SUBSTANCE DATA SHEET – REFERENCES

Source Reference Code	***Source Reference***	***Link(s)***
CAS #	*CAS (Chemical Abstracts Service) is a division of the* ***American Chemical Society****.* ***CAS Registry Numbers*** *(often referred to as CAS RNs or CAS Numbers) are unique identifiers for chemical substances. A CAS Registry Number itself has no inherent chemical significance but provides an unambiguous way to identify a chemical substance or molecular structure when there are many possible systematic, generic, proprietary, or trivial names.*	***www.cas.org***
DOT UN #	*Column 4 lists the* ***identification number*** *assigned to each proper shipping name. Those preceded by the letters "UN" are associated with proper shipping names considered appropriate for international transportation as well as domestic transportation. Those preceded by the letters "NA" are associated with proper shipping names not recognized for international transportation, except to and from Canada. Identification numbers in the "NA9000" series are associated with proper shipping names not appropriately covered by international hazardous materials (dangerous goods) transportation standards, or not appropriately addressed by international transportation standards for emergency response information purposes, except for transportation between the United States and Canada.*	***49 CFR 172.101 Hazardous Materials Table***
RTECS #	***NIOSH Registry of Toxic Effects of Chemical Substances****. RTECS is a compendium of data extracted from the open scientific literature. The data are recorded in the format developed by the RTECS staff and arranged in alphabetical order by prime chemical name. Six types of toxicity data are included in the file: (1) primary irritation; (2) mutagenic effects; (3) reproductive effects; (4) tumorigenic effects; (5) acute toxicity; and (6) other multiple dose toxicity. Specific numeric toxicity values such as LD50, LC50, TDLo, and TCLo are noted as well as species studied and route of administration used. For each citation, the bibliographic source is listed thereby enabling the user to access the actual studies cited. No attempt has been made to evaluate the studies cited in RTECS. The user has the responsibility of making such assessments.*	***www.cdc.gov/niosh/rtecs***
NFPA 704: H-F-R-Special Hazard	***Standard System for the Identification of the Hazards of Materials for Emergency Response, 1996 Edition****.* ***Scope*** *- This standard shall address the health, flammability, instability, and related hazards that are presented by short-term, acute exposure to a material under conditions of fire, spill, or similar emergencies.* *This standard provided a simple, readily recognized and easily understood system of marking that provides a general idea of the hazards of a material and the severity of these hazards as they relate to emergency response. The objectives of the system are:* *(a) To provide an appropriate signal or alert and on-the-spot information to safeguard the lives of both public and private emergency response personnel* *(b) To assist in planning for effective fire and emergency control operations, including clean-up* *(c) To assist all designated personnel in evaluating hazards* ***Purpose*** *– This system is intended to provide basic information to fire fighting, emergency, and other personnel, enabling them to easily decide whether to evacuate the area or to commence emergency control procedures. It is also intended to provide them with information to assist in selecting fire-fighting tactics and emergency procedures.* *See Figure 1 from the University of Florida, Environmental Health and Safety, Hazardous Material Code Identification, NFPA 704, 1996 Edition.*	***www.nfpa.org*** ***(for standard)*** ***www.ehs.ufl.edu/HAZCOM/nfpa704.pdf*** ***(for Figure 1 – below)***

Hazardous Material Code Identification

NFPA 704, 1996 Edition

Identification of Health Hazard Color Code: BLUE		Identification of Flammability Color Code: RED		Identification of Reactivity Stability Color Code: YELLOW	
Type of Possible Injury		Susceptibility of Materials to Burning		Susceptibility to Release of Energy	
Signal		Signal		Signal	
4	Materials that, under emergency conditions, can be lethal.	4	Materials which will rapidly or completely vaporize at atmospheric pressure and normal ambient temperature, or which are readily dispersed in air and which will burn readily.	4	Materials that in themselves are readily capable of detonation or of explosive decomposition or explosive reaction at normal temperature and pressures, are shock sensitive and react explosively with water.
3	Materials that, under emergency conditions, can cause serious or permanent injury.	3	Liquids and solids that can be ignited under almost all ambient temperature conditions.	3	Materials that in themselves are capable of detonation or explosive reaction but require a strong initiating source or which must be heated under confinement before initiation, are shock sensitive or which react explosively with water.
2	Materials that, under emergency conditions, can cause temporary incapacitation or residual injury.	2	Materials that must be moderately heated or exposed to relatively high ambient temperature before ignition can occur.	2	Materials that readily undergo violent chemical change at elevated temperatures and pressures. Also materials which may react violently with water or which may form potentially explosive mixtures with water.
1	Materials that, under emergency conditions, can cause significant irritation.	1	Material that must be preheated before ignition can occur.	1	Materials that in themselves are normally stable, but which can become unstable at elevated temperatures and pressures or which may react vigorously with water. Also materials that change or decompose with exposure to air, light or moisture.
0	Materials that, under emergency conditions, would offer no hazard.	0	Materials that will not burn.	0	Materials that in themselves are normally stable, even under fire exposure conditions, and which are not reactive with water

SPECIAL (WHITE)	
W	REACTS VIOLENTLY OR IN A DANGEROUS MANNER WITH WATER.
	REQUIRES SPECIAL DISPOSAL
OX	SUBSTANCE YIELDS OXYGEN TO SUPPORT COMBUSTION. REACTS TO OXIDIZE FUELS OR COMBUSTIBLES.
COR	ACID, ALKALI OR OTHER MATERIALS THAT WILL CAUSE SEVERE DAMAGE TO LIVING TISSUE.
	MATERIALS POSSESSING RADIOACTIVITY HAZARDS.

The identification systems are focused on the hazards of the materials under fire or spill conditions. This system is used only for the storage of chemicals and may be set up in a number of different designs. The color and number codes are as described above. The hazard number ratings will be either inserted into, or placed next to or below the corresponding colored box. Examples of the various identification systems that may be seen on bottles, drums or other containers are shown below:

FIGURE 1.

NIOSH	***NIOSH Pocket Guide to Chemical Hazards**, NIOSH Publication No. 2005-149, September 2005. The NIOSH Pocket Guide to Chemical Hazards (NPG) is intended as a source of general industrial hygiene information on several hundred chemicals/classes for workers, employers, and occupational health professionals. The NPG does not contain an analysis of all pertinent data, rather it presents key information and data in abbreviated or tabular form for chemicals or substance groupings (e.g. cyanides, fluorides, manganese compounds) that are found in the work environment. The information found in the NPG should help users recognize and control occupational chemical hazards.*	***www.cdc.gov/niosh/npg/default.html***
AIHA – ERPG's	***American Industrial Hygiene Association, 2007**. The Emergency Response Planning Guidelines (ERPGs) were developed as planning guidelines, to anticipate human adverse health effects caused by exposure to toxic chemicals. The ERPGs have been developed by the ERPG committee of the American Industrial Hygiene Association. The ERPG guidelines are clearly defined and are based on extensive, current data. The rationale for selecting each value is explained, and other pertinent information is also provided. Each guideline identifies the substance, its chemical and structural properties, animal toxicology data, human experience, existing exposure guidelines, the rationale behind the selected value, and a list of references.* *ERPG Tiers - The three tiers of each ERPG are defined as follows:* • *ERPG-3 is "the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects."* • *ERPG-2 is "the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action."* • *ERPG-1 is "the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing other than mild transient health effects or perceiving a clearly defined, objectionable odor."* *See Figure 2 below.*	***www.aiha.org/1documents/Committees/ERP-erpglevels.pdf*** ***(for 2007 AIHA ERPG's)***

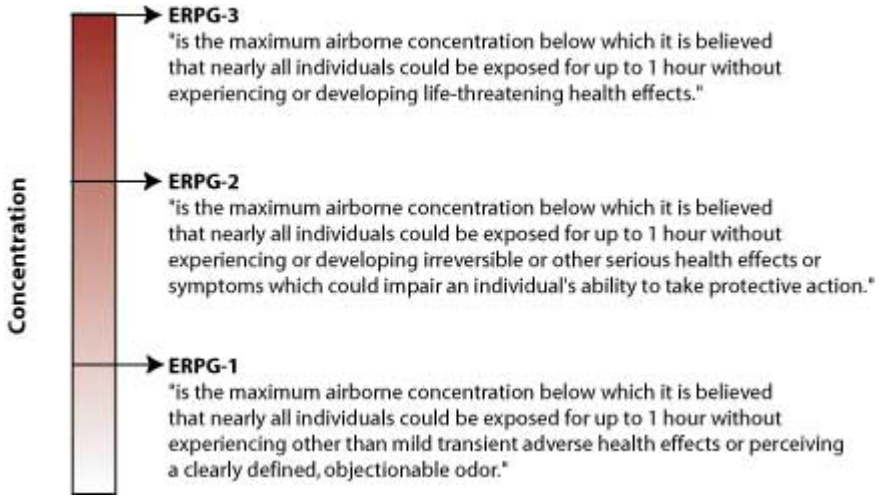

FIGURE 2.

ACGIH	*TLVs and BEIs Based on the Documentation of the* ***Threshold Limit Values*** *for Chemical Substances and Physical Agents and Biological Exposure Indices, 2007.* *The American Conference of Government Industrial Hygienists (ACGIH) is a private, not-for-profit, nongovernmental corporation whose members are industrial hygienists or other occupational health and safety professionals dedicated to promoting health and safety within the workplace. ACGIH is a scientific association. ACGIH is not a standards-setting body. As a scientific organization, it has established committees that review the existing published, peer-reviewed scientific literature. ACGIH publishes guidelines known as Threshold Limit Values (TLVs) and Biological Exposure Indices (BEIs) for use by industrial hygienists in making decisions regarding safe levels of exposure to various chemical and physical agents found in the workplace. In using these guidelines, industrial hygienists are cautioned that the TLVs and BEIs are only one of multiple factors to be considered in evaluating specific workplace situations and conditions.*	***www.acgih.org***
OSHA	*OSHA sets enforceable* ***permissible exposure limits*** *(PELs) to protect workers against the health effects of exposure to hazardous substances. PELs are regulatory limits on the amount or concentration of a substance in the air. They may also contain a skin designation.* *OSHA PELs are based on an 8-hour time weighted average (TWA) exposure.* *Approximately 500 PELs have been established. Existing PELs are contained in 29 CFR 1910.1000****,*** *the air contaminants standard. Most PELs are listed in 29 CFR 1910.1000 Table Z-1. Some are listed in 29 CFR 1910.1000 Table Z-2****.*** *The OSHA PEL is the regulated standard, while the others are recommended limits. The PEL is usually expressed in parts per million parts of air (ppm) or milligrams of dust or vapor per cubic meter of air (mg/m3). It is usually a time weighted average (TWA) - concentration averaged over an eight-hour day. Sometimes, a STEL or short term exposure limit may be listed. The STEL is a 15 minute TWA that should not be exceeded. A ceiling limit (c), is a concentration which may not be exceeded at any time. A skin notation means that skin exposure is significant in contributing to the overall exposure.*	***www.osha.gov/SLTC/pel***
AEGL's	***Acute (acute exposures are single, non-repetitive exposures for not more than 8 hrs) Exposure Guideline Levels****, or AEGLs, are intended to describe the risk to humans resulting from once-in-a-lifetime, or rare, exposure to airborne chemicals. The National Advisory Committee for AEGLs is developing these guidelines to help both national and local authorities, as well as private companies, deal with emergencies involving spills, or other catastrophic exposures.* *AEGLs represent threshold exposure limits for the general public and are applicable to emergency exposure periods ranging from 10 min to 8 h. AEGL-2 and AEGL-3, and AEGL-1 values as appropriate, will be developed for each of five exposure periods (10 and 30 min, 1 h, 4 h, and 8 h) and will be distinguished by varying degrees of severity of toxic effects. It is believed that the recommended exposure levels are applicable to the general population including infants and children, and other individuals who may be susceptible.* *The three AEGLs have been defined as follows:* • *AEGL-1 is the airborne concentration (expressed as parts per million or milligrams per cubic meter (ppm or mg/m3)) of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic nonsensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure.* • *AEGL-2 is the airborne concentration (expressed as ppm or mg/m3) of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.* • *AEGL-3 is the airborne concentration (expressed as ppm or mg/m3) of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death.*	***www.epa.gov/oppt/aegl***

	Airborne concentrations below the AEGL-1 represent exposure levels that can produce mild and progressively increasing but transient and nondisabling odor, taste, and sensory irritation or certain asymptomatic, nonsensory effects. With increasing airborne concentrations above each AEGL, there is a progressive increase in the likelihood of occurrence and the severity of effects described for each corresponding AEGL. Although the AEGL values represent threshold levels for the general public, including susceptible subpopulations, such as infants, children, the elderly, persons with asthma, and those with other illnesses, it is recognized that individuals, subject to unique or idiosyncratic responses, could experience the effects described at concentrations below the corresponding AEGL.	
EPCRA EHS	***Emergency Planning & Community Right to Know Act**, 42 U.S.C. 11001 et seq. (1986). Also known as Title III of SARA, EPCRA was enacted by Congress as the national legislation on community safety. This law was designated to help local communities protect public health, safety, and the environment from chemical hazards.* ***Section 302 Extremely Hazardous Substances (EHS's) – Emergency Planning.** The presence of EHSs in quantities at or above the Threshold Planning Quantity (TPQ) requires certain emergency planning activities to be conducted. The **extremely hazardous substances** and their TPQs are listed in 40 CFR Part 355, Appendices A and B. For section 302 EHSs, Local Emergency Planning Committees (LEPCs) must develop emergency response plans and facilities must notify the State Emergency Response Commission (SERC) and LEPC if they receive or produce the substance on site at or above the EHS's TPQ. Additionally if the TPQ is met, facilities with a listed EHS are subject to the reporting requirements of EPCRA section 311 (provide material safety data sheet or a list of covered chemicals to the SERC, LEPC, and local fire department) and section 312 (submit inventory form – Tier I or Tier II). The minimum threshold for section 311-312 reporting for EHS substances is 500 pounds or the TPQ, whichever is less.* ***TPQ**. For chemicals that are solids, there may be two TPQs given (e.g., 500/10,000). In these cases, the lower quantity applies for solids in powder form with particle size less than 100 microns, or if the substance is in solution or in molten form. Otherwise, the 10,000 pound TPQ applies.* ***EHS RQ**. Releases of reportable quantities (RQ) of EHSs are subject to state and local reporting under section 304 of EPCRA.* *Note that ammonium hydroxide is not covered under section 302; the EHS RQ is based on anhydrous ammonia. Ammonium hydroxide (which is also known as aqueous ammonia) is subject to CERCLA, with its own RQ.*	***yosemite.epa.gov/oswer/ceppoweb.nsf/content/epcraOverview.htm***
CERCLA	***Hazardous Substances – Emergency Release Notification.** Releases of **CERCLA hazardous substances**, in quantities equal to or greater than their reportable quantity (RQ), are subject to reporting to the National Response Center under CERCLA. Such releases are also subject to state and local reporting under section 304 of EPCRA. CERCLA hazardous substances, and their reportable quantities, are listed in 40 CFR Part 302, Table 302.4.*	***yosemite.epa.gov/oswer/ceppoweb.nsf/content/epcraOverview.htm***
EPCRA Section 313	***Toxic Chemicals – Toxic Release Inventory Reporting.** Emissions, transfer, and waste management data for chemicals listed under section 313 must be reported annually as part of the community right-to-know provisions of EPCRA (40 CFR Part 372)*	***yosemite.epa.gov/oswer/ceppoweb.nsf/content/epcraOverview.htm***
RMP	***CAA Section 112(r) List of Substances for Accidental Release Prevention – Risk Management Plan.** Under the accident prevention provisions of section 112(r) of the CAA, EPA developed a list of 77 toxic substances and 63 flammable substances. Threshold quantities (TQs) were established for these substances. The list and TQs identify processes subject to accident prevention regulations. The list of substances and TQs and the requirements for risk management programs for accidental release prevention are found in 40 CFR Part 68.*	***yosemite.epa.gov/oswer/ceppoweb.nsf/content/RMPS.htm?OpenDocument***

PSM	*The **Clean Air Act Amendments** (CAAA) were enacted into law (November 15, 1990). **Section 304** of the CAAA requires that the Secretary of Labor, in coordination with the Administrator of the Environmental Protection Agency (EPA), promulgate, pursuant to the Occupational Safety and Heath Act of 1970, a chemical process safety standard to prevent accidental releases of chemicals that could pose a threat to employees.*	***www.osha.gov***
GENIUM	***Genium's Handbook of Safety, Health, and Environmental Data for Common Hazardous Substances**, 1999*	
CI	***Chlorine Institute, Inc.**, The Chlorine Manual, Fifth Edition, 1986.*	***www.chlorineinstitute.org***
USEPA	***Chemical Summary for Chlorine Prepared By Office of Pollution Prevention and Toxics**, U.S. Environmental Protection Agency, EPA 749-F-94-010a, August 1994.*	***www.epa.gov/chemfact/s_chlori.txt***
NLM	***U.S. National Library of Medicine**, National Institutes of Health.*	***hazmap.nlm.nih.gov***
CHEM	***Chemical Engineers' Handbook**, Fifth Edition, McGraw-Hill Book Company*	
GPSA	***Gas Processors Suppliers Association,** Engineering Data Book, Ninth Edition, 1972, Fifth Revision, 1981.*	
PSYS	*University of Oxford, **Physical and Theoretical Chemistry Laboratory**, Safety Data for Methane*	***physchem.ox.ac.uk***