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

Northstar Chemical, Inc.

SULFURIC ACID (1 – 50%)
SDS No: 30350 Revision Date: 6-19-2015

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

TRADE NAME (AS LABELED): NORTHSTAR SULFURIC ACID (1 – 50%)
CHEMICAL NAME/CLASS: Sulfuric Acid Solution
PRODUCT USE: Neutralization, battery acid
SUPPLIER/MANUFACTURER’S NAME: Northstar Chemical, Inc.
ADDRESS: Corporate Office
14200 S.W. Tualatin-Sherwood Rd.
Sherwood, OR 97140
BUSINESS PHONE: 888-793-9476
EMERGENCY PHONE: CHEMTREC: 800-424-9300
DATE OF PREPARATION: June 19, 2015

Si usted no entiende las Hojas de Informacion de Seguridad sobre Materials, busque a alguien para que se la explique a usted en detalle.
(If you do not understand the Safety Data Sheet, find someone to explain it to you in detail.)

2. HAZARD IDENTIFICATION

Physical hazards
May be corrosive to metals Category 1
Reacts violently with water

Health hazards
Skin corrosion/irritation Category 1
Serious eye damage/irritation Category 1
Acute toxicity, Inhalation Category 2
Specific target organ toxicity, single exposure Category 3 respiratory tract irritation
Chronic Exposure Category 2

Environmental hazards
Hazardous to the aquatic environment, Category 3
acute short term hazard
Hazardous to the aquatic environment, Category 2
long –term hazard

THIS MATERIAL IS HAZARDOUS AS DEFINED BY 49 CFR 172.101 BY THE U.S. DEPARTMENT OF TRANSPORTATION.
LABEL ELEMENTS:

Signal Word: DANGER!

Hazard Statement: Causes severe skin burns and serious eye damage. May cause respiratory irritation. May cause damage to teeth through prolonged and repeated exposure to sulfuric acid mists. Fatal if inhaled. May be corrosive to metals. Harmful to aquatic life.

Precautionary Statement:

Prevention: Wear protective gloves, protective clothing, and eye and face protection. Wash exposed skin thoroughly after handling. Store and use only in a well-ventilated area. Keep containers tightly closed. In case of inadequate ventilation, wear respiratory protection. Do not breathe mist. Avoid release to the environment. Absorb spillage.

Response: IF IN EYES: Rinse continuously with water for several minutes. Continue rinsing and immediately call a poison centre/doctor. Specific treatment is urgent. IF ON SKIN: Take off immediately all contaminated clothing. Rinse skin with water or shower. For large area burns, immediately call a poison centre/doctor. Wash contaminated clothing before reuse. IF INHALED: Remove person to fresh air and keep comfortable for breathing. IF SWALLOWED: Rinse mouth. DO NOT induce vomiting. Get medical attention if you feel unwell. Store in corrosion resistant container with a resistant inner liner.

Storage: Store in a well-ventilated place and away from water. Keep container tightly closed.

Disposal: Dispose of contents/container in accordance with local/regional/national/international regulations.

Emergency Overview: A strong mineral acid present as a colorless and odorless oily liquid when pure but may appear yellow to dark brown when impure. Extremely corrosive to all body tissues, causing rapid tissue destruction and serious chemical burns. Skin or eye contact requires immediate first aid. Can decompose at high temperatures, forming toxic gases such as Sulphur oxides. Non-flammable but reacts violently with water, generating large amounts of heat with potential for spattering of the acid. Can react with combustible materials to generate heat and ignition. Reacts with most metals, particularly when diluted with water, to form flammable hydrogen gas which may create an explosion hazard. It is highly toxic to aquatic organisms and plant life.

Potential Health Effects: Sulfuric acid is not very volatile and workplace exposures are therefore primarily due to accidental splashes or to processes or actions that generate an acid mist. It is extremely corrosive to all body tissues, causing rapid tissue destruction and serious chemical burns on contact with the skin or eyes. Skin or eye contact requires immediate first aid. Inhalation of sulfuric acid mist or fumes may produce irritation of the nose, throat and respiratory tract. High levels of acid mist are also irritating to the skin and eyes. Chronic inhalation of acid mist may cause pitting and erosion of tooth enamel. Sulfuric acid, per se, is not listed as a carcinogen by OSHA, NTP, IARC, or the ACGIH. However, IARC, the ACGIH and the NTP have concluded there is sufficient evidence that occupational exposure to strong inorganic acid mists containing sulfuric acid is carcinogenic or potentially carcinogenic to humans (see Toxicological Information, Section 11).

Potential Environmental Effects: Sulfuric acid is highly toxic to aquatic organisms and terrestrial plant life; however, it does not bio accumulate or bio concentrate through the food chain (see Ecological Information, Section 12).

3. COMPOSITION / INFORMATION ON INGREDIENTS

<table>
<thead>
<tr>
<th>Components</th>
<th>CAS Number</th>
<th>Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>7732-18-5</td>
<td>50-99 %</td>
</tr>
<tr>
<td>Sulfuric acid</td>
<td>7664-93-9</td>
<td>1-50 %</td>
</tr>
</tbody>
</table>
4. FIRST-AID MEASURES

Eye Contact: Symptoms: Burning, pain, blurring. Avoid direct contact. Wear chemical protective gloves, if necessary. Quickly and gently blot excess acid off face. Immediately flush the contaminated eye(s) with lukewarm, gently flowing water, for at least 30 minutes, while holding the eyelid(s) open. If a contact lens is present, DO NOT delay irrigation or attempt to remove the lens. Neutral saline solution may be used as soon as it is available. **DO NOT INTERRUPT FLUSHING.** If necessary, continue flushing during transport to emergency care facility. Take care not to rinse contaminated water into the unaffected eye or onto the face. Quickly transport victim to an emergency care facility.

Skin Contact: Symptoms: Burning, pain, ulceration. Avoid direct contact. Wear chemical protective clothing if necessary. As quickly as possible, remove contaminated clothing, shoes and leather goods (e.g., watchbands, belts), under shower if possible. Flush with lukewarm, gently flowing water for at least 30 minutes. **DO NOT INTERRUPT FLUSHING.** For acid splashes over large areas of the body transport quickly to an emergency care facility. If necessary, and if it can be done safely, continue flushing during transport to emergency care facility. Completely decontaminate clothing, shoes and leather goods before reuse or discard.

Inhalation: Symptoms: Nose throat and lung irritation, coughing, wheezing. Take precautions to ensure your own safety before attempting rescue (e.g., wear appropriate protective equipment, use the buddy system). Remove source of exposure or move person from exposure area to fresh air and keep comfortable for breathing. Call a Poison Centre/doctor or seek medical attention if you feel unwell.

Ingestion: Symptoms: Burning pain in mouth and throat. Have victim rinse mouth thoroughly with water. **DO NOT INDUCE VOMITING.** If vomiting occurs naturally, have person lie on their side in the recovery position. Have victim rinse mouth with water again. Quickly transport victim to an emergency care facility and bring a copy of this SDS.

General Information: 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 SDS to health professional with victim.

Note to Physicians: Treat symptomatically and provide supportive therapy as indicated. Do NOT give acidic antidotes such as juice, soft drink, vinegar, etc. This product contains materials that may cause severe pneumonitis if aspirated. If ingestion has occurred less than 2 hours earlier, carry out careful gastric lavage; use endotracheal cuff if available, to prevent aspiration. Observe patient for respiratory difficulty from aspiration pneumonitis. Give artificial resuscitation and appropriate chemotherapy if respiration is depressed. Following exposure the patient should be kept under medical review for at least 48 hours as delayed pneumonitis may occur. Pulmonary edema is likely and may be delayed. Steroid therapy, if given early, may be effective in preventing or alleviating edema.

5. FIRE-FIGHTING MEASURES

Fire and Explosion Hazards: Sulfuric acid is not flammable or combustible. However, fires may result from the heat generated by contact of concentrated sulfuric acid with combustible materials. Sulfuric acid reacts with most metals, especially when diluted with water, to produce hydrogen gas, which can accumulate to explosive concentrations inside confined spaces. It reacts violently with water and organic materials evolving a considerable amount of heat and is very hazardous when in contact with carbides, cyanides, and sulfides.

Extinguishing Media: Use dry chemical or carbon dioxide extinguishers to extinguish small fires in surrounding combustible materials. Use water spray or fog to cool fire-exposed containers and to knock down large fires. Use water streams only if absolutely necessary and **DO NOT USE WATER DIRECTLY ON ACID** as a violent reaction may occur resulting in spattering of the acid. Do not release runoff from fire control methods to sewers or waterways.

Fire Fighting: Fire fighters must be fully trained and wear full protective clothing including an approved, self-contained breathing apparatus which supplies a positive air pressure within a full face-piece mask. For fires close to a spill or where vapors are present, use acid-resistant personal protective equipment.
6. ACCIDENTAL RELEASE MEASURES

Procedures for Cleanup: Control source of release if possible to do so safely. Contain spill, isolate hazard area, and deny entry to unauthorized personnel. Prevent from entering sewage or drainage systems and bodies of water. Dike area around spill and pump uncontaminated acid back to process if possible. Neutralize spilled material with alkali such as sodium carbonate or sodium bicarbonate, soda ash, lime or limestone granules. If neutralized with lime rock or soda ash, good ventilation is required during neutralization because of the release of carbon dioxide gas. Allow to stand for 1-2 hours to complete neutralization, then absorb any liquid in solid absorbent such as vermiculite or clay absorbents. Place spilled material in suitable (corrosion resistant) labeled containers for final disposal. Treat or dispose of waste spilled material and/or contaminated absorbent material in accordance with all local, regional and national regulations.

Personal Precautions: Acid resistant protective clothing and gloves. Sleeves and pant legs should be worn outside, not tucked into gloves and rubber boots. Use close-fitting safety goggles or a combination of safety goggles and a face shield where splashing is a possibility. Respiratory protection equipment should be worn where exposure to hazardous levels of mist or fume is possible.

Environmental Precautions: This product has the potential to pose ecological risks to organisms in both aquatic and terrestrial environments. Discharge of the product to soil and water should be prevented. Prevent spillage from entering sewers or natural watercourses.

7. HANDLING and STORAGE

Personal precautions, protective equipment and emergency procedures: Wear appropriate personal protective equipment. Do not get in eyes, on skin or on clothing. Wash hands after handling this product. Do not eat or drink while handling this material. Remove contaminated clothing immediately. Discard contaminated clothing items, or launder before re-use. Inform anyone handling such contaminated laundry of the hazards associated with this product. Use ventilation and other engineering controls to minimize potential exposure to this product. All employees who handle this material should be trained to handle it safely. Avoid breathing mists or sprays generated by this product. Use in a well-ventilated location.

For Non-Bulk Containers: Open containers slowly, on a stable surface. Containers of this product must be properly labeled. Store containers in a cool, dry location, away from direct sunlight, sources of intense heat, or where freezing is possible. Material should be stored in secondary containers, or in a diked area, as appropriate. Store containers away from incompatible chemicals. Keep container tightly closed when not in use. Wash thoroughly after using this material. Storage areas should be made of fire-resistant materials. If appropriate, post warning signs in storage and use areas. Inspect all incoming containers before storage, to ensure containers are properly labeled and not damaged. Empty containers may contain residual liquid, therefore, empty containers should be handled with care.

Bulk Containers: All tanks and pipelines which contain this material must be labeled. Perform routine maintenance on tanks or pipelines which contain this product. Report all leaks immediately to the proper personnel.

Tank Car Shipments: Tank cars carrying this product should be loaded and unloaded in strict accordance with tank-car manufacturer’s recommendation and all established on-site safety procedures. Appropriate personal protective equipment must be used (see Section 8, Engineering Controls and Personal Protective Equipment.). All loading and unloading equipment must be inspected, prior to each use. Loading and unloading operations must be attended, at all times. Tank cars must be level, brakes must be set or wheels must be locked or blocked prior to loading or unloading. Tank car (for loading) or storage tank (for unloading) must be verified to be correct for receiving this product and be properly prepared, prior to starting the transfer operations. Hoses must be verified to be clean and free of incompatible chemicals, prior to connection to the tank car or vessel. Valves and hoses must be verified to be in the correct positions, before starting transfer operations. A sample (if required) must be taken and verified (if required) prior to starting transfer operations. All lines must be blown-down and purged before disconnecting them from the tank car or vessel.

Protective Practices During Maintenance of Contaminated Equipment: Follow practices indicated in Section 6 (Accidental Release Measures). Make certain application equipment is locked and tagged-out safely. Always use this product in areas where adequate ventilation is provided. Decontaminate equipment before maintenance begins by a triple-rinse with water followed, if necessary, by using sodium bicarbonate and an additional rinse. Collect all rinsates and dispose of according to applicable Federal, State, or local procedures.
8. EXPOSURE CONTROLS - PERSONAL PROTECTION

Occupational Exposure Guidelines:

<table>
<thead>
<tr>
<th>Component</th>
<th>ACGIH TLV</th>
<th>OSHA PEL</th>
<th>NIOSH REL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulfuric Acid</td>
<td>0.2 mg/m³ Thoracic fraction</td>
<td>1 mg/m³</td>
<td>1 mg/m³</td>
</tr>
</tbody>
</table>

NOTE: OEGs for individual jurisdictions may differ from those given above. Check with local authorities for the applicable OEGs in your jurisdiction.

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

NOTE: The selection of the necessary level of engineering controls and personal protective equipment will vary depending upon the conditions of use and the potential for exposure. The following are therefore only general guidelines that may not fit all circumstances. Control measures to consider include:

**Engineering Controls:**

If required use a corrosion-resistant ventilation system separate from other exhaust ventilation systems to ensure that there is no potential for overexposure to sprays, or mists of this product and that exposures are below those in section 2 (Composition and Information on Ingredients). Ensure eyewash/safety shower stations are available near areas where this product is used.

**Individual protection measures, such as personal protective equipment**

**Eye/Face Protection:**

Splash goggles or safety glasses. Face-shields are recommended when the operation can generate splashes, sprays or mists.

**Skin Protection:**

Wear appropriate gloves for routine industrial use. Use appropriate gloves for spill response, as stated in Section 6 of this SDS (Accidental Release Measures). Use body protection appropriate for task. Cover-all, rubber aprons, or chemical protective clothing made from natural rubber are generally acceptable, depending upon the task.

**Respiratory Protection:**

Maintain airborne contaminant concentrations below exposure limits listed in Section 2 (Composition and Information on Ingredients). If respiratory protection is needed, use only protection authorized in 29 CFR 1910.134, or applicable State regulations. If adequate ventilation is not available or if there is potential for airborne exposure above the exposure limits (listed in Section 2) a respirator may be worn up to respirator exposure limitations, check with respirator equipment manufactures recommendations/limitations. For a higher level of protection use positive pressure supplied air respiration protection or Self Contained Breathing Apparatus or if oxygen levels are below 19.5% or are unknown.

**General Hygiene Considerations:**

Always practice good personal hygiene. Refrain from eating, drinking, or smoking in work areas. Thoroughly wash hands before eating, drinking, or smoking.

9. PHYSICAL and CHEMICAL PROPERTIES

**Appearance and Color:**

clear, oily and viscous

**Odor:**
pungent

**Odor threshold:**
not available

**pH:**
< 1

**Flash point:**
not flammable

**Vapor density (air = 1):**
3.4

**Solubility in water:**
completely soluble.

**Viscosity:**
not available

<table>
<thead>
<tr>
<th>Boiling Point</th>
<th>Sulfuric Acid, weight %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10%</td>
</tr>
<tr>
<td>102°C (215°F)</td>
<td>104°C (219°F)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Freezing Point</th>
<th>10%</th>
<th>20%</th>
<th>30%</th>
<th>36%</th>
<th>50%</th>
</tr>
</thead>
<tbody>
<tr>
<td>-4°C (24°F)</td>
<td>-13°C (8°F)</td>
<td>-33°C (-28°F)</td>
<td>-64°C (-83°F)</td>
<td>-2°C (-35°F)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vapor Pressure, psia @ 60°F</th>
<th>0.242</th>
<th>0.226</th>
<th>0.191</th>
<th>0.151</th>
<th>0.089</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific Gravity @ 15.6°C</td>
<td>1.066</td>
<td>1.142</td>
<td>1.219</td>
<td>1.272</td>
<td>1.394</td>
</tr>
<tr>
<td>Density, lbs/gal @ 15.6°C</td>
<td>8.89</td>
<td>9.52</td>
<td>10.17</td>
<td>10.61</td>
<td>11.63</td>
</tr>
</tbody>
</table>
10. STABILITY and REACTIVITY

Reactivity: Reacts violently with water, organic substances and alkali solutions to generate heat and hazardous mists.

Chemical stability: Stable at room temperature

Possibility of hazardous reactions: This product reacts with bases, reducing agents, alkali metals, carbides, cyanides, sulfides and metal powders.

Conditions to avoid: Avoid exposure or contact to extreme temperatures, ignition sources and incompatible chemicals.

Incompatible materials: This product reacts with bases, reducing agents, alkali metals, carbides, cyanides, sulfides and metal powders. Do not mix this product with sodium hypochlorite, sodium bisulfite, chlorine sanitizers or chlorinated cleaners – a deadly gas can be formed. Corrosive to metals and releases hydrogen gas.

Hazardous decomposition products: Decomposition possible if heated and in contact with sources of ignition. Thermal decomposition products of this solution can include carbon monoxide, carbon dioxide and oxides of sulfur.

11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure

Ingestion: Harmful if swallowed. May cause permanent damage to the digestive tract. Causes gastrointestinal tract burns. May cause perforation of the stomach, bleeding, edema of the glottis, necrosis and scarring, and sudden circulatory collapse (similar to acute inhalation). It may also cause systemic toxicity with acidosis.

Inhalation: May cause severe irritation of the respiratory tract and mucous membranes with sore throat, coughing, shortness of breath, and delayed lung edema. Causes chemical burns to the respiratory tract. Inhalation may be fatal as a result of spasm, inflammation, edema of the larynx and brochi, chemical pneumonitis, and pulmonary edema. May also affect teeth (erosion of enamel).

Skin Contact: Causes severe skin irritation and burns.

Eye Contact: Causes severe eye irritation and burns. May cause irreversible eye damage.

Toxicity Data: $LD_{50}$ (oral, rat) = 2140 mg/kg $LC_{50}$ (inhalation, rat) = 510 mg/m$^3$ for 2 hrs

Information on toxicological effects

Carcinogenicity: The IARC has concluded that occupational exposure to strong inorganic acid mists containing sulfuric acid is carcinogenic to man, causing cancer of the larynx. Although no direct link has been established between exposure to sulfuric acid and cancer in man, exposure to any mist or aerosol during the use of this product should be avoided.

Sensitization: No component of this product is known to be a sensitizer.

Reproductive Toxicity: Slightly embryo toxic in rabbits (a minor, rare skeletal variation). The animals were 3 exposed to 5 and 20 mg/m for 7 hrs/day throughout pregnancy. Slight maternal toxicity was present at the highest dose in both species.
Mutagenicity: Cytogenic analysis (hamster) ovaries 4 mmol/L
Embryotoxicity: This product is not reported to produce embryo toxic effects in humans.
Teratogenicity: This product is not reported to cause teratogenic effects in humans.

Chronic Potential Health Effects:
Inhalation: Prolonged or repeated inhalation may affect behavior (muscle contraction or spasticity), urinary system (kidney damage), and cardiovascular system, heart and respiratory system/lungs (pulmonary edema, lung damage), teeth (dental discoloration, erosion).
Skin: Prolonged or repeated skin contact may cause dermatitis (skin allergy).

12. ECOLOGICAL INFORMATION
Eco toxicity: Sulfuric acid is highly toxic to aquatic organisms and terrestrial plant life; however, it does not bio accumulate or bio concentrate through the food chain. This product is harmful to aquatic life in very low concentrations. May be dangerous if the product enters water intake. Fish toxicity: 2.8 ug/L 96 hrs LC50 rainbow trout.
The product must be transported and stored properly to prevent run off water from a rain event, which can adversely affect flora and fauna.

13. DISPOSAL CONSIDERATIONS
Disposal Instructions: Waste disposal must be in accordance with appropriate Federal, State, and local regulations. This product, if unaltered by use, may be disposed of by treatment at a permitted facility or as advised by your local hazardous waste regulatory authority.
Do not wash down drain or allow to reach natural watercourses. Dispose of neutralized waste consistent with regulatory requirements. If neutralized with lime rock or soda ash, good ventilation is required during neutralization because of the release of carbon dioxide gas.
EPA Waste Code: D002 (Characteristic, Corrosivity), applicable to wastes consisting only of this solution.

14. TRANSPORTATION INFORMATION
This material is hazardous as defined by 49 CFR 172.101 by the U.S. Department of Transportation.

PROPER SHIPPING U.S. DOT Sulfuric Acid, with not more than 51% acid
TRANSPORT CANADA CLASSIFICATION Class 8 Packing Group II
U.S. DOT CLASSIFICATION Class 8 Packing Group II (RQ) – 1,000 lbs.
PRODUCT IDENTIFICATION NUMBER UN2796
MARINE POLLUTANT No
IMO CLASSIFICATION Class 8

Marine Pollutant: This product does not contain any components that are designated by the Department of Transportation to be Marine Pollutants. (49 CFR 172.101, Appendix B).
Canada Transportation of Dangerous Goods Regulations: This material is considered dangerous goods. Use the above information for the preparation of Canadian Shipments.
15. REGULATORY INFORMATION

This product is considered a Hazardous Chemical by the OSHA Hazard Communication Standard, 29 CFR 1910.1200

SARA Reporting Requirements: The components of this product subject to the reporting requirements of Section 302, 304 and 313 of Title III of the Superfund Amendments and Reauthorization Act are as follows.

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>SARA 302</th>
<th>SARA 304</th>
<th>SARA 311/312</th>
<th>SARA 313</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulfuric Acid</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**SARA 313:** Sulfuric Acid (acid aerosols including mists, vapors, gas, fog, and other airborne forms of any particle size): De minimis % Limit = 1.0

**SARA Threshold Planning Quantity:** Sulfuric Acid = 1000 lbs.

**TSCA Inventory Status:** The components of this product are listed on the TSCA Inventory.

**CERCLA Reportable Quantity (RQ):** Sulfuric Acid = 1000 lbs.

**Other Federal Regulations:** Not applicable.

**State Regulatory Information:** Components of this product are covered under specific State regulations, as denoted below:

- **New Jersey** - Special Health Hazard Substance List and Environmental Hazardous Substance
- **Minnesota, Florida, Rhode Island** - Hazardous Substance
- **California** - Director's List of Hazardous Substances
- **Massachusetts** - Extraordinarily Hazardous Substance List

California Proposition 65: This material may contain detectable quantities of the following chemicals, known to the State of California to cause cancer, birth defects or other reproductive harm, and which may be subject to the warning requirements of California Proposition 65: Strong Inorganic Acid Mists containing Sulfuric Acid (type of toxicity = cancer)

**NFPA 704 Rating:**

0 (Minimal) 1 (Slight) 2 (Moderate) 3 (Serious) 4 (Severe)
A large number of abbreviations and acronyms appear on a Safety Data Sheet. Some of these which are commonly used include the following:

**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. Skin adsorption 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:**

- **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); onet ime over-exposure can result in permanent injury and may be fatal); 4 (extreme acute exposure hazard); onetime over-exposure can be fatal).
- **Flammability Hazard:** 0 (minimal hazard); 1 (materials that require substantial pre-heating before burning); 2 (combustible liquid or solid; 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).

**NATIONAL FI R E 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 could cause death or major residual injury).
- **Flammability Hazard and Reactivity Hazard:** Refer to definitions for “Hazardous Materials Identification System”.

**DEFINITIONS OF TERMS**

**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 sources 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.

**T OXICOLOGICAL INFORMATION:**

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: **LD₉₀:** Lethal Dose (solids & liquids) which kills 50% of the exposed animals; **LC₉₀:** 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. Data from several sources are used to evaluate the cancer-causing potential of the material. The sources are: **IARC:** the International Agency for Research on Cancer; **NTP:** the National Toxicology Program; **RETCES:** 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 measures of toxicity include **TDLₙ:** the lowest dose to cause a symptom and **TCLo:** the lowest concentration to cause a symptom; **TDₕ:** the lowest dose or concentration to cause death. **BEI:** 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.

**REGULATORY INFORMATION:**

This section explains the impact of various laws and regulations on the material. **EPA** is the U.S. Environmental Protection Agency. **WHMIS:** The Canadian Workplace Hazardous Materials Information System. **DOT** and **TC** are the U.S. Department of Transportation and the Transport Canada, respectively. Other acronyms used are: **Superfund Amendments and Reauthorization Act (SARA);** the Toxic Substance Control Act (TSCA); Marine Pollutant status according to the DOT; California’s Safe Drinking Water Act; 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 materials package label.