITIES FOR WASHING.

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#### 10. TOXICITY DATA

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L/D50/LC50:	N/A
CARCINOGENICITY	
NTP:	NO
IARC:	NO
ACGIH:	NO
EPIDEMIOLOGY:	N/A
TERATOGENICITY:	N/A
NEUROTOXICITY:	N/A
MUTAGENICITY:	N/A
OTHER STUDY:	NONE

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#### 11. TRANSPORTATION DATA

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NOT REGULATED  
POWDER

PROPER SHIPPING NAME:	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (COPPER INDIUM SELENIDE)
UN NUMBER:	3077
HAZARD CLASS:	9
PACKING GROUP:	III
ADR/RID CLASS:	9
IMDG CLASS:	9
AIR TRAN. ICAO/IATA CLASS:	9

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#### 12. OTHER INFORMATION

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THIS SAFETY DATA SHEET SHOULD BE USED IN CONJUNCTION WITH TECHNICAL SHEETS. IT DOES NOT REPLACE THEM. THE INFORMATION GIVEN IS BASED ON OUR KNOWLEDGE OF THIS PRODUCT, AT THE TIME OF PUBLICATION. IT IS GIVEN IN GOOD FAITH. THE ATTENTION OF THE USER IS DRAWN TO THE POSSIBLE RISKS INCURRED BY USING THE PRODUCT FOR ANY OTHER PURPOSE OTHER THAN THAT FOR WHICH IT WAS INTENDED. THIS DOES NOT IN ANY WAY EXCUSE THE USER FROM KNOWING AND APPLYING ALL THE REGULATIONS GOVERNING HIS ACTIVITY. IT IS THE SOLE RESPONSIBILITY OF THE USER TO TAKE ALL PRECAUTIONS REQUIRED IN HANDLING THE PRODUCT. THE AIM OF THE MANDATORY REGULATIONS MENTIONED IS TO HELP THE USER TO FULFILL HIS OBLIGATIONS REGARDING THE USE OF HAZARDOUS PRODUCTS.