ANNEXURE 7.5 - RISK ASSESSMENT STUDY COMPUTATIONS

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1 QUALITATIVE RISK ASSESSMENT

1.1 Qualitative Risk Assessment – Boiler house

1.1.1 Fire Prevention in Coal Storage

1.1.1.1 Risk Factors

All types of coal, when exposed to the atmosphere, are liable to suffer deterioration of quality through surface oxidation, but the extent of deterioration differs from type to type. Lignite is a type of brown coal containing a high percentage of volatiles. It is subject to weathering much more rapidly than bituminous coal. It contains a large percentage of moisture (as much as 40%) as mined, of which nearly 20% exists even before it is mined. Under dry hot ambient conditions, particularly in India where temperature in a shed could go up to 45^0C and humidity to less than 30%, lignite oxidation rate could be high. The rate of release of carbon monoxide which is indicative of the oxidation rate may be as high as 70 m^3 of CO per ton of lignite, which is about 100 times that of normal bituminous coal. It has also been observed that in large coal storage yards left undisturbed for long periods, smoldering takes place at the surface layers of the pile. In case of lignite, this phenomenon is more rapid. Highly volatile coal is particularly liable to spontaneous combustion.

1.1.1.2 Safeguards/Guidelines to ensure safety in Coal storage yard/shed:

Storage of large quantities of coal requires two conditions to be met viz. (i) avoidance of deterioration in quality and (ii) avoidance of heating in the pile. If neither of the conditions can be fulfilled completely, deterioration and risk of fire can be reduced to a minimum by careful manipulation of the conditions of storage.

As basic necessary steps to avoid spontaneous heating in coal storage, the following guidelines are recommended:

- The ground or floor where coal is to be stored should be thoroughly cleaned of leaves, grass, weeds, pieces of wood, cotton waste or other organic waste and precautions taken to prevent such matter from getting under, into or on the coal pile.
- There should not be any steam or hot process pipelines or openings or sewers under, into, through or adjacent to coal piles.
- The floor and walls of coal storage bins should be of non-combustible material.
- The storage site should be provided with drainage facility to prevent accumulation of water on the ground.
- Special attention should be given to monitoring of the coal stack, floor or wall temperature inexcess of 42^0C.

- The stack should be planned so as to facilitate dissipation of heat by wind from the surface of the stack. Any barrier / obstruction to wind should be removed.
- Newly broken fines of coal are more susceptible to spontaneous heating. Avoid dropping coal from heights while piling and keep watch on newly broken fines of coal.
- Avoid conical piles; this storage should be built up in layers by roll packing; this helps to exclude oxygen and thus prevents fires by discouraging spontaneous heating.
- Never allow coal piles from different sources to be stored together.
- Avoid alternative wetting and drying or keeping one part of the pile wet and another dry. If such a situation arises, look out especially for spots where spontaneous heating occurs to take proper corrective measures.
- Coal stock should be limited in height. Low grade coal should not be piled higher than 3 meters and best grade not higher than 4-5 meters unless it is piled by the roll packing method. Coal should be stored in mixed sizes as too many fines will be hazardous.
- Do not allow any standing timber or pipes, poles, etc. in the piles. These may give rise to formation of duct which allows sluggish air flow which may be sufficient for heating the coal but not sufficient to dissipate the heat.
- It is recommended to locate coal yards at least 6-7 meters away from any important buildings and other combustible storage areas.
- While selecting the site, it is to be kept in mind that all parts of the coal stock are accessible for regular inspection and monitoring.

A well designed and well maintained coal stack and a systematic consumption of coal from storage yard are fundamental to fire safety in the storage of coal in industries.

1.1.1.3 Prevention of Spread of Coal Stock Fires

During the period of low off take, coal stock generally tends to build up to alarming levels. Since most of the grades of coal are susceptible to spontaneous ignition if it is undisturbed for a certain period of time, risk of fire exists in coal stacks. Following are the recommended precautions for preventing spread of coal stock fire:

- Consumption of coal should be done on first in-first out basis.
- Some sealant and protective coatings are commercially available. The manufacturers claim that by spraying these chemicals over the coal heaps, the probability of spontaneous ignition of coal can be reduced. It is believed that these coatings form a film on the surface of the coal lumps which reduces the chances of oxidation.
- Check the temperature of the coal pile regularly if heating has been known to occur. Specific attention should be given to the sloped sides of the piles where vulnerable

air pockets exist. If pile temperature exceeds 70^0C, open the pile and place the overheated material in a separate small pile or use it promptly.

- Inspection of stack is required to detect smoldering and organize removal / consumption of the smoldering coal on priority and to extinguish the flames in time. Such inspections are vital after the rains as water falling on the surface and penetrating the coal pile may aggravate and accelerate spontaneous heating by assisting oxidation.
- Coal having high moisture content should be stored separately, if possible, and used promptly.

1.1.1.4 Fire Protection and Fire Fighting

- During selection of storage sites, it is to be ascertained that all parts of the stack are accessible to mobile appliances for quenching fire in case of an emergency.
- The entire coal yard should be protected with a water hydrant system. Hydrant heads need not necessarily be equidistant from each other. They should be distributed in the stock yard in such a way as to provide protection on all sides. At least one hydrant post should be provided for every 30 m. in the area.
- The capacity of the static water storage exclusively reserved for hydrant purpose should be done as per the Fire Protection Manual, part-I, issued by the Tariff Advisory Committee (TAC).
- The storage yard should also be provided with at least two hoses, each of 15 m. length and nozzles of not less than 16 mm. diameter and not more than 25 mm. diameter, kept in readiness for use during fire emergency. While selecting the place of installation of hose reels, it is to be seen that no part of the premises is more than 6m from a nozzle when the hoses are fully extended.
- During fire fighting, the fire fighters should dig out and remove the coal in the heated zone as promptly as possible and then sufficient water can be applied to chill the burning coal below its ignition point and thereby to extinguish the fire. During fire fighting operation, it is advisable to keep a safe distance from the coal stock. Sometimes the water that penetrates the stock may encounter a very hot spot and may be insufficient to quench the same. The water then turns into steam that bursts out of the pile with considerable force.
- The other recommended practice is to insert 50mm. pipes perforated with 9mm. holes into the stack of the affected zone. Water is then supplied through a hose attached to the upper end of the pipes. This method of fighting coal stack fire is preferred because water can quickly cool the affected burning coal to below its ignition temperature or cut off the air supply around the area due to formation of steam.

1.1.2 Thermic Fluid Heater

The safety in the use of thermic fluid heaters is basically due to handling of thermal fluid, which can catch fire in case of some abnormal conditions. These units are covered under M.F.R. 73 – ZA, the salient features of which are reproduced below:

1.1.2.1 Safety Precautions for Thermic Fluid Heaters

In respect of any factory where thermal fluid heater has been installed (hereinafter called "heater") following provisions shall be complied with

- All heaters shall be of such construction that, the coils shall be removable for periodic cleaning, visual inspections and hydraulic test.
- Suitable arrangements shall be made for cooling the furnace effectively in case of power failure to the heater.
- Before restarting the furnace of heater it shall be effectively purged.
- The thermic fluid used for heater shall be circulated in a closed circuit formation with an expansion cum creator tank. This tank shall be located outside the shed where the heater is installed.
- Every Oil or Gas fired heater shall be provided with a photo-resistor actuated audio visual alarm to indicate flame failure and automatic burner cut-off.
- The stack temperature monitor-cum-controller with audio-visual alarm shall be provided to the heater so as to warn the operator in case the outlet temperature exceeds the specified minimum.
- All heaters shall be provided with following devices and the same shall be maintained in efficient working order:
- Level indicator in the expansion tank.
- Temperature indicator of thermic fluid.
- Different pressure switch across the inlet and the outlet line of the heater tubes and
- Temperature control device for the fuel supply to the burner.
- All devices for oil or gas fired heater shall have inter-locking arrangement with burner so that in case of any pre-determined limits being crossed the supply of fuel and air to burner shall automatically be cut-off.
- All safety inter-locks when operated shall be indicated or on the control panel of the heater by a suitable audio-visual alarm.
- Electrical panel for the heater shall be located near the heater but not so close as to be exposed to spilling or leaking oil.
- The heater shall be located in a place segregated from other manufacturing activities.

- Explosion vent for heater shall be so installed that, the release takes place at safe location.
- The heater coil including the coil connected to it in the users equipment subjected to pressure shall be tested by competent person once atleast in every 12 months. The test pressure shall not be less than twice the operating pressure.
- If repairs are carried out to the heater, coil including coil connected to it in users equipment shall be got examined from competent person before taking it into use.
- Maximum temperature of thermic fluid in the heating of heater coil shall not exceed the figure specified by the manufacturer. The thermic fluid used in heater, shall confirm to the specifications prescribed by the manufacturers and shall be tested by competent person for suitability atleast once in every three months period. Such test shall include test for acidity, suspended matter, ash contents, viscosity and flash point.
- Cleaning of the internal surface of the heater for removing soot and check up the refectory surface on the inside shall be carried out every month, or as often as required depending upon working conditions. The coils of heater shall be removed and surface of the coil cleaned thoroughly once at least in a period of six months.
- The burner, nozzles, oil filters and pumps shall be cleaned once a week during the period of use.
- A separate register containing the following information for the heater shall be maintained.

  Weekly checks carried out confirming the effectiveness of the inter-lock;

  1. Weekly checks confirming that all accessories are in good state of repairs and
  2. Information regarding fuel oil temperature, pressure, thermic fluid inlet/outlet pressure and temperature, fuel gas temperature, recorded at four hourly intervals.

The heater when in operation shall always be kept incharge of a trained operator.

1.2 Material safety data sheets

Material safety data sheets of some **major chemicals** handled are presented below

1.2.1 Methanol

Potential Acute Health Effects:

Hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Slightly hazardous in case of skin contact (permeator). Severe over-exposure can result in death.

Mutagenic effects: Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast.

The substance is toxic to eyes. The substance may be toxic to blood, kidneys, liver, brain, peripheral nervous system, upper respiratory tract, skin, central nervous system (CNS), optic nerve. Repeated or prolonged exposure to the substance can produce target organs damage. Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

First Aid Measures Methyl Alcohol

Eye Contact: Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Get medical attention.

Skin Contact: In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact: Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.
Inhalation: If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Serious Inhalation: Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation.

Warning : It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion: If swallowed, do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

Fire and Explosion Data: Methyl Alcohol

Flammability of the Product: Flammable.
Auto-Ignition Temperature: 464°C (867.2°F)
Flash Points: Close cup: 12°C (53.6°F). Open cup: 16°C (60.8°F).
Flammable Limits: Lower : 6% Upper: 36.5%
Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances: Highly flammable in presence of open flames and sparks, of heat. Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances: Risks of explosion of the product in presence of mechanical impact: Not available. Explosive in presence of open flames and sparks, of heat.

Fire Fighting Media and Instructions: Flammable liquid, soluble or dispersed in water.

Small fire: Use dry chemical powder. Large fire: Use alcohol foam, water spray or fog.

Special Remarks on Fire Hazards: Explosive in the form of vapor when exposed to heat or flame. Vapor may travel considerable distance to source of ignition and flash back. When heated to decomposition, it emits acrid smoke and irritating fumes.

CAUTION: MAY BURN WITH NEAR INVISIBLE FLAME

Special Remarks on Explosion Hazards: Forms an explosive mixture with air due to its low flash point. Explosive when mixed with Choroform + sodium methoxide and diethyl zinc. It boils violently and explodes.

Accidental Release Measures Methyl Alcohol

Small Spill: Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container.

Large Spill: Flammable liquid. Poisonous liquid. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV.

Exposure Controls/Personal Protection Methyl Alcohol

Engineering Controls: Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.
Personal Protection: Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent Gloves.

Personal Protection in Case of a Large Spill: Splash goggles. Full suit. Vapor respirator. Boots. Gloves.

A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this Product.

1.2.2 Sulphuric acid (98%)

Health effects Sulphuric acid (98%)

Acute Skin: Corrosive. Causes redness, inflammation, burns.

Acute Inhalation: Harmful if inhaled. Causes upper respiratory tract irritation, lung irritation, chest pain, wheezing, shortness of breath, a burning sensation, tickling of the nose and throat, sneezing, repeated exposure to high levels of sulfuric acid mist may cause etching of tooth enamel in persons who breathe through their mouths.

Acute Ingestion: Harmful if ingested. Can cause irritation, abdominal pain, corrosion, burns to mouth and esophagus, death.
Chronic Effects: When mists are released from this product they are considered to be probable or suspected human carcinogens.

First aid measures for accidental contact : Sulphuric acid (98%)

Eye Exposure: Hold eyelids open and flush with a steady, gentle stream of water for at least 15 minutes. Seek immediate medical attention.

Skin Exposure: In case of contact, immediately wash with plenty of water for at least 15 minutes. Seek medical attention if irritation developes or persists. Remove contaminated clothing and shoes. Clean contaminated clothing and shoes before re-use.

Inhalation: Remove victim from immediate source of exposure and assure that the victim is breathing. If breathing is difficult, administer oxygen, if available. If victim is not breathing, administer CPR (cardio-pulmonary resuscitation). Seek medical attention.

Ingestion: Do not induce vomiting. If the person is conscious and has no trouble breathing a small (no more than one glass) amount of water may be given. Do not leave victim unattended. To prevent aspiration of the swallowed product, lay victim on side with head lower than waist. If vomiting occurs do not re-administer water. Do not give anything by mouth to an unconscious person. Immediately obtain medical attention.

1.2.3 Acetic acid MSDS

Section 1: Chemical Product and Company Identification
Product Name: Acetic acid
Synonym: Acetic acid; glacial acetic acid
Chemical Name: Acetic Acid, Glacial

Chemical Formula: C2-H4-O2
Toxicological Data on Ingredients: Acetic acid: ORAL (LD50): Acute: 3310 mg/kg [Rat]. 4960 mg/kg [Mouse]. 3530 mg/kg
[Rat]. DERMAL (LD50): Acute: 1060 mg/kg [Rabbit]. VAPOR (LC50): Acute: 5620 ppm 1 hours [Mouse].

Section 3: Hazards Identification

Potential Acute Health Effects:

Very hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Hazardous in case of skin
contact (corrosive, permeator), of eye contact (corrosive). Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:

Hazardous in case of skin contact (irritant), of ingestion, of inhalation.
CARCINOGENIC EFFECTS: Not available.
MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to kidneys, mucous membranes, skin, teeth. Repeated or prolonged exposure to the substance can produce target organs damage. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.

Skin Contact:

In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact: Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Serious Inhalation:

Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation.
WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.
Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.
Serious Ingestion: Not available.

Section 5: Fire and Explosion Data
Flammability of the Product: Flammable.
Auto-Ignition Temperature: 463°C (865.4°F)
Flash Points: CLOSED CUP: 39°C (102.2°F). OPEN CUP: 43°C (109.4°F).
Flammable Limits: LOWER: 4% UPPER: 19.9%
Products of Combustion: These products are carbon oxides (CO, CO2).
Fire Hazards in Presence of Various Substances:
Flammable in presence of open flames and sparks, of heat. Slightly flammable to flammable in presence of oxidizing materials, of metals.
Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available. Slightly explosive in presence of oxidizing materials.
Fire Fighting Media and Instructions:
Flammable liquid, soluble or dispersed in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use alcohol foam, water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.
Special Remarks on Fire Hazards:
Reacts with metals to produces flammable hydrogen gas. It will ignite on contact with potassium-tert-butoxide. A mixture of ammonium nitrate and acetic acid ignites when warmed, especially if warmed.
Special Remarks on Explosion Hazards:
Acetic acid vapors may form explosive mixtures with air. Reactions between acetic acid and the following materials are potentially explosive: 5-azidotetrazole, bromine pentafluoride, chromium trioxide, hydrogen peroxide, potassium permanganate, sodium peroxide, and phorphorus trichloride. Dilute acetic acid and dilute hydrogen can undergo an exothermic reaction if heated, forming peracetic acid which is explosive at 110 degrees C. Reaction between chlorine trifluoride and acetic acid is very violent, sometimes explosive.

Section 6: Accidental Release Measures
Small Spill:

Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. If necessary: Neutralize the residue with a dilute solution of sodium carbonate.

Large Spill:

Flammable liquid. Corrosive liquid. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. If the product is in its solid form: Use a shovel to put the material into a convenient waste disposal container. If the product is in its liquid form: Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Absorb with an inert material and put the spilled material in an appropriate waste disposal. Do not touch spilled material. Use water spray curtain to divert vapor drift. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Neutralize the residue with a dilute solution of sodium carbonate. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:

Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, reducing agents, metals, acids, alkalis.

Storage:

Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:

Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:

Splash goggles. Synthetic apron. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves (impervious).

Personal Protection in Case of a Large Spill:

Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:

TWA: 10 STEL: 15 (ppm) [Australia] TWA: 25 STEL: 27 (mg/m3) [Australia] TWA: 10 STEL: 15 (ppm) from NIOSH TWA: 25
STEL: 37 (mg/m3) from NIOSH TWA: 10 STEL: 15 (ppm) [Canada] TWA: 26 STEL: 39 (mg/m3) [Canada] TWA: 25 STEL: 37

(mg/m3) TWA: 10 STEL: 15 (ppm) from ACGIH (TLV) [United States] [1999] TWA: 10 (ppm) from OSHA (PEL) [United States]
TWA: 25 (mg/m3) from OSHA (PEL) [United States]Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties
Physical state and appearance: Liquid.
Odor: Pungent, vinegar-like, sour (Strong.)
Taste: Vinegar, sour (Strong.)
Molecular Weight: 60.05 g/mole
Color: Colorless. Clear (Light.)
pH (1% soln/water): 2 [Acidic.]
Boiling Point: 118.1°C (244.6°F)
Melting Point: 16.6°C (61.9°F)
Critical Temperature: 321.67°C (611°F)
Specific Gravity: 1.049 (Water = 1)
Vapor Pressure: 1.5 kPa (@ 20°C)
Vapor Density: 2.07 (Air = 1)
Volatility: Not available.
Odor Threshold: 0.48 ppm
Water/Oil Dist. Coeff.: The product is more soluble in water; log(oil/water) = -0.2
Ionicity (in Water): Not available.
Dispersion Properties: See solubility in water, diethyl ether, acetone.
Solubility:
Easily soluble in cold water, hot water. Soluble in diethyl ether, acetone. Miscible with Glycerol, alcohol, Benzene, Carbon Tetrachloride. Practically insoluble in Carbon Disulfide.

Section 10: Stability and Reactivity Data
Stability: The product is stable.
Instability Temperature: Not available.
Conditions of Instability: Heat, ignition sources, incompatible materials
Incompatibility with various substances: Reactive with oxidizing agents, reducing agents, metals, acids, alkalis.
Corrosivity:
Highly corrosive in presence of stainless steel(304). Slightly corrosive in presence of aluminum, of copper. Non-corrosive in presence of stainless steel(316).
Special Remarks on Reactivity:
Reacts violently with strong oxidizing agents, acetaldehyde, and acetic anhydride. Material can react with metals, strong bases, amines, carbonates, hydroxides, phosphates, many oxides,cyanides, sulfides, chromic acid, nitric acid, hydrogen peroxide, carbonates. ammonium nitrate, ammonium thiosulfate, chlorine trifluoride, chlorosulfonic acid, perchloric acid, permanganates, xylene, oleum, potassium hydroxide, sodium hydroxide, phosphorus isocyanate, ethylenediamine, ethylene amine.
Special Remarks on Corrosivity: Moderate corrosive effect on bronze. No corrosion data on brass

Polymerization: Will not occur.

Section 11: Toxicological Information
Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation. Ingestion.
Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 3310 mg/kg [Rat]. Acute dermal toxicity (LD50): 1060 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 5620 1 hours [Mouse].
Chronic Effects on Humans:
MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. May cause damage to
the following organs: kidneys, mucous membranes, skin, teeth.
Other Toxic Effects on Humans:
Extremely hazardous in case of inhalation (lung corrosive). Very hazardous in case of skin contact (irritant), of ingestion, .
Hazardous in case of skin contact (corrosive, permeator), of eye contact (corrosive).
Special Remarks on Toxicity to Animals: Not available.
Special Remarks on Chronic Effects on Humans: May affect genetic material and may cause reproductive effects based on
animal data. No human data found.
Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Extremely irritating and corrosive. Causes skin irritation (reddening and itching, nflammation). May cause blistering , tissue damage and burns. Eyes: Extremely irritating and corrosive. Causes eye irritation, lacrimation, redness, and pain. May cause burns, blurred vision, conjunctivitis, conjunctival and corneal destruction and permanent injury. Inhalation: Causes severe respiratory tract irritation. Affects the sense organs (nose, ear, eye, taste), and blood. May cause chemical pneumonitis, bronchitis, and pulmonary edema. Severe exposure may result in lung tissue damage and corrosion (ulceration) of the mucous membranes. Inhalation may also cause rhinitis, sneezing, coughing, oppressive feeling in the chest or chest pain, dyspnea, wheezing, tachypnea, cyanosis, salivation, nausea, giddiness, muscular weakness. Ingestion: Moderately toxic. Corrosive. Causes gastrointestinal tract irritation (burning and pain of the mouth, throat, and abdomen, coughing, ulceration, bleeding, nausea, abdomial spasms, vomiting, hematemesis, diarrhea. May Also affect the liver (impaired liver function), behavior (convulsions, giddines, muscular weakness), and the urinary system - kidneys (Hematuria, Albuminuria, Nephrosis, acute renal failure, acute tubular necrosis). May also cause dyspnea or asphyxia. May also lead to shock, coma and death. Chronic Potential Health Effects: Chronic exposure via ingestion may cause blackening or erosion of the teeth and jaw necrosis, pharyngitis, and gastritis. It may also behavior (similar to acute ingestion), and metabolism (weight loss). Chronic exposure via inhalation may cause asthma and/or bronchitis with cough, phlegm, and/or shortness of breath . It may also affect the blood (decreased leukocyte count), and urinary system (kidneys). Repeated or prolonged skin contact may cause thickening, blackening, and cracking of the skin.

1.2.4 Acetic anhydride MSDS

Section 1: Chemical Product and Company Identification
Product Name: Acetic anhydride
CAS#: 108-24-7
Synonym:
Chemical Formula: (CH3CO)2)
Toxicological Data on Ingredients: Acetic anhydride: ORAL (LD50): Acute: 1780 mg/kg [Rat]. DERMAL (LD50): Acute: 4000 mg/kg [Rabbit].

Section 3: Hazards Identification
Potential Acute Health Effects:
Extremely hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Very hazardous in case of skin contact (corrosive). Hazardous in case of skin contact (permeator). Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.
Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available. The substance is toxic to lungs, mucous membranes. Repeated or prolonged
exposure to the substance can produce target organs damage. Repeated or prolonged contact with spray mist may produce
chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract
irritation leading to frequent attacks of bronchial infection.

Section 4: First Aid Measures
Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention immediately.
Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.
Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.
Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.
Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.
Serious Ingestion: Not available.

Section 5: Fire and Explosion Data
Flammability of the Product: Flammable.
Auto-Ignition Temperature: 316°C (600.8°F)
Flash Points: CLOSED CUP: 49°C (120.2°F). OPEN CUP: 51°C (123.8°F).
Flammable Limits: LOWER: 2.7% UPPER: 10.3%
Products of Combustion: These products are carbon oxides (CO, CO2).
Fire Hazards in Presence of Various Substances: Flammable in presence of heat.
Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.
Fire Fighting Media and Instructions:
Flammable liquid. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use alcohol foam, water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.
Special Remarks on Fire Hazards: Not available.
Special Remarks on Explosion Hazards: Not available.
Section 6: Accidental Release Measures
Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.
Large Spill:
Flammable liquid. Corrosive liquid. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Use water spray curtain to divert vapor drift. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.
Section 7: Handling and Storage
Precautions:
Keep container dry. Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Never add water to this product. In case of insufficient ventilation, wear suitable

respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes.

Storage:

Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:

Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:

Face shield. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves. Boots.

Personal Protection in Case of a Large Spill:

Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:

TWA: 5 TWA: 20 Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.
Odor: Strong.
Taste: Strong.
Molecular Weight: 102.09 g/mole
Color: Light.
pH (1% soln/water): Not available.
Boiling Point: 139.9°C (283.8°F)
Melting Point: -73.1 (-99.6°F)
Critical Temperature: Not available.
Specific Gravity: 1.08 (Water = 1)
Vapor Pressure: 0.5 kPa (@ 20°C)
Vapor Density: 3.52 (Air = 1)
Volatility: Not available.
Odor Threshold: 0.1 ppm
Water/Oil Dist. Coeff.: Not available.
Ionicity (in Water): Not available.
Dispersion Properties: Not available.
Solubility: Not available.

Section 10: Stability and Reactivity Data

Stability: The product is stable.
Instability Temperature: Not available.
Conditions of Instability: Not available.

Incompatibility with various substances: Not available.
Corrosivity: Not available.
Special Remarks on Reactivity: Not available.
Special Remarks on Corrosivity: Not available.
Polymerization: Will not occur.

1.2.5 Toluene

Material Safety Data Sheet : Toluene MSDS

Section 1: Chemical Product and Company Identification
Product Name: Toluene
Synonym: Toluol, Tolu-Sol; Methylbenzene; Methacide; Phenylmethane; Methylbenzol
Chemical Name: Toluene
Chemical Formula: C6-H5-CH3 or C7-H8
Name CAS # % by Weight Toluene 108-88-3 100
Toxicological Data on Ingredients: Toluene: ORAL (LD50): Acute: 636 mg/kg [Rat]. DERMAL (LD50): Acute: 14100 mg/kg [Rabbit]. VAPOR (LC50): Acute: 49000 mg/m 4 hours [Rat]. 440 ppm 24 hours [Mouse].

Section 3: Hazards Identification
Potential Acute Health Effects:
Hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Slightly hazardous in case of skin contact (permeator).
Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH, 3 (Not classifiable for human.) by IARC.
MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to blood, kidneys, the nervous system, liver, brain, central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures
Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention.
Skin Contact:
In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.
Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.
Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek medical attention.
Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.
Serious Ingestion: Not available.

Section 5: Fire and Explosion Data
Flammability of the Product: Flammable.
Auto-Ignition Temperature: 480°C (896°F)
Flash Points: CLOSED CUP: 4.4444°C (40°F). (Setaflash) OPEN CUP: 16°C (60.8°F).
Flammable Limits: LOWER: 1.1% UPPER: 7.1%
Products of Combustion: These products are carbon oxides (CO, CO2).
Fire Hazards in Presence of Various Substances:
Flammable in presence of open flames and sparks, of heat. Non-flammable in presence of shocks.
Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.
Fire Fighting Media and Instructions:
Flammable liquid, insoluble in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray or fog.
Special Remarks on Fire Hazards: Not available.
Special Remarks on Explosion Hazards:
Toluene forms explosive reaction with 1,3-dichloro-5,5-dimethyl-2,4-imidazolididione; dinitrogen tetraoxide; concentrated nitric acid, sulfuric acid + nitric acid; N2O4; AgClO4; BrF3; Uranium hexafluoride; sulfur dichloride. Also forms an explosive mixture with tetranitromethane.

Section 6: Accidental Release Measures
Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.
Large Spill:
Toxic flammable liquid, insoluble or very slightly soluble in water. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions: Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents.

Storage:

Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:

Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:

Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:

Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:

TWA: 200 STEL: 500 CEIL: 300 (ppm) from OSHA (PEL) [United States] TWA: 50 (ppm) from ACGIH (TLV) [United States] SKIN TWA: 100 STEL: 150 from NIOSH [United States] TWA: 375 STEL: 560 (mg/m3) from NIOSH [United States] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.
Odor: Sweet, pungent, Benzene-like.
Taste: Not available.
Molecular Weight: 92.14 g/mole
Color: Colorless.
pH (1% soln/water): Not applicable.
Boiling Point: 110.6°C (231.1°F)
Melting Point: -95°C (-139°F)
Critical Temperature: 318.6°C (605.5°F)
Specific Gravity: 0.8636 (Water = 1)
Vapor Pressure: 3.8 kPa (@ 25°C)
Vapor Density: 3.1 (Air = 1)
Volatility: Not available.

Odor Threshold: 1.6 ppm
Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 2.7
Ionicity (in Water): Not available.
Dispersion Properties: See solubility in water, diethyl ether, acetone.
Solubility: Soluble in diethyl ether, acetone. Practically insoluble in cold water. Soluble in ethanol, benzene, chloroform, glacial acetic
acid, carbon disulfide. Solubility in water: 0.561 g/l @ 25 deg. C.

Section 10: Stability and Reactivity Data
Stability: The product is stable.
Instability Temperature: Not available.
Conditions of Instability: Heat, ignition sources (flames, sparks, static), incompatible materials
Incompatibility with various substances: Reactive with oxidizing agents.
Corrosivity: Non-corrosive in presence of glass.
Special Remarks on Reactivity:
Incompatible with strong oxidizers, silver perchlorate, sodium difluoride, Tetranitromethane, Uranium Hexafluoride. Frozen Bromine Trifluoride reacts violently with Toluene at -80 deg. C. Reacts chemically with nitrogen oxides, or halogens to form nitrotoluene, nitrobenzene, and nitrophenol and halogenated products, respectively.
Special Remarks on Corrosivity: Not available.
Polymerization: Will not occur.

Section 11: Toxicological Information
Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation. Ingestion.
Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 636 mg/kg [Rat]. Acute dermal toxicity (LD50): 14100 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 440 24 hours [Mouse].
Chronic Effects on Humans:
CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH, 3 (Not classifiable for human.) by IARC. May cause damage to the following organs: blood, kidneys, the nervous system, liver, brain, central nervous system (CNS).
Other Toxic Effects on Humans:
Hazardous in case of skin contact (irritant), of ingestion, of inhalation. Slightly hazardous in case of skin contact (permeator).
Special Remarks on Toxicity to Animals:
Lowest Published Lethal Dose: LDL [Human] - Route: Oral; Dose: 50 mg/kg LCL [Rabbit] - Route: Inhalation; Dose: 55000 ppm/40min
Special Remarks on Chronic Effects on Humans:
Detected in maternal milk in human. Passes through the placental barrier in human. Embryotoxic and/or foetotoxic in animal. May cause adverse reproductive effects and birth defects (teratogenic). May affect genetic material (mutagenic)

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Causes mild to moderate skin irritation. It can be absorbed to some extent through the skin. Eyes: Cauess mild to moderate eye irritation with a burning sensation. Splash contact with eyes also causes conjunctivitis, blepharospasm, corneal edema, corneal abraisons. This usually resolves in 2 days. Inhalation: Inhalation of vapor may cause respiratory tract irritation causing coughing and wheezing, and nasal discharge. Inhalation of high concentrations may affect behavior and cause central nervous system effects characterized by nausea, headache, dizziness, tremors, restlessness, lightheadedness, exhilaration, memory loss, insomnia, impaired reaction time, drowsiness, ataxia, hallucinations, somnolence, muscle contraction or spasticity, unconsciousness and coma. Inhalation of high concentration of vapor may also affect the cardiovascular system (rapid heart beat, heart palpitations, increased or decreased blood pressure, dysrhythmia,), respiration (acute pulmonary edema, respiratory depression, apnea, asphyxia), cause vision disturbances and dilated pupils, and cause loss of appetite. Ingestion: Aspiration hazard. Aspiration of Toluene into the lungs may cause chemical pneumonitis. May cause irritation of the digestive tract with nausea, vomiting, pain. May have effects similar to that of acute inhalation. Chronic Potential Health Effects: Inhalation and Ingestion: Prolonged or repeated exposure via inhalation may cause central nervous system and cardiovascular symptoms similar to that of acute inhalation and ingestion as well liver damage/failure, kidney damage/failure (with hematuria, proteinuria, oliguria, renal tubular acidosis), brain damage, weight loss, blood (pigmented or nucleated red blood cells, changes in white blood cell count), bone marrow changes, electrolyte imbalances (Hypokalemia, Hypophostatemia), severe, muscle weakness and Rhabdomyolysis. Skin: Repeated or prolonged skin contact may cause defatting dermatitis.

Section 12: Ecological Information
Ecotoxicity:
Ecotoxicity in water (LC50): 313 mg/l 48 hours [Daphnia (daphnia)]. 17 mg/l 24 hours [Fish (Blue Gill)]. 13 mg/l 96 hours [Fish (Blue Gill)]. 56 mg/l 24 hours [Fish (Fathead minnow)]. 34 mg/l 96 hours [Fish (Fathead minnow)]. 56.8 ppm any hours [Fish (Goldfish)].
BOD5 and COD: Not available.
Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.
Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.
Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations
Waste Disposal:
Waste must be disposed of in accordance with local environmental control regulations.
HMIS (U.S.A.):
Health Hazard: 2
Fire Hazard: 3

Reactivity: 0
Personal Protection: h
National Fire Protection Association (U.S.A.):
Health: 2
Flammability: 3
Reactivity: 0
Specific hazard:
Protective Equipment: Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles. , and sudden circulatory collapse (similar to acute inhalation).

1.2.6 1-Pentanol

Section 1 - Chemical Product
MSDS Name: 1-Pentanol
Synonyms: n-Amyl alcohol; Pentyl alcohol

Section 2 - Composition, Information on Ingredients
CAS# Chemical Name: % EINECS#
71-41-0 1-Pentanol 99% 200-752-1
Hazard Symbols: XN
Risk Phrases: 10 20 37 66

Section 3 - Hazards Identification
EMERGENCY OVERVIEW
Flammable. Irritating to respiratory system. Harmful by inhalation. Repeated exposure may cause skin dryness or cracking.
Potential Health Effects
Eye: May cause eye irritation.
Skin: May cause skin irritation. Repeated or prolonged exposure may cause drying and cracking of the skin.
Ingestion: May cause irritation of the digestive tract. May cause central nervous system depression. May cause burning sensations, coughing, wheezing, laryngitis, shortness of breath and headache.
Inhalation: Harmful if inhaled. Causes respiratory tract irritation. May cause narcotic effects in high concentration. Inhalation may produce burning sensation, coughing, wheezing, laryngitis, shortness of breath, headache, nausea, and vomiting.

Section 4 - First Aid Measures
Eyes: Flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid.
Skin: Get medical aid. Flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes.

Ingestion: Get medical aid. Wash mouth out with water.
Inhalation: Remove from exposure and move to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid.

Section 5 - Fire Fighting Measures
General Information:
As in any fire, wear a self-contained breathing apparatus in pressure demand, MSHA/NIOSH (approved or equivalent), and full protective gear.
Vapors can travel to a source of ignition and flash back. Will burn if involved in a fire. Flammable liquid and vapor. Vapors may be heavier than air. They can spread along the ground and collect in low or confined areas.

Extinguishing Media: Use water spray, dry chemical, carbon dioxide, or chemical foam.

Section 6 - Accidental Release Measures
General Information:
Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks: Absorb spill with inert material (e.g. vermiculite, sand or earth), then place in suitable container. Remove all sources of ignition. Use a spark-proof tool.

Section 7 - Handling and Storage
Handling: Use spark-proof tools and explosion proof equipment. Avoid breathing dust, vapor, mist, or gas. Avoid contact with skin and eyes. Take precautionary measures against static discharges. Use only in a chemical fume hood.
Storage: Keep away from sources of ignition. Store in a cool, dry place. Store in a tightly closed container. Flammables-area.

Section 8 - Exposure Controls, Personal Protection
Engineering Controls: Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use adequate general or local explosion-proof ventilation to keep airborne levels to acceptable levels.
Exposure Limits
CAS# 71-41-0:
Germany: 360 mg/m3 TWA
Personal Protective Equipment
Eyes: Wear chemical splash goggles.
Skin: Wear appropriate protective gloves to prevent skin exposure.
Clothing: Wear appropriate protective clothing to prevent skin exposure.
Respirators: Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Section 9 - Physical and Chemical Properties
Physical State: Clear liquid

Color: colorless
Odor: stench
pH: 7 (25 g/l water)
Vapor Pressure: 2.6mbar @20 deg C
Viscosity: 4 mPa s @20 deg C
Boiling Point: 137 - 139 deg C @760mmHg
Freezing/Melting Point: -78 deg C (-108.40°F)
Autoignition Temperature: 300 deg C (572.00 deg F)
Flash Point: 49 deg C (120.20 deg F)
Explosion Limits: Lower: 1.3 Vol %
Explosion Limits: Upper: 10.5 Vol %
Decomposition Temperature: Not available
Solubility in water: 22 g/l (22°C)
Specific Gravity/Density: 0.811
Molecular Formula: C5H12O
Molecular Weight: 88.15

Section 10 - Stability and Reactivity
Chemical Stability: Stable. Hygroscopic: absorbs moisture or water from the air.
Conditions to Avoid: Incompatible materials, ignition sources, excess heat exposure to moist air or water. Incompatibilities with Other Materials Strong oxidizing agents, alkali metals, alkaline earth metals.
Hazardous Decomposition Products Carbon monoxide, carbon dioxide.
Hazardous Polymerization Will not occur.

Section 11 - Toxicological Information
RTECS#:
CAS# 71-41-0: SB9800000
LD50/LC50:
RTECS:
CAS# 71-41-0: Draize test, rabbit, eye: 81 mg Severe;
Draize test, rabbit, eye: 5 uL/24H Severe;
Draize test, rabbit, skin: 3200 mg/24H Severe;
Draize test, rabbit, skin: 20 mg/24H Moderate;
Oral, mouse: LD50 = 200 mg/kg;
Oral, mouse: LD50 = 200 mg/kg;
Oral, rat: LD50 = 5660 uL/kg;
Oral, rat: LD50 = 370 mg/kg;
Skin, rabbit: LD50 = 2830 uL/kg;
Other:
Carcinogenicity:
1-Pentanol - Not listed as a carcinogen by ACGIH, IARC, NTP, or CA
Prop 65.
Other: See actual entry in RTECS for complete information.

Section 12 - Ecological Information
Ecotoxicity:
Daphnia: Daphnia: EC/LC50 = 440 mg/l (acuut); 48H; .
Other: Biodegradable. Avoid entering into waters or underground water. Do not empty into drains.
log POW = 1.30

Section 13 - Disposal Considerations
Dispose of in a manner consistent with local, state, and local regulations.

1.2.7 Dicyclopentadiene

Section 1: Chemical Product and Company Identification
Product Name: Dicyclopentadiene
Chemical Name: Dicyclopentadiene
Chemical Formula: C10-H12

Section 2: Composition and Information on Ingredients
Composition:
Name CAS # % by Weight
Dicyclopentadiene 77-73-6 100
Toxicological Data on Ingredients: Dicyclopentadiene: ORAL (LD50): Acute: 353 mg/kg [Rat]. 190 mg/kg [Mouse]. 1200 mg/ kg [Cattle]. DERMAL (LD50): Acute: 5080 mg/kg [Rabbit].

Section 3: Hazards Identification
Potential Acute Health Effects:
Hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Severe over-exposure can result in death.
Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Classified None. by OSHA, None. by NIOSH. MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance is toxic to kidneys,
liver, gastrointestinal tract, upper respiratory tract, skin, eyes, central nervous system (CNS). Repeated or prolonged exposure
to the substance can produce target organs damage. Repeated exposure to an highly toxic material may produce general
deterioration of health by an accumulation in one or many human organs.

4: First Aid Measures
Eye Contact: Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.

Skin Contact: After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.
Serious Skin Contact: Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.
Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.
Serious Inhalation: Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.
Ingestion:
Do not induce vomiting. Examine the lips and mouth to ascertain whether the tissues are damaged, a possible indication that the toxic material was ingested; the absence of such signs, however, is not conclusive. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.
Serious Ingestion: Not available.

Section 5: Fire and Explosion Data
Flammability of the Product: Flammable.
Auto-Ignition Temperature: 505°C (941°F)
Flash Points: CLOSED CUP: 24°C (75.2°F). OPEN CUP: 32.24°C (90°F).
Flammable Limits: LOWER: 1% UPPER: 10%
Products of Combustion: These products are carbon oxides (CO, CO2).
Fire Hazards in Presence of Various Substances: Not available.
Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in
presence of static discharge: Not available.
Fire Fighting Media and Instructions:
Flammable liquid, soluble or dispersed in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use alcohol foam,
water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.
Special Remarks on Fire Hazards: Not available.
Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures
Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.
Large Spill: Flammable liquid. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material.

Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions: Keep locked up Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapour/spray. Wear suitable protective clothing In case of insufficient ventilation, wear suitable respiratory equipment If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes Keep away from incompatibles such as oxidizing agents.

Storage:

Flammable materials should be stored in a separate safety storage cabinet or room. Keep away from heat. Keep away from sources of ignition. Keep container tightly closed. Keep in a cool, well-ventilated place. Ground all equipment containing material. A refrigerated room would be preferable for materials with a flash point lower than 37.8°C (100°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls: Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:

Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:

Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits: TWA: 5 (ppm) TWA: 30 (mg/m3) from NIOSH Australia: TWA: 5 (ppm)Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.
Odor: Camphor like
Taste: Not available.
Molecular Weight: 132.21 g/mole
Color: Pale Straw color. (Light.)
pH (1% soln/water): Not available.
Boiling Point: 64.5°C (148.1°F)
Melting Point: 5°C (41°F)
Critical Temperature: Not available.
Specific Gravity: 0.978 (Water = 1)

Vapor Pressure: Not available.
Vapor Density: 4.6 (Air = 1)
Volatility: Not available.
Odor Threshold: 0.003 ppm
Water/Oil Dist. Coeff.: Not available.
Ionicity (in Water): Not available.
Dispersion Properties:
Partially dispersed in methanol, diethyl ether, n-octanol. Very slightly dispersed in cold water, hot water. See solubility in methanol, diethyl ether, n-octanol, acetone.
Solubility: Soluble in acetone. Partially soluble in methanol, diethyl ether, n-octanol. Very slightly soluble in cold water, hot water.

Section 10: Stability and Reactivity Data
Stability: The product is stable.
Instability Temperature: Not available.
Conditions of Instability: Not available.
Incompatibility with various substances: Reactive with oxidizing agents.
Corrosivity: Not available.
Special Remarks on Reactivity: Not available.
Special Remarks on Corrosivity: Not available.
Polymerization: No.

Section 11: Toxicological Information
Routes of Entry: Dermal contact. Eye contact. Inhalation. Ingestion.
Toxicity to Animals: Acute oral toxicity (LD50): 190 mg/kg [Mouse]. Acute dermal toxicity (LD50): 5080 mg/kg [Rabbit].
Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified None. by OSHA, None. by NIOSH. The substance is toxic to kidneys, liver, gastrointestinal tract, upper respiratory tract, skin, eyes, central nervous system (CNS).
Other Toxic Effects on Humans: Hazardous in case of skin contact (irritant), of ingestion, of inhalation.
Special Remarks on Toxicity to Animals: Not available.
Special Remarks on Chronic Effects on Humans: Not available.
Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information
Ecotoxicity: Not available.
BOD5 and COD: Not available.
Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.
Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.
Special Remarks on the Products of Biodegradation: Not available.

HMIS (U.S.A.):
Health Hazard: 2
Fire Hazard: 3
Reactivity: 0
Personal Protection: h
National Fire Protection Association (U.S.A.):
Health: 1
Flammability: 3
Reactivity: 1
Specific hazard:
Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

1.2.8 Propionaldehyde

MATERIAL SAFETY DATA SHEET
SUBSTANCE: PROPIONALDEHYDE
TRADE NAMES/SYNONYMS:
MTG MSDS 235; PROPANAL; PROPYL ALDEHYDE; METHYLACETALDEHYDE; PROPIONIC ALDEHYDE; PROPYLIC ALDEHYDE; PROPALDEHYDE; UN 1275; MAT19740; RTECS UE0350000
CHEMICAL FAMILY: aldehydes, aliphatic

2. COMPOSITION, INFORMATION ON INGREDIENTS
COMPONENT: PROPIONALDEHYDE
CAS NUMBER: 123-38-6
PERCENTAGE: 100.0

3. HAZARDS IDENTIFICATION
NFPA RATINGS (SCALE 0-4): HEALTH=3 FIRE=3 REACTIVITY=0
EMERGENCY OVERVIEW:
COLOR: colorless
PHYSICAL FORM: liquid
ODOR: irritating odor
MAJOR HEALTH HAZARDS: harmful if inhaled, respiratory tract burns, skin burns, eye burns, mucous membrane burns, allergic reactions
PHYSICAL HAZARDS: Flammable liquid and vapor. Vapor may cause flash fire.
POTENTIAL HEALTH EFFECTS:
INHALATION:
SHORT TERM EXPOSURE: burns, nausea, vomiting, difficulty breathing, lung congestion, liver damage,
LONG TERM EXPOSURE: same as effects reported in short term exposure

SKIN CONTACT:
SHORT TERM EXPOSURE: allergic reactions, burns
LONG TERM EXPOSURE: same as effects reported in short term exposure
EYE CONTACT:
SHORT TERM EXPOSURE: burns, blurred vision
LONG TERM EXPOSURE: same as effects reported in short term exposure
INGESTION:
SHORT TERM EXPOSURE: burns, sore throat, vomiting, diarrhea, stomach pain, lung congestion, kidney
damage, liver damage, convulsions
LONG TERM EXPOSURE: same as effects reported in short term exposure

4. FIRST AID MEASURES
INHALATION: If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. If breathing is difficult, oxygen should be administered by qualified personnel. Get immediate medical attention.
SKIN CONTACT: Wash skin with soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get immediate medical attention. Thoroughly clean and dry contaminated clothing before reuse. Destroy contaminated shoes.
EYE CONTACT: Flush eyes with plenty of water for at least 15 minutes. Then get immediate medical attention.
INGESTION: Contact local poison control center or physician immediately. Never make an unconscious person vomit or drink fluids. Give large amounts of water or milk. Allow vomiting to occur. When vomiting occurs, keep head lower than hips to help prevent aspiration. If person is unconscious, turn head to side. Get medical attention immediately.
NOTE TO PHYSICIAN: For inhalation, consider oxygen. Avoid gastric lavage or emesis.

5. FIRE FIGHTING MEASURES
FIRE AND EXPLOSION HAZARDS: Severe fire hazard. Severe explosion hazard. The vapor is heavier than air. Vapors or gases may ignite at distant ignition sources and flash back. Vapor/air mixtures are explosive above flash point.
EXTINGUISHING MEDIA: alcohol-resistant foam, carbon dioxide, regular dry chemical, water, alcoholresistant foam Large fires: Use alcohol-resistant foam or flood with fine water spray.
FIRE FIGHTING: Move container from fire area if it can be done without risk. Cool containers with water spray until well after the fire is out. Stay away from the ends of tanks. For fires in cargo or storage area: Cool containers with water from unmanned hose holder or monitor nozzles until well after fire is out. If this is impossible then take the following precautions: Keep unnecessary people away, isolate hazard area and deny entry. Let the fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tanks due to fire. For tank, rail car or tank truck: Evacuation radius: 800 meters (1/2 mile). Water may be ineffective.

FLASH POINT: -22 F (-30 C) (OC)
LOWER FLAMMABLE LIMIT: 2.6%

UPPER FLAMMABLE LIMIT: 17%
AUTOIGNITION: 405 F (207 C)
FLAMMABILITY CLASS (OSHA): IB

6. ACCIDENTAL RELEASE MEASURES
OCCUPATIONAL RELEASE: Avoid heat, flames, sparks and other sources of ignition. Remove sources of ignition. Stop leak if possible without personal risk. Reduce vapors with water spray. Small spills: Absorb with sand or other noncombustible material. Collect spilled material in appropriate container for disposal. Large spills: Dike for later disposal. Keep unnecessary people away, isolate hazard area and deny entry. Stay upwind and keep out of low areas.

7. HANDLING AND STORAGE
STORAGE: Protect from physical damage. Store in a cool, dry place. Store in a well-ventilated area. Store outside or in a detached building. Avoid heat, flames, sparks and other sources of ignition. Store with flammable liquids. Keep separated from incompatible substances.

8. EXPOSURE CONTROLS, PERSONAL PROTECTION
EXPOSURE LIMITS:
PROPIONALDEHYDE:
20 ppm ACGIH TWA
20 ppm AIHA WEEL TWA
VENTILATION: Provide local exhaust ventilation system. Ventilation equipment should be explosionresistant if explosive concentrations of material are present. Ensure compliance with applicable exposure limits.
EYE PROTECTION: Wear splash resistant safety goggles with a faceshield. Provide an emergency eye wash fountain and quick drench shower in the immediate work area.
CLOTHING: Wear appropriate chemical resistant clothing.
GLOVES: Wear appropriate chemical resistant gloves.
RESPIRATOR: Under conditions of frequent use or heavy exposure, respiratory protection may be needed. Respiratory protection is ranked in order from minimum to maximum. Consider warning properties before use. Any chemical cartridge respirator with organic vapor cartridge(s). Any chemical cartridge respirator with a full facepiece and organic vapor cartridge(s). Any air-purifying respirator with a full facepiece and an organic vapor canister.
For Unknown Concentrations or Immediately Dangerous to Life or Health -
Any supplied-air respirator with a full facepiece that is operated in a pressure-demand or other positivepressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressuredemand or other positive-pressure mode. Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

9. PHYSICAL AND CHEMICAL PROPERTIES
PHYSICAL STATE: liquid
COLOR: colorless
ODOR: irritating odor
MOLECULAR FORMULA: C3-H6-O
BOILING POINT: 120 F (49 C)
FREEZING POINT: -114 F (-81 C)
VAPOR PRESSURE: 300 mmHg @ 20 C
VAPOR DENSITY (air=1): 2.0
SPECIFIC GRAVITY (water=1): 0.8
WATER SOLUBILITY: 20%
PH: Not available
VOLATILITY: Not available
ODOR THRESHOLD: 1 ppm
EVAPORATION RATE: Not available
COEFFICIENT OF WATER/OIL DISTRIBUTION: Not available
SOLVENT SOLUBILITY:
Miscible: alcohol, ether

10. STABILITY AND REACTIVITY
REACTIVITY: Stable at normal temperatures and pressure.
CONDITIONS TO AVOID: Avoid heat, flames, sparks and other sources of ignition. Containers may rupture or explode if exposed to heat.
HAZARDOUS DECOMPOSITION:
Thermal decomposition products or contact with light: oxides of carbon, hydrocarbon gases
POLYMERIZATION: May polymerize. Avoid contact with acids, alkalis, amines or mercaptans.

11. TOXICOLOGICAL INFORMATION
PROPIONALDEHYDE:
IRRITATION DATA: 500 mg open skin-rabbit mild; 41 mg eyes-rabbit severe; 20 mg/24 hour(s) eyesrabbit moderate
TOXICITY DATA: 21800 mg/m3 inhalation-mammal LC50; 2460 mg/kg skin-rabbit LD50; 1410 mg/kg oral-rat LD50
LOCAL EFFECTS:
Corrosive: inhalation, skin, eye, ingestion
ACUTE TOXICITY LEVEL:
Moderately Toxic: inhalation, ingestion Slightly Toxic: dermal absorption
TARGET ORGANS: immune system (sensitizer)
MUTAGENIC DATA: Available.

12. ECOLOGICAL INFORMATION
ECOTOXICITY DATA:

FISH TOXICITY: 100000 ug/L 96 hour(s) LC50 (Mortality) Inland silverside (Menidia beryllina)
ALGAL TOXICITY: 8000 ug/L 11-20 day(s) (Population Growth) Green algae (Chlorella sp)
13. DISPOSAL CONSIDERATIONS
Dispose in accordance with all applicable regulations.

1.2.9 Citreonellol

1. Product /Company Identification
Product Name: CITRONELLOL (ALL GRADES)

2. Composition/Information on Ingredient
Synonyms: 2,6-Dimethyl-2-octen-8-ol
CAS Number: 106-22-9
FEMA: 2309
Molecular Formula: C10 H20 O Molecular Weight: 156.27

3. Hazards Identification
Emergency Overview: Harmful by inhalation and if swallowed. Irritant. Irritating to eyes, respiratory system and skin. Causes severe irritation
HMIS NFPA
Health 2 2
Flammability 0 0
Reactivity 0 0

4. First Aid Measures
Oral Exposure: If swallowed, wash out mouth with water provided person is conscious. Call a physician.
Inhalation Exposure: If inhaled, move to fresh air. If not breathing give artificial respiration. IF breathing is difficult, give oxygen.
Skin Exposure: In case of contact, immediately wash skin with soap and copious amounts of water.
Eye Exposure: In case of contact, immediately flush eyes with copious amounts of water for at least 15 minutes

5. Fire Fighting Measures
Flammable Hazards: No
Flash Point: 99ºC

Extinguishing Material: Water Spray, Carbon Dioxide, Dry Chemical Powder, Foam
Protective Equipment: Wear self-contained breathing apparatus and protective clothing to prevent contact with skin and eyes.
Specific Fire Fighting Hazards: Emits toxic fumes under fire conditions.
6.Accidental Release Measures
In case of spill: Evacuate Area
Personal Protection: Exercise appropriate precautions to minimize direct contact with skin or eyes. Wear self-contained breathing apparatus, rubber boots and heavy rubber gloves.
Clean up Methods: Cover with dry lime or soda ash, pick up and hold in a closed container for waste disposal. Ventilate area and wash spill site after clean up is complete.

7. Handling and Storage Procedures
Handling: Do not breathe vapor. Do not get in eyes, skin and clothing. Avoid prolonged or repeated exposure.
Storage: Keep container tightly closed.

8. Exposure Controls/ PPE
Respiratory: At a minimum, workers should wear a NIOSH-approved full-face airpurifying respirator.
Eyes: Chemical Safety goggles
Skin: Chemical resistant gloves.
Ventilation: Mechanical exhaust required.
General Hygiene Measures: Wash thoroughly after handling.

9. Physical/Chemical Properties
Appearance: Colorless to pale yellow Liquid
Odor: Rose-like odor
Boiling Point: 105º C
Melting Point:
Flash Point: 99 ºC (201 F)
Vapor Density: 5.4 g/1
Specific Gravity: 0.855
Refractive Index: 1.458

10. Stability and Reactivity
Stability: Stable
Materials to Avoid: Strong oxidizing agents
Hazardous Decomposition Products: Carbon Monoxide, Carbon Dioxide.

11. Toxicological Information
Exposure Effects:
Skin Contact: Causes severe skin irritation.
Skin Absorption: May be harmful if absorbed through skin.
Eye Contact: Causes eye irritation.
Inhalation: May be harmful if inhaled. Material is extremely destructive to the

tissue of the mucous membranes and upper respiratory tract.
Ingestion: May be harmful if swallowed.
To the best of our knowledge, the chemical, physical and toxicological properties have not been thoroughly investigated.

12. Ecological Information
No Data Available.
13. Disposal Considerations
Disposal: Dissolve or mix this material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber. Dispose of in accordance with local, state regulations.

1.2.10 Benzyl Chloride

Benzyl chloride MSDS
Section 1: Chemical Product and Company Identification
Product Name: Benzyl chloride
CAS#: 100-44-7
Synonym: Alpha-chlorotoluene
Chemical Name: 1-Chloromethylbenzene
Chemical Formula: (-C(CH2Cl)=CHCH=CHCH=CH-)

Section 2: Composition and Information on Ingredients
Composition:
Name CAS # % by Weight
Benzyl chloride 100-44-7 100
Toxicological Data on Ingredients: Benzyl chloride: ORAL (LD50): Acute: 1231 mg/kg [Rat.].

Section 3: Hazards Identification
Potential Acute Health Effects:
Very hazardous in case of skin contact (irritant, permeator), of eye contact (irritant), of inhalation. Hazardous in case of ingestion. Corrosive to skin and eyes on contact. Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Severe over-exposure can result in death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.
Potential Chronic Health Effects:
Very hazardous in case of skin contact (irritant, permeator), of eye contact (irritant), of inhalation. Hazardous in case of ingestion. CARCINOGENIC EFFECTS: Classified A2 (Suspected for human.) by ACGIH. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance is toxic

to kidneys, lungs, the nervous system, liver, mucous membranes. Repeated or prolonged exposure to the substance can produce target organs damage. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection. Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs. Repeated or prolonged inhalation of vapors may lead to chronic respiratory irritation.

Section 4: First Aid Measures

Eye Contact: Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention immediately.

Skin Contact: In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact: Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation: If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Serious Inhalation: Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion: Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Combustible.

Auto-Ignition Temperature: 525°C (977°F)

Flash Points: CLOSED CUP: 67.2°C (153°F). OPEN CUP: 74°C (165.2°F) (Cleveland).

Flammable Limits: LOWER: 1.1% UPPER: 14%

Products of Combustion: These products are carbon oxides (CO, CO2), halogenated compounds.

Fire Hazards in Presence of Various Substances: Flammable in presence of open flames and sparks, of heat.

Explosion Hazards in Presence of Various Substances:

Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in

presence of static discharge: Not available.

Fire Fighting Media and Instructions:

SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray, fog or foam. Do not use water jet.
Special Remarks on Fire Hazards: Combustible. When heated to decomposition it emits toxic fumes.
Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures
Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.
Large Spill: Combustible material. Corrosive liquid. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Use water spray curtain to divert vapor drift. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage
Precautions: Keep locked up.. Keep container dry. Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents.
Storage: Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame).

Section 8: Exposure Controls/Personal Protection
Engineering Controls: Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.
Personal Protection: Face shield. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves. Boots.
Personal Protection in Case of a Large Spill: Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.
Exposure Limits: TWA: 1 Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties
Physical state and appearance: Liquid. (Liquid.)
Odor: Pungent.
Taste: Not available.
Molecular Weight: 126.59 g/mole
Color: Colorless.

pH (1% soln/water): Not applicable.
Boiling Point: 179°C (354.2°F)
Melting Point: -43°C (-45.4°F)
Critical Temperature: Not available.
Specific Gravity: 1.1 (Water = 1)
Vapor Pressure: 0.1 kPa (@ 20°C)
Vapor Density: 4.36 (Air = 1)
Volatility: 100% (v/v).
Odor Threshold: 0.041 ppm
Water/Oil Dist. Coeff.: Not available.
Ionicity (in Water): Not available.
Dispersion Properties: See solubility in water, methanol, diethyl ether.
Solubility:
Partially soluble in methanol, diethyl ether. Insoluble in cold water, hot water.

Section 10: Stability and Reactivity Data
Stability: The product is stable.
Instability Temperature: Not available.
Conditions of Instability: Not available.
Incompatibility with various substances:
Reactive with oxidizing agents. Slightly reactive to reactive with metals.
Corrosivity: Non-corrosive in presence of glass.
Special Remarks on Reactivity: May decompose on exposure to moist air or water.
Special Remarks on Corrosivity: Not available.
Polymerization: Yes.

Section 11: Toxicological Information
Routes of Entry: Dermal contact. Eye contact. Inhalation. Ingestion.
Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral
toxicity (LD50): 1231 mg/kg [Rat.]. Acute toxicity of the vapor (LC50): 150 1 hours [Rat].
Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified A2 (Suspected for human.) by ACGIH. Causes damage to the following organs:
kidneys, lungs, the nervous system, liver, mucous membranes.
Other Toxic Effects on Humans:
Very hazardous in case of skin contact (irritant, permeator), of inhalation. Hazardous in case of ingestion.
Special Remarks on Toxicity to Animals: Not available.
Special Remarks on Chronic Effects on Humans: Tumorigen. 0700 In vitro studies in mammal cells, has shown mutagenic action.
Special Remarks on other Toxic Effects on Humans: Material is extremely destructive to tissue of the mucous membranes
and upper respiratory tract.

Section 12: Ecological Information
Ecotoxicity: Not available.
BOD5 and COD: Not available.
Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.
Toxicity of the Products of Biodegradation: The products of degradation are as toxic as the original product.

1.2.11 Tetrahydrofuran

Tetrahydrofuran MSDS

Section 1: Chemical Product and Company Identification
Product Name: Tetrahydrofuran
CAS#: 109-99-9
Synonym: Tetrahydrofuran stabilized with BHT;
THF; Butylene Oxide; Cyclotetramethylene oxide; 1,4- Epoxybutane
Chemical Name: Tetrahydrofuran
Chemical Formula: C4H8O

Section 2: Composition and Information on Ingredients
Composition:
Name CAS # % by Weight
Tetrahydrofuran 109-99-9 100
Toxicological Data on Ingredients: Tetrahydrofuran: ORAL (LD50): Acute: 1650 mg/kg [Rat]. VAPOR (LC50): Acute: 21000 mg/m 3 hours [Rat].

Section 3: Hazards Identification
Potential Acute Health Effects:
Hazardous in case of skin contact (irritant), of eye contact (irritant). Slightly hazardous in case of skin contact (permeator), of ingestion, of inhalation.
Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to blood, kidneys, lungs, liver, upper respiratory tract, skin, eyes, central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures
Eye Contact: Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention.

Skin Contact: In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.
Serious Skin Contact: Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.
Inhalation: If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.
Serious Inhalation: Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek medical attention.
Ingestion: Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.
Serious Ingestion: Not available.

Section 5: Fire and Explosion Data
Flammability of the Product: Flammable.
Auto-Ignition Temperature: 321°C (609.8°F)
Flash Points: CLOSED CUP: -14.5°C (5.9°F). OPEN CUP: -20°C (-4°F).
Flammable Limits: LOWER: 2% UPPER: 11.8%
Products of Combustion: These products are carbon oxides (CO, CO2).
Fire Hazards in Presence of Various Substances: Highly flammable in presence of open flames and sparks, of heat. Non-flammable in presence of shocks.
Explosion Hazards in Presence of Various Substances: Risks of explosion of the product in presence of mechanical impact: Not available. Explosive in presence of open flames and sparks, of heat.
Fire Fighting Media and Instructions: Flammable liquid, soluble or dispersed in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use alcohol foam, water spray or fog.
Special Remarks on Fire Hazards: Vapor may travel considerable distance to source of ignition and flash back. May form explosive mixtures with air.
Special Remarks on Explosion Hazards: Reacts explosively with lithium-aluminum alloys, and Sodium Aluminum Hydride, Potassium hydroxide, Calcium Hydride. It is normally stable, however, prolonged storage, and exposure to air and light may cause formation of unstable explosive peroxides especially when anhydrous and unless it is inhibited against peroxide formation. Explosive in the form of vapor when exposed to heat or flame.

Section 6: Accidental Release Measures
Small Spill: Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container.

Large Spill: Flammable liquid. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage
Precautions: Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents.
Storage: Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame). Prolonged exposure to air and light may form unstable explosive peroxides unless it is inhibited against peroxide formation.

Section 8: Exposure Controls/Personal Protection
Engineering Controls: Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.
Personal Protection: Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.
Personal Protection in Case of a Large Spill: Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.
Exposure Limits: TWA: 590 STEL: 737 (mg/m3) from ACGIH (TLV) [United States] Inhalation TWA: 200 STEL: 250 (ppm) from ACGIH (TLV) [United States] Inhalation TWA: 590 STEL: 735 (mg/m3) from NIOSH [United States] Inhalation TWA: 200 STEL: 250 (ppm) from NIOSH [United States] Inhalation TWA: 200 STEL: 250 (ppm) from OSHA (PEL) [United States] Inhalation TWA: 590 STEL: 735 (mg/m3) from OSHA (PEL) [United States] Inhalation TWA: 100 STEL: 200 (ppm) [United Kingdom (UK)] Inhalation TWA: 300 STEL: 599 (mg/m3) [United Kingdom (UK)] Inhalation3 Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties
Physical state and appearance: Liquid.
Odor: Ethereal. Fruity.
Taste: Pungent.
Molecular Weight: 72.11 g/mole
Color: Colorless.
pH (1% soln/water): Not available.
Boiling Point: 65°C (149°F) @ 760 mm Hg

Melting Point: -108.3°C (-162.9°F)
Critical Temperature: 267°C (512.6°F)
Specific Gravity: 0.8892 (Water = 1)
Vapor Pressure: 19.3 kPa (@ 20°C)
Vapor Density: 2.5 (Air = 1)
Volatility: 100% (v/v).
Odor Threshold: 20 ppm - 50 ppm
Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 0.5
Ionicity (in Water): Not available.
Dispersion Properties: See solubility in water, diethyl ether, acetone.
Solubility: Easily soluble in diethyl ether, acetone. Partially soluble in cold water. Solubility in water is 30%. Miscible with alcohols, ketones, esters, hydrocarbons, and ethers. Very soluble in benzene, ethanol, and chloroform.

Section 10: Stability and Reactivity Data
Stability: The product is stable.
Instability Temperature: Not available.
Conditions of Instability: Heat, ignition sources (sparks, flames), light, air, and incompatible materials
Incompatibility with various substances: Reactive with oxidizing agents, acids, alkalis.
Corrosivity: Non-corrosive in presence of glass.
Special Remarks on Reactivity: Reacts violently with Bromine. Addition of anhydrous chlorides (hafnium tetrachloride, titanium tetrachloride, and zirconium tetrachloride) directly to tetrahydrofuran will cause a violent exothermic reaction. Also incompatible with Calcium Hydride + heat, caustics (e.g. ammonia, ammonium hydroxide, calcium hyroxide, potassium hydroxide, sodium hydroxide), metal halides, moisture, lithium tetrahydroaluminate, borane, 2-aminophenol + potassium dioxide, sodium tetrahydroaluminate, and 2-aminophenol. Prolonged exposure to air and light may form unstable peroxides especially when anhydrous and unless it is inhibited against peroxide formation.
Special Remarks on Corrosivity: It will attack some forms of plastics, rubber, coatings.
Polymerization: Will not occur.

Section 11: Toxicological Information
Routes of Entry: Absorbed through skin. Dermal contact. Eye contact.
Toxicity to Animals: WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 1650 mg/kg [Rat]. Acute toxicity of the vapor (LC50): 24000 mg/m3 2 hours [Mouse].
Chronic Effects on Humans: MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. May cause damage to the following organs: blood, kidneys, lungs, liver, upper respiratory tract, skin, eyes, central nervous system (CNS).
Other Toxic Effects on Humans: Hazardous in case of skin contact (irritant). Slightly hazardous in case of skin contact (permeator), of ingestion, of inhalation.
Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:
It is excreted in mother's milk. May cause cancer based on animal data. No human data found at this point. May cause adverse reproductive effects (fetotoxicity) based on animal data. No human data found at this point. May affect genetic material.
Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Causes skin irritation. May be absorbed through skin and cause symptoms similar those of inhalation and ingestion. Eyes: Contact with eyes may cause severe irritation with possible eye burns. Vapors may cause eye irritation.
Inhalation: May cause upper respiratory tract (nose, throat) irriation. High concentrations may affect behavior/ central nervous system (central nervous system depression/effects characterized by headache, general anesthetic, dizziness, somnolence, muscle weakness, loss of conciousness, and coma), respiration (respiratory stimulation, dyspnea), and gastrointestinal tract (nausea, vomiting). Ingestion: May cause gastrointestinal irritation with nausea, vomiting, and diarrhea, abdominal pain. May also affect the liver and behavior/central nervous system with symptoms similar to inhalation. Chronic Potential Health Effects: Skin: Prolonged or repeated skin contact may cause defatting and dermatitis. Eyes: Prolonged or repeated eye contact may cause conjunctivitis. Inhalation: Prolonged or repeated exposure to vapors may affect the liver, kidneys, muculosketal system, endrocrine system (spleen and thymus), blood, cardiovascular system, thymus, spleen, and lungs (lung damage). Ingestion: Prolonged or repeated exposure from ingestion may affect the blood, and metabolism.

Section 12: Ecological Information
Ecotoxicity: Ecotoxicity in water (LC50): 2160 mg/l 96 hours [Fish (Fathead Minnow)].
BOD5 and COD: Not available.
Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.
Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.
Special Remarks on the Products of Biodegradation: Not available.

HMIS (U.S.A.):
Health Hazard: 2
Fire Hazard: 3
Reactivity: 0
Personal Protection: h
National Fire Protection Association (U.S.A.):
Health: 2
Flammability: 3
Reactivity: 1
Specific hazard:
Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

1.2.12 Isobutyric acid

Isobutyric Acid MSDS

Section 1: Chemical Product and Company Identification
Product Name: Isobutyric Acid
CAS#: 79-31-2
Synonym: 2-Methylpropionic acid
Chemical Name: Isobutyric Acid
Chemical Formula: C4-H8-O2

Section 2: Composition and Information on Ingredients
Composition:
Name CAS # % by Weight
Isobutyric Acid 79-31-2 100
Toxicological Data on Ingredients: Isobutyric Acid: ORAL (LD50): Acute: 266 mg/kg [Rat]. DERMAL (LD50): Acute: 475 mg/ kg [Rabbit].

Section 3: Hazards Identification
Potential Acute Health Effects:
Very hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Hazardous in case of skin contact (corrosive, permeator), of eye contact (corrosive). Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.
Potential Chronic Health Effects: CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection.

Section 4: First Aid Measures
Eye Contact: Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. WARM water MUST be used. Get medical attention immediately.
Skin Contact: In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.
Serious Skin Contact: Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.
Inhalation: If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.
Serious Inhalation: Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.
Ingestion: Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.
Serious Ingestion: Not available.

Section 5: Fire and Explosion Data
Flammability of the Product: Flammable.
Auto-Ignition Temperature: 501.67°C (935°F)
Flash Points: CLOSED CUP: 55°C (131°F). OPEN CUP: 76.667°C (170°F).
Flammable Limits: LOWER: 2% UPPER: 9%
Products of Combustion: These products are carbon oxides (CO, CO2).
Fire Hazards in Presence of Various Substances: Flammable in presence of open flames and sparks, of heat. Non-flammable in presence of shocks.
Explosion Hazards in Presence of Various Substances: Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.
Fire Fighting Media and Instructions: Flammable liquid, soluble or dispersed in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use alcohol foam, water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.
Special Remarks on Fire Hazards: Not available.
Special Remarks on Explosion Hazards: Vapor forms explosive mixtures with air.

Section 6: Accidental Release Measures
Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill: Flammable liquid. Corrosive liquid. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Use water spray curtain to divert vapor drift. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal.

Section 7: Handling and Storage
Precautions: Keep container dry. Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents.
Storage: Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame).

Section 8: Exposure Controls/Personal Protection
Engineering Controls: Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.
Personal Protection: Face shield. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves. Boots.
Personal Protection in Case of a Large Spill: Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid
inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.
Exposure Limits: Not available.

Section 9: Physical and Chemical Properties
Physical state and appearance: Liquid.
Odor: Pungent, like rancid butter
Taste: Sharp, butter-fat-like, cheesy
Molecular Weight: 88.1g/mole
Color: Clear Colorless.
pH (1% soln/water): Not available.
Boiling Point: 154°C (309.2°F)
Melting Point: -47°C (-52.6°F)
Critical Temperature: 336.11°C (637°F)
Specific Gravity: 0.95 (Water = 1)
Vapor Pressure: Not available.
Vapor Density: 3.04 (Air = 1)
Volatility: Not available.
Odor Threshold: 8.1 ppm
Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 0.5

Ionicity (in Water): Not available.
Dispersion Properties: See solubility in water, diethyl ether.
Solubility: Soluble in diethyl ether. Very slightly soluble in cold water, hot water. Miscible with alcohol and chloroform.

Section 10: Stability and Reactivity Data
Stability: The product is stable.
Instability Temperature: Not available.
Conditions of Instability: High temperatures, ignition sources (flames, sparks), incompatible materials
Incompatibility with various substances: Reactive with oxidizing agents.
Corrosivity: Not available.
Special Remarks on Reactivity: Not available.
Special Remarks on Corrosivity: It is corrosive to metals.
Polymerization: Yes.

Section 11: Toxicological Information
Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation. Ingestion.
Toxicity to Animals:
Acute oral toxicity (LD50): 266 mg/kg [Rat]. Acute dermal toxicity (LD50): 475 mg/kg [Rabbit].
Chronic Effects on Humans: Not available.
Other Toxic Effects on Humans:
Very hazardous in case of skin contact (irritant), of ingestion, . Hazardous in case of skin contact (corrosive, permeator), of eye
contact (corrosive), of inhalation (lung corrosive).
Special Remarks on Toxicity to Animals: Not available.
Special Remarks on Chronic Effects on Humans: Not available.
Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Corrosive. Causes severe skin irritation and skin burns. May be harmful if absorbed through skin. Eyes: Corrosive. Causes severe eye irritation and burns. Inhalation: Inhalation of vapors causes irritation and chemical burns to the respiratory tract and may cause dizziness or suffocation. Inhalation may be fatal as a result of spasm, inflammation, edema of the larynx and bronchi, chemical pneumonitis and pulmonary edema. Ingestion: Harmful of swallowed. May cause severe digestive tract irritation with possible burns. May cause permanent damage to the digestive tract.

Section 12: Ecological Information
Ecotoxicity: Not available.
BOD5 and COD: Not available.
Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.
Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations
Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

HMIS (U.S.A.):
Health Hazard: 3
Fire Hazard: 2
Reactivity: 0
Personal Protection:
National Fire Protection Association (U.S.A.):
Health: 3
Flammability: 2
Reactivity: 0
Specific hazard:
Protective Equipment:
Gloves. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Face shield.

1.2.13 Ethyl chloroacetate

Ethyl Chloroacetate MSDS

Section 1: Chemical Product and Company Identification
Product Name: Ethyl Chloroacetate
CAS#: 105-39-5
Synonym: Chloroacetic Acid, ethyl ester; Ethyl alpha-chloroacetate; Ethyl chloroethanoate; Ethyl monochloracetate; Ethyl monochloroacetate
Chemical Name: Acetic acid, chloro-, ethyl ester
Chemical Formula: C4-H7-Cl-O2

Section 2: Composition and Information on Ingredients
Composition: Name CAS # % by Weight Ethyl Chloroacetate 105-39-5 100
Toxicological Data on Ingredients: Ethyl Chloroacetate: ORAL (LD50): Acute: 180 mg/kg [Rat]. 350 mg/kg [Mouse]. DERMAL (LD50): Acute: 161 mg/kg [Rat]. 230 mg/kg [Rabbit]. VAPOR (LC50): Acute: 3.3 mg/m 4 hours [Rat].

Section 3: Hazards Identification
Potential Acute Health Effects:

Hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Severe over-exposure can result in death.
Potential Chronic Health Effects: CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to lungs, upper respiratory tract. Repeated or prolonged exposure to the substance can produce target organs damage. Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4: First Aid Measures
Eye Contact: Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention.
Skin Contact: In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.
Serious Skin Contact: Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.
Inhalation: If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.
Serious Inhalation: Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.
Ingestion: If swallowed, do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.
Serious Ingestion: Not available.

Section 5: Fire and Explosion Data
Flammability of the Product: Flammable.
Auto-Ignition Temperature: Not available.
Flash Points: OPEN CUP: 64°C (147.2°F).
Flammable Limits: Not available.
Products of Combustion: These products are carbon oxides (CO, CO2), halogenated compounds.
Fire Hazards in Presence of Various Substances: Flammable in presence of open flames and sparks, of heat.
Explosion Hazards in Presence of Various Substances: Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.
Fire Fighting Media and Instructions: Flammable liquid, insoluble in water.
SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray or fog. Never direct a water jet in the container in order to prevent any splashing of the product which could

cause spreading of the fire. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.
Special Remarks on Fire Hazards: When heated to decomposition it emits highly toxic fumes.
Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures
Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.
Large Spill: Toxic flammable liquid, insoluble or very slightly soluble in water. Poisonous liquid. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal.

Section 7: Handling and Storage
Precautions: Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do notbreathe gas/fumes/ vapor/spray. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, reducing agents, acids, alkalis.
Storage: Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame). Moisture sensitive.

Section 8: Exposure Controls/Personal Protection
Engineering Controls: Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.
Personal Protection: Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.
Personal Protection in Case of a Large Spill: Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.
Exposure Limits: Not available.

Section 9: Physical and Chemical Properties
Physical state and appearance: Liquid.
Odor: Fruity. Pungent.
Taste: Not available.
Molecular Weight: 122.56 g/mole
Color: Colorless.
pH (1% soln/water): Not applicable.

Boiling Point: 144°C (291.2°F) - 146 C
Melting Point: -26°C (-14.8°F)
Critical Temperature: 344.85°C (652.7°F)
Specific Gravity: 1.1498 (Water = 1)
Vapor Pressure: 0.6 kPa (@ 25°C)
Vapor Density: 4.23 - 4.46 (Air = 1)
Volatility: Not available.
Odor Threshold: Not available.
Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 0.9
Ionicity (in Water): Not available.
Dispersion Properties: See solubility in water, diethyl ether, acetone.
Solubility:
Miscible in diethyl ether, acetone. Insoluble in cold water, hot water. Miscible with alcohol, ethanol.

Section 10: Stability and Reactivity Data
Stability: The product is stable.
Instability Temperature: Not available.
Conditions of Instability: Heat, ignition sources, incompatible materials
Incompatibility with various substances: Reactive with oxidizing agents, reducing agents, acids, alkalis.
Corrosivity: Not available.
Special Remarks on Reactivity: Can react vigorously with oxidizing materials. Will react with water or steam to produce toxic and corrosiive fumes. Vigorous reaction with sodium cyanide. When heated to decomposition, it emits highly toxic fumes of hydrogen chloride. Moisture sensitive
Special Remarks on Corrosivity: Not available.
Polymerization: Will not occur.

Section 11: Toxicological Information
Routes of Entry: Absorbed through skin. Eye contact. Inhalation. Ingestion.
Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 180 mg/kg [Rat]. Acute dermal toxicity (LD50): 161 mg/kg [Rat]. Acute toxicity of the vapor (LC50): 3.3 mg/m3 4 hours [Rat].
Chronic Effects on Humans: May cause damage to the following organs: lungs, upper respiratory tract.
Other Toxic Effects on Humans: Hazardous in case of skin contact (irritant), of ingestion, of inhalation.
Special Remarks on other Toxic Effects on Humans: Acute Potential Health Effects: Skin: Causes skin irritation. It can be absorbed through the skin in harmful amounts and cause systemic effects similar to inhalation and ingestion. Eyes: Causes severe eye irritation. It is a lacrimator. May cause conjunctivitis or eye damage. Inhalation: Harmful if inhaled. Causes respiratory tract irritation (nose, throat), and mucous membrane irritation with coughing and wheezing. Vapors may cause headache, nausea, dizziness, tremor, or suffocation.

Breathing Ethyl chloroacetate can also irritate the lungs causing coughing and/or shortness of breath (dyspnea) or respiratory stimulation. Higher exposures can also cause a build-up of fluid in the lungs (pulmonary edema) Ingestion: Harmful if swallowed. Causes digestive tract (mouth, stomach)irritation with nausea, vomiting, headache. May affect behavior may affect behavior/central nervous system (somnolence, ataxia, hallucinations, flaccid paralysis without anesthesia, tremor, dizziness).

Section 12: Ecological Information
Ecotoxicity: Not available.
BOD5 and COD: Not available.
Products of Biodegradation: Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.
Toxicity of the Products of Biodegradation: The products of degradation are as toxic as the product itself.
Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations
Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

HMIS (U.S.A.):
Health Hazard: 2
Fire Hazard: 2
Reactivity: 0
Personal Protection: h
National Fire Protection Association (U.S.A.):
Health: 3
Flammability: 2
Reactivity: 0
Specific hazard:
Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator
when ventilation is inadequate. Splash goggles.

1.2.14 Salycylic acid

Salicylic acid MSDS
Section 1: Chemical Product and Company Identification
Product Name: Salicylic acid
CAS#: 69-72-7
Synonym: 2-hydroxybenzoic acid
Chemical Name: Salicylic Acid
Chemical Formula: C7-H6-O3

Section 2: Composition and Information on Ingredients
Composition: Name CAS # % by Weight Salicylic acid 69-72-7 100
Toxicological Data on Ingredients: Salicylic acid: ORAL (LD50): Acute: 891 mg/kg [Rat]. 480 mg/kg [Mouse]. 1300 mg/kg [Rabbit].

Section 3: Hazards Identification
Potential Acute Health Effects: Hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation (lung irritant). Slightly hazardous in case of skin contact (permeator). Severe over-exposure can result in death.
Potential Chronic Health Effects: CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Classified Reproductive system/toxin/female, Development toxin [POSSIBLE]. Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4: First Aid Measures
Eye Contact: Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.
Skin Contact: In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.
Serious Skin Contact: Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.
Inhalation: If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.
Serious Inhalation: Not available.
Ingestion: Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Section 5: Fire and Explosion Data
Flammability of the Product: May be combustible at high temperature.
Auto-Ignition Temperature: 545°C (1013°F)

Flash Points: CLOSED CUP: 157°C (314.6°F).
Flammable Limits: LOWER: 1.1%
Products of Combustion: These products are carbon oxides (CO, CO2).
Fire Hazards in Presence of Various Substances: Slightly flammable to flammable in presence of heat.
Explosion Hazards in Presence of Various Substances: Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.
Fire Fighting Media and Instructions:
SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray, fog or foam. Do not use water jet.
Special Remarks on Fire Hazards: Not available.
Special Remarks on Explosion Hazards: Dust-Air mixtures may pose an explosion hazard.

Section 6: Accidental Release Measures
Small Spill: Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.
Large Spill: Poisonous solid. Stop leak if without risk. Do not get water inside container. Do not touch spilled material. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Call for assistance on disposal. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system.

Section 7: Handling and Storage
Precautions: Keep locked up.. Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not ingest. Do not breathe dust. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, moisture.
Storage: LIGHT SENSITIVE. MOISTURE SENSITIVE. Store in light resistant containers. Keep container tightly closed. Keep container in a cool, well-ventilated area. Do not store above 23°C (73.4°F).

Section 8: Exposure Controls/Personal Protection
Engineering Controls: Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.
Personal Protection: Splash goggles. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill: Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Section 9: Physical and Chemical Properties
Physical state and appearance: Solid. (Crystalline granules)
Odor: Odorless.
Taste: sweetish , afterward acrid
Molecular Weight: 138.12 g/mole
Color: White.
pH (1% soln/water): Not available.
Boiling Point: Decomposition temperature: 211°C (411.8°F)
Melting Point: 159°C (318.2°F)
Critical Temperature: Not available.
Specific Gravity: 1.443 (Water = 1)
Vapor Pressure: Not applicable.
Vapor Density: 4.8 (Air = 1)
Volatility: Not available.
Odor Threshold: Not available.
Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 2.3
Ionicity (in Water): Not available.
Dispersion Properties: See solubility in water, acetone.
Solubility: Soluble in acetone. Partially soluble in cold water. Very slightly soluble in hot water.

Section 10: Stability and Reactivity Data
Stability: The product is stable.
Conditions of Instability:
Excessive heat, excessive dust generation, Incompatible materials. Dust-Air mixtures
Incompatibility with various substances: Reactive with oxidizing agents, moisture.
Corrosivity: Non-corrosive in presence of glass.
Special Remarks on Reactivity: Light, moisture, Iron salts, spirt nitrous ether, lead acetate, iodine
Special Remarks on Corrosivity: Not available.
Polymerization: Will not occur.

Section 11: Toxicological Information
Routes of Entry: Absorbed through skin. Inhalation. Ingestion.
Toxicity to Animals: WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 480 mg/kg [Mouse]. Acute toxicity of the dust (LC50): 900 mg/m3 1 hours [Rat].
Chronic Effects on Humans: MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast. DEVELOPMENTAL TOXICITY: Classified Reproductive system/toxin/female, Development toxin [POSSIBLE].

Other Toxic Effects on Humans: Hazardous in case of skin contact (irritant), of ingestion, of inhalation (lung irritant). Slightly hazardous in case of skin contact (permeator).
Special Remarks on Chronic Effects on Humans: May affect genetic material (mutagenicity) based on animal studies. May cause adverse reproductive effects. Teratorgenic, Embryotoxic and/or foetotoxic in animal studies. Human: Transferred into maternal breast milk.
Special Remarks on other Toxic Effects on Humans: Acute Potential Health Efffects: Skin: May be harmful through skin absorption, May cause skin irritation. May affect the cardiovascular system (increase in blood pressure), and metabolism (body temperature increase) if absorbe through skin Eye: Causes eye irritation, tempory injury. Inhalation: Causes irritation of the respiratory system (coughing, difficult breathing), ringing in the ears, confusion, rapid pulse, headache, dizziness, nausea, and vomiting. Ingestion: May be harmful if swallowed in large amounts. Causes irritation of the gastrointestinal tract (nausea, vomiting abdominal pains). May affect behavior (muscle weakness and general depressed activity, confusion). May cause ringing in the ears, rapid breathing, sweating and possible kidney damage. Sever overexposure may result in central nervous system stimulation followed by depression. Chronic Potential Heath Effects: Possible hypersensitization.

Section 12: Ecological Information
Ecotoxicity: Not available.
Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.
Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

HMIS (U.S.A.):
Health Hazard: 2
Fire Hazard: 1
Reactivity: 0
Personal Protection: E
National Fire Protection Association (U.S.A.):
Health: 0
Flammability: 1
Reactivity: 0
Specific hazard:
Protective Equipment:
Gloves. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator
when ventilation is inadequate. Splash goggles.

1.2.15 Benzaldehyde

Benzaldehyde MSDS

Section 1: Chemical Product and Company Identification
Product Name: Benzaldehyde
CAS#: 100-52-7
Chemical Formula: C7H6O

Section 2: Composition and Information on Ingredients
Composition: Name CAS # % by Weight Benzaldehyde 100-52-7 100
Toxicological Data on Ingredients: Benzaldehyde: ORAL (LD50): Acute: 1300 mg/kg [Rat].

Section 3: Hazards Identification
Potential Acute Health Effects: Very hazardous in case of ingestion. Hazardous in case of skin contact (irritant), of eye contact (irritant), of inhalation. Slightly hazardous in case of skin contact (permeator).
Potential Chronic Health Effects: CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance is toxic to lungs, the nervous system, mucous membranes. Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures
Eye Contact: Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. WARM water MUST be used. Get medical attention.
Skin Contact: In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated
clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.
Serious Skin Contact: Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.
Inhalation: If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.
Ingestion: Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar,
tie, belt or waistband.

Section 5: Fire and Explosion Data
Flammability of the Product: Combustible.
Auto-Ignition Temperature: 192°C (377.6°F)
Flash Points: CLOSED CUP: 64.4°C (147.9°F). OPEN CUP: 73.9°C (165°F).
Flammable Limits: LOWER: 1.4%
Products of Combustion: These products are carbon oxides (CO, CO2).
Fire Hazards in Presence of Various Substances: Not available.
Explosion Hazards in Presence of Various Substances:

Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:

SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill: Combustible material. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system.

Section 7: Handling and Storage

Precautions: Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes.

Storage: Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame).

Section 8: Exposure Controls/Personal Protection

Engineering Controls: Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection: Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill: Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Molecular Weight: 106.13 g/mole

Color: Not available.

pH (1% soln/water): Not available.

Boiling Point: 179°C (354.2°F)

Melting Point: -26°C (-14.8°F)

Critical Temperature: Not available.

Specific Gravity: 1.04 (Water = 1)

Vapor Pressure: 0.1 kPa (@ 20°C)

Vapor Density: 3.66 (Air = 1)

Solubility: Very slightly soluble in cold water.

Section 10: Stability and Reactivity Data
Stability: The product is stable.
Incompatibility with various substances: Not available.
Corrosivity: Non-corrosive in presence of glass.
Polymerization: Will not occur.

Section 11: Toxicological Information
Routes of Entry: Eye contact. Inhalation. Ingestion.
Toxicity to Animals: Acute oral toxicity (LD50): 1300 mg/kg [Rat].
Chronic Effects on Humans: Causes damage to the following organs: lungs, the nervous system, mucous membranes.
Other Toxic Effects on Humans: Very hazardous in case of ingestion. Hazardous in case of skin contact (irritant), of inhalation. Slightly hazardous in case of skin contact (permeator).

Section 12: Ecological Information
Products of Biodegradation: Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.
Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Section 13: Disposal Considerations
Waste Disposal: As pe regulation

HMIS (U.S.A.):
Health Hazard: 2
Fire Hazard: 2
Reactivity: 0
Personal Protection: h
National Fire Protection Association (U.S.A.):
Health: 2
Flammability: 2
Reactivity: 0
Specific hazard:
Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator
when ventilation is inadequate. Splash goggles.

1.2.16 Hydrochloric acid

Hydrochloric acid MSDS

Section 1: Chemical Product and Company Identification
Product Name: Hydrochloric acid

CAS#: Mixture.
Synonym: Hydrochloric Acid; Muriatic Acid

Section 2: Composition and Information on Ingredients
Composition: Name CAS # % by Weight Hydrogen chloride 7647-01-0 20-38
Water 7732-18-5 62-80
Toxicological Data on Ingredients: Hydrogen chloride: GAS (LC50): Acute: 4701 ppm 0.5 hours [Rat].

Section 3: Hazards Identification
Potential Acute Health Effects: Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (irritant, corrosive), of ingestion, . Slightly hazardous in case of inhalation (lung sensitizer). Non-corrosive for lungs. Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Severe over-exposure can result in death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.
Potential Chronic Health Effects: Slightly hazardous in case of skin contact (sensitizer). CARCINOGENIC EFFECTS: Classified 3 (Not classifiable for human.) by IARC [Hydrochloric acid]. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to kidneys, liver, mucous membranes, upper respiratory tract, skin, eyes, Circulatory System, teeth. Repeated or prolonged exposure to the substance can produce target organs damage. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection. Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4: First Aid Measures
Eye Contact: Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.
Skin Contact: In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.
Serious Skin Contact: Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.
Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Serious Inhalation: Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.
Ingestion: If swallowed, do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

Section 5: Fire and Explosion Data
Flammability of the Product: Non-flammable.
Auto-Ignition Temperature: Not applicable.
Flash Points: Not applicable.
Flammable Limits: Not applicable.
Products of Combustion: Not available.
Fire Hazards in Presence of Various Substances: of metals
Explosion Hazards in Presence of Various Substances: Non-explosive in presence of open flames and sparks, of shocks.
Fire Fighting Media and Instructions: Not applicable.
Special Remarks on Fire Hazards: Non combustible. Calcium carbide reacts with hydrogen chloride gas with incandescence. Uranium phosphide reacts with hydrochloric acid to release spontaneously flammable phosphine. Rubidium acetylene carbides burns with slightly warm hydrochloric acid. Lithium silicide in contact with hydrogen chloride becomes incandescent. When dilute hydrochloric acid is used, gas spontaneously flammable in air is evolved. Magnesium boride treated with concentrated hydrochloric acid produces spontaneously flammble gas. Cesium acetylene carbide burns hydrogen chloride gas. Cesium carbide ignites in contact with hydrochloric acid unless acid is dilute. Reacts with most metals to produce flammable Hydrodgen gas.
Special Remarks on Explosion Hazards: Hydrogen chloride in contact with the following can cause an explosion, ignition on contact, or other violent/vigorous reaction: Acetic anhydride AgClO + CCl4 Alcohols + hydrogen cyanide, Aluminum Aluminum-titanium alloys (with HCl vapor), 2-Amino ethanol, Ammonium hydroxide, Calcium carbide Ca3P2 Chlorine + dinitroanilines (evolves gas), Chlorosulfonic acid Cesium carbide Cesium acetylene carbide, 1,1-Difluoroethylene Ethylene diamine Ethylene imine, Fluorine, HClO4 Hexalithium disilicide H2SO4 Metal acetylides or carbides, Magnesium boride, Mercuric sulfate, Oleum, Potassium permanganate, beta-Propiolactone Propylene oxide Rubidium carbide, Rubidium, acetylene carbide Sodium (with aqueous HCl), Sodium hydroxide Sodium tetraselenium, Sulfonic acid, Tetraselenium tetranitride, U3P4 , Vinyl acetate. Silver perchlorate with carbon tetrachloride in the presence of hydrochloric acid produces trichloromethyl perchlorate which detonates at 40 deg. C.

Section 6: Accidental Release Measures
Small Spill: Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. If necessary: Neutralize the residue with a dilute solution of sodium carbonate.

Large Spill: Corrosive liquid. Poisonous liquid. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Use water spray curtain to divert vapor drift. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Neutralize the residue with a dilute solution of sodium carbonate. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage
Precautions: Keep locked up.. Keep container dry. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, organic materials, metals, alkalis, moisture. May corrode metallic surfaces. Store in a metallic or coated fiberboard drum using a strong polyethylene inner package.
Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection
Engineering Controls: Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.
Personal Protection: Face shield. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves. Boots.
Personal Protection in Case of a Large Spill: Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.
Exposure Limits: CEIL: 5 (ppm) from OSHA (PEL) [United States] CEIL: 7 (mg/m3) from OSHA (PEL) [United States] CEIL: 5 from NIOSH CEIL: 7 (mg/m3) from NIOSH TWA: 1 STEL: 5 (ppm) [United Kingdom (UK)] TWA: 2 STEL: 8 (mg/m3) [United Kingdom (UK)]Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties
Physical state and appearance: Liquid.
Odor: Pungent. Irritating (Strong.)
Color: Colorless to light yellow.
pH (1% soln/water): Acidic.
Boiling Point: 108.58 C @ 760 mm Hg (for 20.22% HCl in water) 83 C @ 760 mm Hg (for 31% HCl in water) 50.5 C (for 37% HCl in water)
Melting Point: -62.25°C (-80°F) (20.69% HCl in water) -46.2 C (31.24% HCl in water) -25.4 C (39.17% HCl in water)
Specific Gravity:
1.1- 1.19 (Water = 1) 1.10 (20%and 22% HCl solutions) 1.12 (24% HCl solution) 1.15 (29.57% HCl solution) 1.16 (32% HCl

solution) 1.19 (37% and 38%HCl solutions)
Vapor Pressure: 16 kPa (@ 20°C) average
Vapor Density: 1.267 (Air = 1)
Volatility: Not available.
Odor Threshold: 0.25 to 10 ppm
Dispersion Properties: See solubility in water, diethyl ether.
Solubility: Soluble in cold water, hot water, diethyl ether.

Section 10: Stability and Reactivity Data
Stability: The product is stable.
Conditions of Instability: Incompatible materials, water
Incompatibility with various substances: Highly reactive with metals. Reactive with oxidizing agents, organic materials, alkalis, water.
Corrosivity: Extremely corrosive in presence of aluminum, of copper, of stainless steel(304), of stainless steel(316). Non-corrosive in presence of glass.
Special Remarks on Reactivity:
Reacts with water especially when water is added to the product. Absorption of gaseous hydrogen chloride on mercuric sulfate becomes violent @ 125 deg. C. Sodium reacts very violently with gaseous hydrogen chloride. Calcium phosphide and hydrochloric acid undergo very energetic reaction. It reacts with oxidizers releasing chlorine gas. Incompatible with, alkali metals, carbides, borides, metal oxides, vinyl acetate, acetylides, sulphides, phosphides, cyanides, carbonates. Reacts with most metals to produce flammable Hydrogen gas. Reacts violently (moderate reaction with heat of evolution) with water especially when water is added to the product. Isolate hydrogen chloride from heat, direct sunlight, alkalies (reacts vigorously), organic materials, and oxidizers (especially nitric acid and chlorates), amines, metals, copper and alloys (e.g. brass), hydroxides, zinc (galvanized materials), lithium silicide (incandescence), sulfuric acid(increase in temperature and pressure) Hydrogen chloride gas is emitted when this product is in contact with sulfuric acid. Adsorption of Hydrochloric Acid onto silicon dioxide results in exothmeric reaction. Hydrogen chloride causes aldehydes and epoxides to violently polymerize. Hydrogen chloride or Hydrochloric Acid in contact with the folloiwng can cause explosion or ignition on contact.

Special Remarks on Corrosivity:
Highly corrosive. Incompatible with copper and copper alloys. It attacks nearly all metals (mercury, gold, platinium, tantalum, silver, and certain alloys are exceptions). It is one of the most corrosive of the nonoxidizing acids in contact with copper alloys. No corrosivity data on zinc, steel. Severe Corrosive effect on brass and bronze
Polymerization: Will not occur.

Section 11: Toxicological Information
Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation.
Toxicity to Animals: Acute oral toxicity (LD50): 900 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 1108 ppm, 1 hours [Mouse]. Acute toxicity of the vapor (LC50): 3124 ppm, 1 hours [Rat].

Chronic Effects on Humans: CARCINOGENIC EFFECTS: Classified 3 (Not classifiable for human.) by IARC [Hydrochloric acid]. May cause damage to the following organs: kidneys, liver, mucous membranes, upper respiratory tract, skin, eyes, Circulatory System, teeth.
Other Toxic Effects on Humans: Very hazardous in case of skin contact (corrosive, irritant, permeator), of ingestion, . Hazardous in case of eye contact (corrosive), of inhalation (lung corrosive).
Special Remarks on Toxicity to Animals: Lowest Published Lethal Doses (LDL/LCL) LDL [Man] -Route: Oral; 2857 ug/kg LCL [Human] - Route: Inhalation; Dose: 1300 ppm/30M LCL [Rabbit] - Route: Inhalation; Dose: 4413 ppm/30M
Special Remarks on Chronic Effects on Humans: May cause adverse reproductive effects (fetoxicity). May affect genetic material.
Special Remarks on other Toxic Effects on Humans: Acute Potential Health Effects: Skin: Corrosive. Causes severe skin irritation and burns. Eyes: Corrosive. Causes severe eye irritation/conjuntivitis, burns, corneal necrosis. Inhalation: May be fatal if inhaled. Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract. Inhalation of hydrochloric acid fumes produces nose, throat, and larryngeal burning, and irritation, pain and inflammation, coughing, sneezing, choking sensation, hoarseness, laryngeal spasms, upper respiratory tract edema, chest pains, as well has headache, and palpitations. Inhalation of high concentrations can result in corrosive burns, necrosis of bronchial epithelium, constriction of the larynx and bronchi, nasospetal perforation, glottal closure, occur, particularly if exposure is prolonged. May affect the liver. Ingestion: May be fatal if swallowed. Causes irritation and burning, ulceration, or perforation of the gastrointestinal tract and resultant peritonitis, gastric hemorrhage and infection. Can also cause nausea, vomitting (with "coffee ground" emesis), diarrhea, thirst, difficulty swallowing, salivation, chills, fever, uneasiness, shock, strictures and stenosis (esophogeal, gastric, pyloric). May affect behavior (excitement), the cardiovascular system (weak rapid pulse, tachycardia), respiration (shallow respiration), and urinary system (kidneys- renal failure, nephritis). Acute exposure via inhalation or ingestion can also cause erosion of tooth enamel. Chronic Potential Health Effects: dyspnea, bronchitis. Chemical pneumonitis and pulmonary edema.

Section 12: Ecological Information
Products of Biodegradation: Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.
Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Section 13: Disposal Considerations
Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

HMIS (U.S.A.):
Health Hazard: 3
Fire Hazard: 0

Reactivity: 1
Personal Protection:
National Fire Protection Association (U.S.A.):
Health: 3
Flammability: 0
Reactivity: 1
Specific hazard:
Protective Equipment: Gloves. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Face shield.