

ALCAN INTERNATIONAL NETWORK

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Alcan Chemical Division

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TIN OXIDE CF

ANALYSIS CERTIFICATE

LOT # PQ-00464/E9

SnO ₂ PD	99.952	%
Pb	0.012	%
Bi	0.005	%
Cu	0.004	%
As	<0.001	%
Fe	0.010	%
Ag	<0.001	%
Sb	0.007	%
Ni	<0.001	%
Co	<0.001	%
Zn	<0.001	%
Cd	<0.001	%
Al	<0.001	%
SiO ₂	<0.001	%
Bulk Density	0.37	g/cm ³

Typical Particle Size Distribution (analyzed in Shimadzu Particle Size Distribution
SA-CP3 equipment)

Diam.	Cum. (%)
30.0	100.00
20.0	98.06
13.90	95.00
12.0	92.14
11.81	90.00
6.0	88.00
3.0	85.98
1.0	85.98
0.5	66.87
0.37	50.00
0.1	35.11



MATERIAL SAFETY DATA SHEET

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

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

1. PRODUCT IDENTIFICATION

TRADE NAME (AS LABELED):

STANNIC OXIDE

SYNONYMS:

Stannous oxide, Tin oxide

SUPPLIER/MANUFACTURER'S NAME:

Alcan International Network U.S.A. Inc.

ADDRESS:

333 Ludlow Street
Stamford, CT 06902

EMERGENCY PHONE:

United States: 800/424-9300

BUSINESS PHONE:

(203) 541-9190

DATE OF PREPARATION:

September 3, 1998

DATE OF REVISION:

April 23, 2005

2. COMPOSITION and INFORMATION ON INGREDIENTS

CHEMICAL NAME	CAS #	% w/w	EXPOSURE LIMITS IN AIR					
			ACGIH-TLV		OSHA-PEL		NIOSH	OTHER
			TWA mg/m ³	STEL mg/m ³	TWA mg/m ³	STEL mg/m ³	IDLH mg/m ³	mg/m ³
Stannic Oxide Exposure limits are for Tin Oxides, as Sn	18282-10-5	> 99	2	NE	2 (Vacated 1989 PEL)	NE	NE	NIOSH REL: TWA = 2
Other components which are each present in less than 1 percent concentration (0.1% concentration for potential carcinogens, reproductive toxins, respiratory tract sensitizers, and mutagens).		Balance	None of the other components contribute significant additional hazards at the concentrations present in this product. All pertinent hazard information has been provided in this document, per the requirements of the Federal Occupational Safety and Health Administration Standard (29 CFR 1910.1200), U.S. State equivalent Standards and Canadian Workplace Hazardous Materials Identification System Standards (CPR 4).					

NE = Not Established

See Section 16 for Definitions of Terms Used

NOTE: ALL WHMIS required information is included 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

EMERGENCY OVERVIEW: This product consists of a white to grayish white powder. Stannic Oxide may mildly irritate exposed tissue. If involved in a fire, Stannic Oxide may decompose to produce irritating vapors and toxic gases, including hazardous tin compounds. Stannic Oxide is not flammable or reactive. Emergency responders must wear proper personal protective equipment and have adequate fire protection for the situation to which they are responding.

SYMPTOMS OF OVEREXPOSURE BY ROUTE OF EXPOSURE: The most significant routes of occupational overexposure are contact with skin and eyes. The symptoms of overexposure to Stannic Oxide, via route of entry, are as follows:

INHALATION: If dusts or particulates of Stannic Oxide are inhaled, irritation of the nose and throat may occur (as well as pulmonary irritation and irritation of the mucous membranes). Symptoms can include coughing and chest discomfort. Acute exposure symptoms are generally alleviated when overexposure ends. Prolonged inhalation of dust or fumes of Stannic Oxide may result in benign pneumoconiosis, producing distinctive changes in the lungs with no apparent disability or complications. Inhalation of freshly formed fumes may cause metal fume fever with symptoms including metallic taste, dry throat, chest pains, and dry cough. Other symptoms which may be delayed for 4-12 hours and may include chills, headache, and fatigue.

CONTACT WITH SKIN or EYES: Contact with the eyes will cause mild irritation, pain, reddening. Skin contact may cause discomfort from physical abrasion, and mild irritation (especially on prolonged exposure). Symptoms are generally alleviated when overexposure ends.

3. HAZARD IDENTIFICATION (Continued)

SKIN ABSORPTION: Skin absorption is not a significant route of exposure for Stannic Oxide.

INGESTION: Ingestion is not anticipated to be a significant route of overexposure to Stannic Oxide. If ingestion of Stannic Oxide occurs, especially in large quantities, gastric distress may result. Symptoms of such overexposure can include nausea, vomiting, and diarrhea.



INJECTION: Accidental injection of Stannic Oxide, via laceration or puncture by a contaminated object, may cause pain and irritation in addition to the wound.

HEALTH EFFECTS OR RISKS FROM EXPOSURE: An Explanation in Lay Terms. In the event of exposure, the following symptoms may be observed:

ACUTE: Stannic Oxide may be mildly irritating to eyes, skin, mucous membranes, and any other exposed tissue. Inhalation of freshly formed fumes may cause metal fume fever.

CHRONIC: Prolonged inhalation of dust or fumes of Stannic Oxide may result in benign pneumoconiosis (called stannosis), producing distinctive changes in the lungs with no apparent disability or complications. This condition develops after 3-5 years of overexposure. See Section 11 (Toxicology Data) for additional information.

TARGET ORGANS: Acute: Skin, eyes, respiratory system. Chronic: Respiratory system.

HAZARDOUS MATERIAL IDENTIFICATION SYSTEM			
HEALTH HAZARD (BLUE)		1	
FLAMMABILITY HAZARD (RED)		0	
PHYSICAL HAZARD (YELLOW)		0	
PROTECTIVE EQUIPMENT			B, C
EYES	RESPIRATORY	HANDS	BODY
	SEE SECTION 8		SEE SECTION 8
For Routine Industrial Use and Handling Applications			

See Section 16 for Definition of Ratings

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. Rescuers should be taken for medical attention, if necessary. Take a copy of label and MSDS to health professional with victim.

SKIN EXPOSURE: If this product contaminates the skin, immediately begin decontamination with running water. Minimum flushing is for 15 minutes. Remove exposed or contaminated clothing, taking care not to contaminate eyes. Victim must seek immediate medical attention if adverse effect occurs after decontamination.

EYE EXPOSURE: If vapors, mists, or sprays of this product 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 if adverse effect occurs after flushing.

INHALATION: If vapors, mists, or sprays of this product are inhaled, remove victim to fresh air. If necessary, use artificial respiration to support vital functions. Remove or cover gross contamination to avoid exposure to rescuers. Seek medical attention if adverse effect occurs after removal to fresh air.

INGESTION: If this product is 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: Existing eye, skin and respiratory disorders may be aggravated by exposure to Stannic Oxide.

RECOMMENDATIONS TO PHYSICIANS: Treat symptoms and reduce overexposure.

5. FIRE-FIGHTING MEASURES

FLASH POINT: Not flammable.

AUTOIGNITION TEMPERATURE: Not flammable.

FLAMMABLE LIMITS (in air by volume, %):

Lower (LEL): Not applicable.

Upper (UEL): Not applicable.

FIRE EXTINGUISHING MATERIALS:

Water Spray: YES

Foam: YES

Halon: YES

Carbon Dioxide: YES

Dry Chemical: YES

Other: Any "ABC" Class.

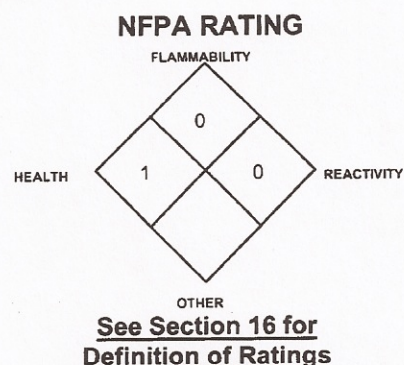
5. FIRE-FIGHTING MEASURES (Continued)

UNUSUAL FIRE AND EXPLOSION HAZARDS: When involved in a fire, this material may decompose and produce mildly irritating vapors of tin compounds.

Explosion Sensitivity to Mechanical Impact: Not sensitive.

Explosion Sensitivity to Static Discharge: Not sensitive.

SPECIAL FIRE-FIGHTING PROCEDURES: Incipient fire responders should wear eye protection. Structural firefighters must wear Self-Contained Breathing Apparatus and full protective equipment. Move fire-exposed containers if it can be done without risk to firefighters. If possible, firefighters should control run-off water to prevent environmental contamination. Rinse contaminated equipment with soapy water before returning such equipment to service.



6. ACCIDENTAL RELEASE MEASURES

SPILL AND LEAK RESPONSE: Uncontrolled releases should be responded to by trained personnel using pre-planned procedures. Proper protective equipment should be used. In case of a spill, clear the affected area and protect people. For small releases, clean-up spilled material wearing gloves, goggles, and suitable body protection. If dusts can be generated, wear a dust mask. The minimum Personal Protective Equipment recommended for response to non-incident releases should be Level C: triple-gloves (rubber and nitrile gloves over latex gloves), chemical resistant suit and boots, hard-hat, and an Air-Purifying Respirator with a high-efficiency particulate filter. Level B, which includes Self-Contained Breathing Apparatus, should be worn if oxygen levels are below 19.5% or are unknown. Sweep-up or vacuum spilled solid (minimizing the generation of airborne particulates). Decontaminate area completely. If necessary, triple rinse contaminated items with water. Place all spill residue in a suitable container. Dispose of in accordance with applicable U.S. Federal, State, or local procedures, or appropriate Canadian standards (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 Stannic Oxide ON YOU or IN YOU. Wash thoroughly after handling Stannic Oxide. Do not eat, drink, smoke, or apply cosmetics while handling Stannic Oxide. Avoid dusts generated from Stannic Oxide. Use in a well-ventilated location. Remove contaminated clothing immediately.

STORAGE AND HANDLING PRACTICES: All employees who handle this material should be trained to handle it safely. Keep container tightly closed when not in use. If Stannic Oxide is transferred into another container, only use portable containers approved for chemical solids. Store containers in a cool, dry location, away from direct sunlight, or sources of intense heat. Material should be stored in secondary containers, as necessary. Store containers away from incompatible chemicals (see Section 10, Stability and Reactivity). Post warning and "NO SMOKING" signs in storage and use areas, as appropriate. Empty containers may contain residual material which is toxic; therefore, empty containers should be handled with care. Never store food, feed, or drinking water in containers which held Stannic Oxide.

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 and appropriate Canadian standards.

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), if applicable. Ensure eyewash/safety shower stations are available near areas where Stannic Oxide is used.

RESPIRATORY PROTECTION: Maintain airborne contaminant concentrations below exposure limits listed in Section 2 (Composition and Information on Ingredients), if applicable. If respiratory protection is needed, use only protection authorized in the U.S. Federal OSHA Standard (29 CFR 1910.134), applicable U.S. State regulations, or the appropriate standards of Canada and its Provinces. Use supplied air respiration protection if oxygen levels are below 19.5% or are unknown. The following NIOSH Guidelines for Inorganic Tin Compounds are provided for additional information.

TIN COMPOUNDS CONCENTRATION

Up to 10 mg/m³:
Up to 20 mg/m³:

RESPIRATORY PROTECTION

Dust and mist respirator.
Dust and mist respirator except single-use and quarter-mask respirator; or supplied Air Respirator (SAR).

8. EXPOSURE CONTROLS - PERSONAL PROTECTION (Continued)

TIN COMPOUNDS (continued)

CONCENTRATION

Up to 50 mg/m³:

Up to 100 mg/m³:

Emergency Or Planned Entry Into

Escape:

Note:

EYE PROTECTION: Splash goggles or safety glasses. A full face shield should be used when handling more than 1 gallon of material. If necessary, refer to U.S. OSHA 29 CFR 1910.133 or appropriate Canadian Standards. If necessary, refer to U.S. OSHA 29 CFR 1910.133 or appropriate Canadian Standards.

HAND PROTECTION: Use rubber, neoprene, or polyvinyl chloride gloves. Use triple gloves for spill response, as stated in Section 6 (Accidental Release Measures) of this MSDS. If necessary, refer to U.S. OSHA 29 CFR 1910.138 or appropriate Standards of Canada.

BODY PROTECTION: Use body protection appropriate for task. An apron, or other impermeable body protection is suggested. Full-body chemical protective clothing is recommended for emergency response procedures. 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.

RESPIRATORY PROTECTION

SAR operated in a continuous-flow mode; or powered air-purifying respirator with dust and mist filter(s).

Full-facepiece respirator with high-efficiency particulate filter(s); or full-facepiece Self-Contained Breathing Apparatus (SCBA); or full-facepiece SAR.

Unknown Concentrations or IDLH Conditions: Positive pressure, full-facepiece SCBA; or positive pressure, full-facepiece SAR with an auxiliary positive pressure SCBA.

Full-facepiece respirator with high-efficiency particulate filter(s); or escape-type SCBA.

The IDLH concentration for tin is 100 mg/m³.

9. PHYSICAL and CHEMICAL PROPERTIES

RELATIVE VAPOR DENSITY (air = 1): Not applicable.

SPECIFIC GRAVITY (water = 1): 6.95

SOLUBILITY IN WATER: Insoluble.

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

PARTITION COEFFICIENT (n-octanol/water): Not established.

ODOR THRESHOLD: Not established.

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

MELTING POINT: 1157°C (2061°F)

BOILING POINT: 1800°C (3272°F)

pH: Not applicable.

APPEARANCE and COLOR: Stannic Oxide consists of a white to grayish-white, odorless powder.

HOW TO DETECT THIS SUBSTANCE (warning properties): The appearance and odor may be distinguishing characteristics.

10. STABILITY and REACTIVITY

STABILITY: Stable.

DECOMPOSITION PRODUCTS: Tin compounds.

MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: Strong acids and strong oxidizers. Stannic oxide is known to be incompatible with these specific compounds: Chlorine trifluoride (violent reaction); hydrogen trisulfide (possible ignition); magnesium (explodes when heated); potassium (reduced with incandescence); and, aluminum (reduced violently and explosively).

HAZARDOUS POLYMERIZATION: Will not occur.

CONDITIONS TO AVOID: Avoid exposure or contact to extreme temperatures, and/or incompatible chemicals.

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

11. TOXICOLOGICAL INFORMATION

TOXICITY DATA: The following toxicology information is currently available for Stannic Oxide.

STANNIC OXIDE:

LD₅₀ (Oral-Rat) > 20 gm/kg

STANNIC OXIDE (continued):

LD₅₀ (Oral-Mouse) > 20 gm/kg

LD₅₀ (Intraperitoneal-Rat) > 6600 mg/kg

STANNIC OXIDE (continued):

LD₅₀ (Intraperitoneal-Mouse) > 6600 mg/kg

SUSPECTED CANCER AGENT: Stannic Oxide is not listed on the following lists: FEDERAL OSHA Z LIST, NTP, IARC, CAL/OSHA and therefore it is not considered to be, or suspected to be, a cancer-causing agent by these agencies.

IRRITANCY OF PRODUCT: Stannic Oxide is a mild eye, skin and respiratory system irritant.

SENSITIZATION TO THE PRODUCT: Stannic Oxide is not reported to be a skin or respiratory sensitizer.

REPRODUCTIVE TOXICITY INFORMATION: Listed below is information concerning the effects of Stannic Oxide on the human reproductive system.

Mutagenicity: Stannic Oxide is not reported to produce mutagenic effects in humans.

Embryotoxicity: Stannic Oxide is not reported to produce embryotoxic effects in humans.

Teratogenicity: Stannic Oxide is not reported to cause teratogenic effects in humans.

Reproductive Toxicity: Stannic Oxide is not reported to cause reproductive effects in humans.

11. TOXICOLOGICAL INFORMATION (Continued)

REPRODUCTIVE TOXICITY INFORMATION (continued): 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.

ACGIH BIOLOGICAL EXPOSURE INDICES: Currently there are no ACGIH Biological Exposure Indices (BEIs) associated with the components of Stannic Oxide.

12. ECOLOGICAL INFORMATION

ALL WORK PRACTICES MUST BE AIMED AT ELIMINATING ENVIRONMENTAL CONTAMINATION.

ENVIRONMENTAL STABILITY: Stannic Oxide is extremely stable and can remain in the environment indefinitely.

EFFECT OF MATERIAL ON PLANTS or ANIMALS: Stannic Oxide may affect terrestrial plant and animal life if large amounts are released. Tin is not accumulated effectively by plants in the form of Tin Oxide. The insolubility of tin in neutral to alkaline pH ranges prevents plant uptake and subsequent food chain contamination.

EFFECT OF CHEMICAL ON AQUATIC LIFE: Stannic Oxide may adversely affect aquatic environments if large quantities are released into water.

13. DISPOSAL CONSIDERATIONS

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

U.S. EPA WASTE NUMBER: Not applicable.

14. TRANSPORTATION INFORMATION

THIS MATERIAL IS NOT HAZARDOUS, PER THE U.S. DEPARTMENT OF TRANSPORTATION (49 CFR 172.101)

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

NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (2000): Not applicable.

MARINE POLLUTANT: This product is not designated by the DOT to be a Marine Pollutant (49 CFR 172.101, Appendix B).

TRANSPORT CANADA TRANSPORTATION OF DANGEROUS GOODS REGULATIONS: This product is not considered as dangerous goods, per regulations of Transport Canada.

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

15. REGULATORY INFORMATION

ADDITIONAL U.S. REGULATIONS:

U.S. SARA REPORTING REQUIREMENTS: Stannic Oxide is not subject to the reporting requirements of Sections 302, 304, and 313 of Title III of the Superfund Amendments and Reauthorization Act.

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

U.S. CERCLA REPORTABLE QUANTITY (RQ): Not applicable.

U.S. TSCA INVENTORY STATUS: The components of Stannic Oxide are listed on the TSCA Inventory.

OTHER U.S. FEDERAL REGULATIONS: Not applicable.

U.S. STATE REGULATORY INFORMATION: Stannic Oxide is not covered under specific State regulations, as denoted below:

Alaska - Designated Toxic and Hazardous Substances: No.

California - Permissible Exposure Limits for Chemical Contaminants: No.

Florida - Substance List: No.

Illinois - Toxic Substance List: No.

Kansas - Section 302/313 List: No.

Massachusetts - Substance List: No.

Michigan - Critical Materials Register: No.

Minnesota - List of Hazardous Substances: No.

Missouri - Employer Information/Toxic Substance List: No.

New Jersey - Right to Know Hazardous Substance List: No.

North Dakota - List of Hazardous Chemicals, Reportable Quantities: No.

Pennsylvania - Hazardous Substance List: No.

Rhode Island - Hazardous Substance List:

Texas - Hazardous Substance List: No.

West Virginia - Hazardous Substance List: No.

Wisconsin - Toxic and Hazardous Substances: No.

15. REGULATORY INFORMATION (Continued)

ADDITIONAL U.S. REGULATIONS (continued):

CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65): Stannic Oxide is not on the California Proposition 65 lists.

ANSI LABELING [Z129.1] (Precautionary Statements): **CAUTION!** MAY CAUSE SKIN AND EYE IRRITATION. MAY BE HARMFUL IF INGESTED OR INHALED. Avoid contact with skin, eyes, or clothing. Wash thoroughly after handling. Avoid breathing dusts or particulates. Work in well-ventilated area. Do not taste or swallow. Wear gloves, goggles, and appropriate body protection. **FIRST-AID**: In case of contact with skin or eyes, flush skin with plenty of water for 15 minutes. If inhaled, remove to fresh air. If swallowed, do not induce vomiting. Get medical attention if adverse effects develop. **IN CASE OF FIRE**: Use water fog, dry chemical, CO₂, or "alcohol" foam. **IN CASE OF SPILL**: Sweep-up or vacuum spilled solid. Consult Material Safety Data Sheet for additional information.

ADDITIONAL CANADIAN REGULATIONS:

CANADIAN DSL/NDL INVENTORY STATUS: Stannic Oxide is listed on the DSL Inventory.

OTHER CANADIAN REGULATIONS: Not applicable.

CANADIAN ENVIRONMENTAL PROTECTION ACT (CEPA) PRIORITIES SUBSTANCES LISTS: Stannic Oxide is not on the CEPA Priorities Substances Lists.

CANADIAN WHMIS SYMBOLS: Not applicable.

16. OTHER INFORMATION

PREPARED BY:

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619/670-0609

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REVISION HISTORY:

April 2002: Up-date of exposure limits; revision of HMIS Ratings to reflect current HMIS III version; general review and up-date throughout MSDS.

information contained herein is based on data considered accurate. However, no warranty is expressed or implied regarding the accuracy of these data or the results to be obtained from the use thereof. AIN U.S.A. assumes no responsibility for injury to the vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, AIN U.S.A. assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in his use of the material.

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 which uniquely identifies each constituent. It is used for computer-related searching.

EXPOSURE LIMITS IN AIR:

ACGIH - American Conference of Governmental Industrial Hygienists, a professional association which establishes exposure limits. **TLV** - Threshold Limit Value - an airborne concentration of a substance which 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 Time Weighted Average (**TWA**), the 15-minute Short Term Exposure Limit, and the instantaneous Ceiling Level (**C**). Skin absorption effects must also be considered.

OSHA - U.S. Occupational Safety and Health Administration.

PEL - Permissible Exposure Limit - This exposure value means exactly the same as a TLV, except that it is enforceable by OSHA. 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 which was vacated by Court Order. **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. **The DFG - MAK** is the Republic of Germany's Maximum Exposure Level, similar to the U.S. PEL. **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**). NIOSH issues exposure guidelines called Recommended Exposure Levels (**RELs**). When no exposure guidelines are established, an entry of **NE** is made for reference.

HAZARD RATINGS:

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM: 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 acute or chronic exposure hazard); 1 (slight acute or chronic exposure hazard); 2 (moderate acute or significant chronic exposure hazard); 3 (severe acute exposure hazard; onetime overexposure can result in permanent injury and may be fatal); 4 (extreme acute exposure hazard; onetime overexposure can be fatal). **Flammability Hazard:** 0 (minimal hazard); 1 (materials that require substantial pre-heating before burning); 2 (combustible liquid or solids; liquids with a flash point of 38-93°C [100-200°F]); 3 (Class IB and IC flammable liquids with flash points below 38°C [100°F]); 4 (Class IA flammable liquids with flash points below 23°C [73°F] and boiling points below 38°C [100°F]). **Reactivity Hazard:** 0 (normally stable); 1 (material that can become unstable at elevated temperatures or which can react slightly with water); 2 (materials that are unstable but do not detonate or which can react violently with water); 3 (materials that can detonate when initiated or which can react explosively with water); 4 (materials that can detonate at normal temperatures or pressures). **PPE Rating B:** Hand and eye protection is required for routine chemical use. **PPE Rating C:** Hand, eye, and body protection is required for routine chemical use.

NATIONAL FIRE PROTECTION ASSOCIATION: **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 causes death or major residual injury). **Flammability Hazard and Reactivity Hazard:** Refer to definitions for "Hazardous Materials Identification System".

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; **TD₀**, **LDLo**, and **LD₀₁**, or **TC**, **TC₀**, **LCLo**, and **LC₀₁**, 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:

This section explains the impact of various laws and regulations on the material. **U.S.:** **EPA** is the U.S. Environmental Protection Agency. **DOT** is the U.S. Department of Transportation. **SARA** is the Superfund Amendments and Reauthorization Act. **TSCA** is the U.S. Toxic Substance Control Act. **CERCLA** (or **Superfund**) refers to the Comprehensive Environmental Response, Compensation, and Liability Act. Labeling is per the American National Standards Institute (**ANSI Z129.1**). **CANADA:** **CEPA** is the Canadian Environmental Protection Act. **WHMIS** is the Canadian Workplace Hazardous Materials Information System. **TC** is Transport Canada. **DSL/NDSL** are the Canadian Domestic/Non-Domestic Substances Lists.