



JAMNAGAR

DISTRICT DISASTER MANAGEMENT PLAN

CHEMICAL DISASTER



**DEPARTMENT OF INDUSTRIAL SAFETY AND HEALTH,
JAMNAGAR,
GUJARAT, INDIA.**



GOVERNMENT OF GUJARAT

PREFACE

Each and every part of the world faces variety of disasters from time to time. At any moment some part of the earth and its habitants are attacked with some kind of disaster, Gir Somnath District in particular is a multi-hazard prone district. Sometimes it is affected by Draught, Scarcity, Flood, Cyclone, and Earthquake and possible terrorist attack as the district is on costal area and off course by Industrial and Chemical Disasters.

I am very happy to place on record that DY.DISH, Jamnagar office has prepared the District Disaster Management (Chemical Disaster) Plan of Jamnagar District. Apart from the Training programmes, there are other many important functions to be fulfilled during the occurrence of disasters to make a disaster management plan successful. After a long thought, team work has been created, where head to head responsibility has been decided. It has a fire and rescue team, medical and paramedical assistance, maintenance of law and order during the disaster occurrence.

The Industrial sector of the District has been asked to prepare such action plans which can be implemented during disasters. Each action plan is tested in the form of full scale mock drill / rehearsal at least once in a calendar year.

The guideline issued by The Home Ministry- Government of India National Disaster Management Authority and Gujarat State Disaster Management Authority have been kept in focus in preparation of this plan.

I hope that each and every administrative unit of the district and industrial stake holders will use this action plan in the true spirit. We wish that no disasters ever occur, but in case of their occurrence, this action plan and preparedness at macro to micro level will be very helpful to the people of the district and state as a whole.

I wish all the great success to combat the disasters.

**Chair Person & District Collector,
District Crisis Group – Jamnagar**

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ABBREVIATION

AERB	Atomic Energy Regulatory Board
CCG	Central Crisis Group
CFO	Chief Fire Officer
CMG	Crisis Management Group
CIFT	Central Institute of fisheries Technology.
CWC	Central Water Commission
DCG	District Crisis Group
DCR	District Control Room
DDO	District Development Officer
DEOCs	District Emergency Operation Centres
DG	Director General
DGHS	Directorate General of the Health Services
DIG	Director General of Police
DSO	District Supply Officer
DSP	District Superintendent of Police
DISH	Director Industrial Safety & Health
DM	Disaster Management
EOC	Emergency Operation Centre
ERCs	Emergency Response Centres
ERTs	Emergency Response Teams
GEB	Gujarat Electricity Board
GIDC	Gujarat Industrial Development Corporation
GIDM	Gujarat Institute of Disaster Management
GMB	Gujarat Maritime Board
GPCB	Gujarat Pollution Control Board
GSDMA	Gujarat State Disaster Management Authority
GWSSB	Gujarat Water Supply & Sewerage board
HAZCHEM	Hazardous Chemicals
IMD	Indian Meteorology Department
IRC	Indian Road Congress
ISR	Institute of Seismological Research
ISRO	Indian Space Research Organisation
LCG	Local Crisis Group

MAH	Major Accident Hazard
MSIHC	Manufacture, Storage& Import of Hazardous Chemicals
NCMC	National Crisis Management Committee
NDRF	National Disaster Response Force
NGO	Non Government Organization
PESO	Petroleum and Explosive Safety Organization
PPE	Personal Protective Equipments
R & B	Roads & buildings Department
SCG	State Crisis Group
SEOC	State Emergency Operation Centre

1.0 INTRODUCTION

The growth of chemical industries has led to an increase in the risk of occurrence of incidents associated with hazardous chemicals (HAZCHEM).

A chemical industry that incorporates the best principles of safety can largely prevent such incidents. Common causes for chemical accidents are deficiencies in safety management systems and human errors, or they may occur as a consequence of natural calamities or sabotage activities.

Chemical accidents result in fire, explosion and/or toxic release. The nature of chemical agents and their concentration during exposure ultimately decides the toxicity and damaging effects on living organisms in the form of symptoms and signs like irreversible pain, suffering, and death.

Meteorological conditions such as wind speed, wind direction, height of inversion layer, stability class, etc., also play an important role by affecting the dispersion pattern of toxic gas clouds. The Bhopal Gas tragedy of 1984—the worst chemical disaster in history, where over 2000 people died due to the accidental release of the toxic gas Methyl Isocyanate, is still fresh in our memories. Such accidents are significant in terms of injuries, pain, suffering, loss of lives, damage to property and environment. A small accident occurring at the local level may be a prior warning signal for an impending disaster. Chemical disasters, though low in frequency, have the potential to cause significant immediate or long-term damage.

A critical analysis of the lessons learnt from major chemical accidents exhibited various deficiencies. Laxity towards safety measures, nonconformation to techno-legal regimes and a low level of public consultation are a few such shortcomings. The scenario called for concerted and sustained efforts for effective risk reduction strategies and capacity development under a national authority to decrease the occurrence of such incidents and lessen their impact. Although tremendous efforts have been made to minimise such accidents and to improve emergency preparedness at all levels, substantial efforts are still required to predict the occurrence of disasters, assess the damage potential, issue warnings, and to take other precautionary measures to mitigate their effects. Another pressing need is to properly assess the potential of chemical emergencies and develop tools for emergency planning and response to minimise the damage in case of any eventuality.

1.1. OBJECTIVE

The objective of a Disaster management plan is to localize a Disaster and contain its effect to the greatest extent so as to minimize its impact on life, environment and property. Response to any disaster, in the absence of a well-defined plan, would be arbitrary, leading to overemphasis of some actions and absence of other critical actions. A formal plan for Managing Disaster is therefore necessary. This Disaster management plan has a strong preparedness focus which aims at reducing our vulnerability to disasters and at the same time, it includes a plan of action/response mechanism for dealing with earthquakes, floods, cyclones, epidemics, industrial and chemical accidents, road accidents and fires.

This document provides basic information required for the management of disasters in Gir Somnath District by:

- Defining the Risks and Vulnerabilities of citizens of the district to different disasters;
- Identifying private and public sector stakeholders with prime and supporting responsibilities to reduce or negate these vulnerabilities
- Defines actions to be taken by these parties to avoid or mitigate the impact of possible disasters in the district.
- For major industrial sites located in the district (Off-site Emergency plan for Industrial Accidents available with DISH);
- Through Standard Operating Procedures (SOPs) of Line Departments detailing how specific disaster response actions will be accomplished.

Developing and maintaining SOPs are the responsibility of parties with designated prime or supporting tasks assigned by this plan.

Keeping in view all the possible aspects of the aforesaid problem in mind and to keep the Administration prepared in all possible ways to respond properly to various Disaster situations with minimum delay, possible Disaster situations have been identified and the component plans have also been identified & mentioned in detail in this document.

(A) Natural Calamities

* Floods

* Earthquake

* Cyclone

* Fire

- * Biological Disaster or Epidemic of Human/livestock/crops

(B) Man Made Calamities

- | | |
|------------------------------|-------------------------------------|
| * Industrial Disaster | * Radiological Disaster |
| * Accidents | * Railways |
| * Road | * Air |
| * Building Collapse | * Bomb Blast (Terrorist Activities) |
| * Stampede at crowded Places | * Food Poisoning |

1.2 RISKS POSED BY HAZCHEM

Increased industrial activities and the risks associated with HAZCHEM and enhanced vulnerability lead to industrial and chemical accidents. Chemical accidents may originate in the manufacturing or formulation facility, or during the process operations at any stage of the product cycle, material handling, transportation and storage of HAZCHEM. Vulnerability is sometimes compounded due to the location of Major Accident Hazard (MAH) industries closer to densely populated areas. Chemical and industrial accidents generally occur due to technical failures that can be anticipated. The risk associated with them can thus be predicted and reduced effectively by identification of risk areas, risk assessment and designing pre-operative measures. The occurrence of chemical accidents and probability thereof, manifesting in a disaster, remain a cause of concern.

Disaster threatens sustainable economic development worldwide. In the past twenty years, earthquakes, floods, tropical storms, droughts and other calamities have killed millions of people, inflicted injury, disease and caused homelessness and misery to around one billion others in the world. These have caused damage to infrastructure worth millions of rupees. Disaster destroys decades of human effort and investments, thereby, placing new demands on society for reconstruction and rehabilitation. Disaster management thus requires proactive approach. The community, civil society organizations, media and the proverbial man on the street, everyone has to play a role in case such exigency occurs. The various prevention and mitigation measures outlined below are aimed at building up capabilities as also how to deal with disasters.

Handling large quantities of HAZCHEM in installations, isolated storages, and during transportation, poses the grave risk of a sudden release of copious quantities of toxicants in the environment. There are about 2393 MAH units in India, handling a large number of chemicals as raw materials, in processes, products, and wastes, with flammable, explosive, corrosive, toxic and

noxious properties. Any accident involving these may have an adverse impact on both the community and the environment. Large quantities of chemicals are also stored/ processed in industries that are located in densely populated areas. Inappropriate and haphazard construction and the lack of awareness and preparedness on the part of the community further enhance their vulnerability. The potential of heavy losses and adverse consequences on the environment due to a chemical accident calls for further improvement of safety measures in all processes /procedures and the adoption of appropriate methods for handling HAZCHEMs.

The Bhopal Gas Disaster in December 1984 brought into sharp focus the unprecedented potential of HAZCHEM like Methyl Isocyanate in terms of loss of life, health, injury and the long term effects on the population and environment. It created compelling evidence to approach DM and chemical safety holistically. The era of restructuring with the induction of new HAZCHEM control systems and procedures all over the world in the wake of the Bhopal disaster also resulted in the strengthening of institutional mechanisms at local, district, state and central levels for the management of chemical disasters in India. The consolidation of these institutional mechanisms and the mobilisation of corporate support for the preparation and implementation of emergency plans is an integral part of these Guidelines.

1.3 CHEMICAL ACCIDENTS

- i) Manufacturing and formulation installations including commissioning and process operations; maintenance and disposal.
- ii) Material handling and storage in manufacturing facilities, and isolated storages; warehouses and godowns including tank farms in ports and docks and fuel depots.
- iii) Transportation (road, rail, air, water, and pipelines).

Chemical disasters, in general, may result from:

- i) Fire.
- ii) Explosion.
- iii) Toxic release.
- iv) Poisoning.
- v) Combinations of the above.

Chemical disasters may occur due to process deviations concerning the chemistry of the process, pressure, temperature and other identified parameters with regard to the state of the substance i.e., solid, liquid or gas, proximity to other toxic substances and the probability of a runaway reaction due to the incidental mixing of two or more HAZCHEMs with dissimilar properties. In addition, it may be due to hardware failure, resulting in large-scale spills of toxic substances (in any form) due to loss of containment, or an explosion. Further, Boiling Liquid Expanding Vapour Explosion (BLEVE) may occur due to sparks, shocks or frictional forces on the chemicals during transportation.

1.4 NATURAL CALAMITIES

The Indian subcontinent is highly prone to natural disasters, which can also trigger chemical disasters. Damage to phosphoric acid sludge containment during the Orissa super cyclone in 1999 and the release of acrylonitrile at Kandla Port, during an earthquake in 2001, are some of the recent examples.

1.5 TERRORIST ATTACKS/SABOTAGE

Vulnerability to chemical disasters is further compounded by likely terrorist and warfare activities, which include sabotage and attack on HAZCHEM installations and transportation vehicles. This can occur at sources anywhere, and at any time. Guidelines for the management of chemical warfare agents and chemical weapons of mass destruction will be issued separately.

1.6. ORGANIZATION OF PLAN

The present plan document identifies the roles and responsibilities of the organizations in key identified sectors. Taskforces have been constituted for taking response measures in specific sectors. Each task force consists of a lead organization/department supported by other organizations/ departments. Action plan has been prepared for each taskforce, which covers their roles and responsibilities in different phases of disaster.

The mode, degree and extent of response to fight out any Disaster depend upon the nature, degree and extent of Disaster, but some points are common to all kinds of situations. For example, first and foremost, appropriate and adequate steps for preventing the disaster should be undertaken. Secondly, preparedness is required to contain the damages and casualties resulting from the Disaster. Thirdly, steps for rehabilitation and restoration of community life within a reasonable time should be focused on.

Hence, some necessary and common steps are as below:

1. Establishment of Central Control Rooms and capacity enhancement of Emergency Operation Centers.
2. District Disaster Management Committee to meet post early warning or immediately post disaster occurrence.
3. A general line of action and some special duties to various officers and departments will have to be assigned, keeping in mind a timeline for finishing specific tasks.
4. Voluntary Organizations may have to be involved and their role will have to be clearly specified and coordinated.
5. Media may have to be briefed to suppress all kinds of rumors.
6. Information regarding resource inventory of Health Services, Transport Services, Evacuation & Rehabilitation Centers and Food etc. needs to be kept handy so that resources can be deployed where required.
7. Consistent follow-up of relief operations and constant reporting of pre and post disaster work.

To achieve the above objectives, different tasks have to be performed by Government Departments and other agencies before, during and after the Disaster. Each Department's role and responsibilities have to be clearly identified and an action plan needs to be drawn up by each department. For close cooperation between the various Department and Agencies, close coordination is required between the Collector at the District Headquarters and Prant Officers (SDM) at the Sub-division or Taluka level. The responsibility to manage any type of Disaster in the district rests with the District Disaster Management Committee headed by the Collector Jamnagar, who may, depending upon the gravity of the situation, seek the help of State Disaster Management Committee and the National Disaster Management Committee. This tiered and hierarchical structure ensures that the best possible response is accorded to any disaster situation, depending upon the severity of damage.

1.7. LEVEL OF DISASTERS

For operational expediency, the level of Disasters has been categorized and classified as under:

L concept has been developed to define different levels of disasters in order to facilitate the responses and assistances to States and Districts.

L0 level denotes normal times which will be utilized for close monitoring, documentation, prevention and preparatory activities. Training on search and rescue, rehearsals, evaluation and inventory updation for response activities will be carried out during this time.

L1 level specifies disaster that can be managed at the District level, however, the State and centre will remain in readiness to provide assistance if needed.

L2 level disaster situations are those, which require assistance and active participation of the state, mobilization of its resources for management of disasters.

L3 level disaster situation is in case of large scale disaster where the State and District authorities have been overwhelmed and require assistance from the Central Government for reinstating the State and District machinery as well as for rescue, relief, other response and recovery measures. In most cases, the scale and intensity of the disaster as determined by the concerned technical agency like IMD are sufficient for the declaration of L3 disaster.

1.8 PLAN CONSIDERATIONS

This plan is prepared considering compact and to be easily understood by users, mitigation, prevention and preparedness aspects are addressed adequately.

Recognizing the fact that most tasks and actions before and following a disaster are common at the district level, the Jamnagar district administration has used industrial disaster approach while developing disaster management plan for the district.

The present plan is not intended to provide comprehensive explanations and background information about a disaster, or serve as a training manual on how to respond to a disaster or conduct a disaster related task. The approach taken is that plans and SOPs should be limited to the extent of sufficient information need to respond to a specific disaster or undertake a disaster related task. Steps to address disaster specific requirements can be covered in procedures related to actions. This approach does require that task forces develop disaster specific procedures where appropriate.

In other words, this plan is intended for use by persons who are technically competent in the tasks or responsibilities set out in the plan.

1.9. AUTHORITY AND RESPONSIBILITIES

The requirement for district and subsidiary plans is set by the Gujarat State Disaster Management Authority (GSDMA) under the authority of the Gujarat State Disaster Management Act of 2003. The Act authorizes the collector to secure cooperation and assistance from other parties in efforts to avoid or reduce the impact of disasters.

The Collector (Specifically) and Government authorities (generally) are responsible for managing hazards and disasters that affect a district, with support from GSDMA, the Relief Commissioner and other public and private parties as may be needed. The roles, responsibilities and obligations of the Collector and other key parties are set out in detail in the Act and are considered as part of this plan.

1.10. PREPARATION AND REVISION OF THE PLAN

The District Collector is authorized /responsible by the chemical accidents (EPPR) Rules 1996 for the preparation and revision of the District Disaster Management Plan in collaboration with the Government administrative line departments, DCG, LCG, MAH installations in all the pockets of the district and other organizations in the district.

The plan should be reviewed annually and updated:

- When significant changes occur in the nature of hazards
- Lessons learnt following any major disaster or
- When there is any significant change to the organization or responsibilities of primary members of the task forces defined in the plan.
- Lessons learnt from the mockdrill.

1.11. LEGAL BACKUP

Preparation and execution of Disaster Management Plan (Chemical Disaster) is one of the mandatory provisions under The Rule 14 of The MSIHC Rules-1989, and under Rule 9 and 12 of The Chemical Accidents (EPPR) Rules 1996, The Gujarat State Disaster Management Act-2003 and The National Disaster Management Act- 2005. In respect to above, National Disaster Management Authority has issued guidelines for preparation of State Disaster Management Plan.

- I. As per The Rule 14 of the MSIHC Rules-1989, and under Rule 9 and 12 of the Chemical Accidents (EPPR) Rules 1996.
- II. As per The Gujarat State Disaster Management Act, 2003 under Clause 15. Sub section (1), (2) & (3) Of Chapter VI Functions of the Authority, the authority shall develop or cause to be developed guidelines for the preparation of disaster management plans and strategies.
- III. Under the provision of The Disaster Management Act, 2005.

- a. Section 18 subsection (1), (2) & (3) subject to provisions of this Act, a State Authority shall have the responsibility for laying down policies and plans for disaster management in the State.

The DMC will follow the techno-legal regime set up by the SDMA and other government Acts and Policies. It shall periodically review the extent of compliance to some of the key regulative provisions.

Trigger mechanism for putting the plan into action

Chapter XIII, Section 32 of Gujarat Disaster Management Act 2003 clearly defines the process of declaring an area as disaster affected or disaster prone, which acts a trigger mechanism for putting relevant DM plan into action. These provisions are:

Where there is threat of an impending disaster or where a disaster has occurred-

- (a) In an area spread over more than one district; the Commissioner, and
- (b) In an area restricted to a district, the Collector –may immediately make a report to that effect to the State Government.

If the State Government is of the opinion that there is a threat of an impending disaster or that a disaster has occurred in an area of the State and that it is expedient, for the purposes of preventing such disaster or of coping with its effects, it may, by notification published in the Official Gazette and in any one or more newspapers having widest circulation in the area, declare such area to be disaster prone area or disaster affected area. The respective authorities (including State authority, Commissioner, Collector, Departments and other agencies) shall perform the duties of Disaster Management in accordance to the act until the time period of declaration. This period can be extended, if required by the competent authority. The Authority, the Commissioner, the Collector and all other agencies, shall cease to perform their functions in the affected area, on the expiry of the period.

2.0 JAMNAGAR DISTRICT PROFILE

2.1 TOPOGRAPHY

Jamnagar District is located on the Western side of Gujarat. The District is spread between 21° 47' & 22° 57' of northern latitude and 68° 57' & 70° 37' of West longitude in the peninsular region in the northwest known as Kathiawar or saurashtra in the state of Gujarat. The district is bounded on North by the Rann and Gulf of Kuchchh, on the East by Rajkot district, on the South by Junagadh district and on the west by Devbhoomidwarka district. The Jamnagar District measures about 128.75 kms from North to South and about 167.37 kms from East to West. The district is spread over an area of 10,927 sq.kms.

2.2 METEOROLOGICAL DATA

The Jamnagar Dist. Experiences a tropical dry climate but generally pleasant. The Max. DBT During April is 43 deg.C in January Max. DBT recorded is 30 Deg. C, wintering temperature falls upto 10 Deg. C. The Max. Rain fall recorded in the day is 522mm. The Humidity level rises upto 92.8% in June.

2.3 Climate data for Jamnagar

Month	Temperature		Rain-fall Mon-thly Total (In mm)	% R H	Wind Data				
	Max. °C	Min. °C			No of days for 1-19 kmph	Wind Direction for % No. of Days* from			
						N	NE	S	SW
January	31.4	12.8	1.2	65	29	14	34	4	5
February	34.3	14.9	0.3	56	26	10	25	8	13
March	37.6	19.8	1.6	59	29	8	14	12	24
April	40.0	23.7	1.8	59	28	6	6	15	34
May	39.7	26.9	17.0	71	31	1	1	8	73
June	35.4	26.9	154.2	79	30	1	0	15	71
July	32.0	25.7	322.8	87	31	0	0	13	70
August	31.1	25.1	228.3	89	31	0	0	8	76
September	32.7	24.5	207.7	86	29	2	3	10	57

October	35.9	22.1	55.7	74	30	3	14	16	17
November	35.1	17.2	1.2	62	29	3	32	7	6
December	33.0	14.0	0.1	66	30	12	32	5	4

2.6 Industrial Profile

Jamnagar is one of the fast developing, highly industrialized Districts in the Country. The District is sub-divided into 6 Talukas viz. Dhrol, Jodia, Jamnagar, Kalavad, Jamjodhpur, Lalpur. Major Accident Hazard (MAH) units have been identified based on the information received from the Office of the Director, Industrial Safety & Health, Gujarat and latest information available with the Asst. Director, Industrial Safety & Health, Jamnagar As per the latest information available (as on 12th June 2003) there are Four functional Major Accident Hazard (MAH) units in Jamnagar District. A list of these functional Major Accident Hazard (MAH) units in the Jamnagar District is given at Table – 2.2.

MAH UNIT		
Sr.No.	Factory Name	Address
1.	Reliance Industries Limited	Meghpar/ Padana, Ta. Lalpur
2.	Gujarat State Fertilizers & Chemicals Limited	Motikhavdi, Sikka
3.	Reliance Industries Limited (SEZ)	Motikhavdi
4.	Reliance Syngas Limited SEZ	Kanalus / Padana, Ta. Lalpur
5.	Gujarat State Fertilizers & Chemicals Limited(Sikka Shore Terminal)	Sikka
6.	Bharat Oman Refinery Ltd	Singach, Ta. Lalpur
7.	RELIANCE SIBUR ELASTOMERS PVT LTD	Kanalus, Ta. Lalpur
8.	Reliance Syngas Limited DTA	Kanalus, Ta. Lalpur

9.	Sikka Port & Terminal Limited	Nani Khavdi, Jamnagar
10.	AEGIS Gas LPG Pvt. Ltd	Dhrol
11.	Reliance Industries Ltd. (New Energy Complex)	Navagam Kanachhikari

2.7. Taluka level Information:

Tulaka name	No. of village
Dhrol	40
Jamjodhpur	66
Jamnagar Rural	100
Jodiya	37
Kalavad	97
Lalpur	77

(As per Jamnagar District Administration website data)

2.9. Health Facilities

Health:

The major hospitals are Gurugovind sinh Government, Government Detntal Hospital, Samarpan General Hospital, Oswal Ayush Hospital in Jamnagar.

The district has 33 PHCs and 9 CHCs in the District to cater to the needs of people

3.0. ORGANIZATION STRUCTURE AND ROLES AND RESPONSIBILITIES

3.1 ROLES & RESPONSIBILITY OF SOME OF THE FIRST RESPONDERS DURING CHEMICAL EMERGENCY

1. POLICE

- Control and divert the traffic near the affected areas.
- Ensure law and order at the incident site during chemical emergency/disaster and at evacuation centres too.
- Provide security in evacuated areas
- As per GSDM Act 2003, Give warning, carry out Search & Rescue operation and carry out relief & rehabilitation operation too.
- They help the Fire & Emergency Services and the Deputy Director, Industrial Safety and Health with Police Wireless sets, so that there is continuous communication among the first responders in the emergency.
- Police will ensure that the police force will not enter the area under disaster without the permission of the Fire & Emergency Services and Health officials.
- They will order deployment of the police force for evacuation of the people from the zone of the danger.
- People should not be allowed access anywhere close to the site of the disaster.
- The primary aim would be to ensure the transport of the injured to the hospital, easy access for emergency responders and safe evacuation of the people from the danger zone.
- They will also issue directives that all the Private and Public Transport (trains and buses) be diverted from the disaster area.

Note: Jamnagar District Police Department Details is as Annexure 5.

2. FIRE, SEARCH & RESCUE

- Reach at the site soonest possible and assess the situation. (information about the chemical leak/spill, the action taken and current status)
- In case of fire, start fire fighting with suitable media and also take care of surrounding storages/tanks to be over heated so that reduce the chances of 'domino effect'.
- In case of chemical leak, try to plugging /stopping of leak with the use of proper PPE. DISH will coordinate redeployment of GIDC Fire Tenders from other places, as required.
- Search and identify the risk and nullify the sources of leak / toxic release. If any unclear or unidentified substance or source is identified or detected, the team should send them immediately to the laboratory for further investigation / analysis.
- To search and evacuate the affected population from the site of the incident.

Note: Details of Fire Brigade/ Fire fighter is as Annexure 6.

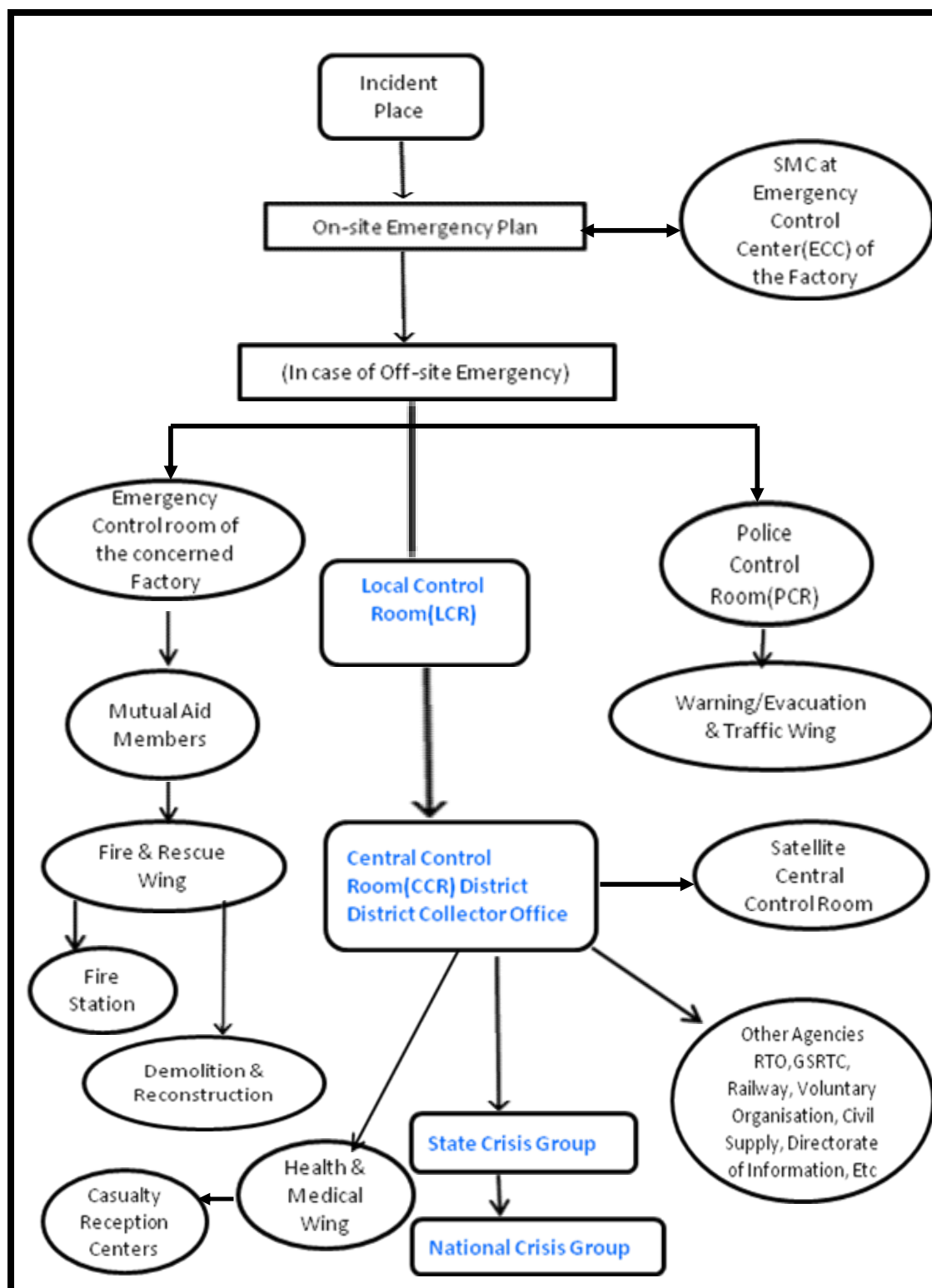
3. MEDICAL SERVICES

- The relevant agency for emergency medicine in the Government of India is the Directorate General of the Health Services (DGHS) in the Ministry of Health and Family Welfare. The DGHS has set up the Emergency Medical Relief cell, for dealing with these contingencies.
- The DHO will review the administrative support required for the situation, which includes communications, transport of the victims and of the personnel, feeding of the personnel and patients, and supplies.
- The DHO will collect information on the number of deaths and persons injured; the nature of injuries and the likely long-term consequences.

The DHO must assess the medical needs of the area on the basis of likely long-term consequences and take steps to equip local medical facilities for treating people on a long-term basis. The DHO must also make financial provision for spending on long-term treatment.

Note: Jamnagar District Health Facility is as Annexure 7, 8, 9, 10, 11, 15 & 16.

3.2. SCHEMATIC DIAGRAM FOR DISASTER MANAGEMENT PLAN



3.3. ROLE OF EMERGENCY ORGANIZATION AGENCIES

3.3.1 DISTRICT EMERGENCY AUTHORITY (DEA – DISTRICT COLLECTOR)

- The District Collector shall be the Overall Incident Command Officer for emergency operations as Jamnagar District Emergency Authority and shall provide suitable instructions to the District Crisis Group.
- Depending upon the level of emergency, The Collector shall seek help from Chief Secretary, Chairman, State Crisis Group, Gujarat State. For this Collector shall be in touch with State Control Room, Gandhinagar or Chief Secretary, Gujarat State for progress of emergency.
- Take overall responsibility for combating the Off-site emergency.
- Ensure that the Police and Fire personnel combat the emergency.
- Arrange, if necessary, for warning and evacuating the public, through the Department of Police
- Communicate with Media to disseminate vital information to public.
- Arrange for dispensing vital information to public using arrangements like mass-SMS, public announcement using pre-recorded tapes.
- Direct the team of Doctors headed by the Medical Officer.
- Direct the local chief of State Transport Corporation to arrange for transport of victims and evacuation of people trapped within the hazard zone, if necessary.
- Direct the Electricity Board officials to give uninterrupted power supply.
- Direct the official in-charge to provide uninterrupted water supply as required.
- If evacuation of population is necessary direct the Revenue officer and the Supply officer to provide safe shelters, food and other life sustaining requirements for the evacuees, if required.
- Co-ordinate with the media.
- Arrange for, release and provide necessary funds at various stages of disaster mitigation.
- Direct railways to stop train, if required.

Roles and Responsibilities of Different Key Departments	Before Emergency	During Emergency	After Emergency
Collector & DM	• Training and Rehearsals • Develop disaster management plans at all levels down to the village level. • Hold regular meetings on disaster management including government, NGOs and private sectors. • Check warning, communications and other systems, is including the use of drills. • Mobilize task forces at all levels (District, Taluka, village depending on disaster) • Telecommunications Media Task Forces. • Assign/guide district departments for preparedness task as & when required.	• Shall provide suitable instruction to the District Crisis Group of Jamnagar • Provide reinforcement and support for emergency response from the district resources, such as technical expert opinion for combating fire fighting. • Evacuation of people, rescue operation to save the life of people incase of disaster. • Effective working of communication system, traffic control, evacuated property security, maintain law and order and cordoning of area, environment monitoring, disease control, demolition and reconstruction of structure, transport facility for evacuation, • Provide relief & shelter after/ during emergency, damage assessment & funeral process. • Shall ask help from Chief Secretary, Chairman, State Crisis Group, Gujarat State depending upon the level of emergency. • Shall Instruct	• Start Rehabilitation activities. • Conduct detailed survey of damage and needs. • Restore all public and private sector services. • Final Report/Case Study • Lessons Learned meeting. • Assign/guide district departments for relief & Rehabilitation work as & when required.

Roles and Responsibilities of Different Key Departments	Before Emergency	During Emergency	After Emergency
		Superintendent of railway to stop train in case of any emergency. - Establish regular liaison with State Control Room. - Assign / guide district departments for relief & rescue work as & when required.	
Resident Additional Collector (RAC)	- Training and Rehearsals - Develop disaster management plans at all levels down to the village level. - Hold regular meetings on disaster management with government, NGOs and private sectors. - Check warning, communications and other systems, is including the use of drills. - Mobilize task forces at all levels (District, Taluka, village depending on disaster) - Telecommunication, Media Task Forces. - Assign/guide district	- Shall provide suitable instruction to the District Crisis Group, Jamnagar/ - Provide reinforcement and support for emergency response from the district resources, Such as technical expert opinion combating fire fighting. - Evacuation of people, rescue operation to save the life of people incase of disaster. - Effective working of communication system, traffic control, evacuated property security, maintain law and order and cordon of area, environment monitoring, disease control, demolition and reconstruction of structure, transport facility for evacuation, - Provide relief & shelter	- Start Rehabilitation activities. - Conduct detailed survey of damage and needs. (Damage Assessment Task Force) - Restore all public and private sector services. - Final Report/Case Study - Lessons Learned meeting and reporting to State office. - Assign/guide district

Roles and Responsibilities of Different Key Departments	Before Emergency	During Emergency	After Emergency
	departments for preparedness task as & when required	after/ during emergency, damage assessment & funeral process. • Shall ask Superintendent of railway to stop train in case of any emergency. • Establish regular liaison with State Control Room. • Assign/guide district departments for relief & rescue work as & when required. • Will perform general roll during emergency as stated in District.	departments for relief & rehabilitation work as & when required. • Effective working of communication system, traffic control, evacuated property security, maintain law and order and cordoning of area, environment monitoring, disease control, demolition and reconstruction of structure, transport facility for evacuation.
District Development Officer	• Before disaster/emergency, he/she will prepare plan of district for Relief and shelter work & damage assessment • With the help of village level worker; he will circulate intimation of the emergency. • Will keep the panchayat	• As per instruction of a District collector or message, DDO will do operation of relief and shelter with their staff, group members & their staff and NGOs with their equipment and facilities. • Will look after the duty performs by their staff member's i.e TDMC,	• Starts Rehabilitation operation with staff, group members & • NGOs as required with their equipment as facilities under guidance of Collector.

Roles and Responsibilities of Different Key Departments	Before Emergency	During Emergency	After Emergency
	staff ready for possible relief and damage assessment. • Prepare departmental Disaster • Management Plan and submit copy to the collector.	VDMC as per disaster management plan. • Will arrange for relief and shelter camps in the rural areas. • Ensure ground staff at headquarter during disaster.	• Will provide cash dolls, shanty house/ building relief, house grocery relief, death relief, food, water, clothes, utensils etc. • Will assess the damage occurred due to disaster / emergency with staff & Group members.
SDM & Deputy Collector	• As Liaison Officer will conduct meeting of Taluka flood relief co-ordination committee and will do proper planning for mitigation of effect in case of flood, cyclone, and heavy rain fall. • Monitor Preparatory work at Taluka level.	• Will assist the Collector in the relief and rescue operation along with his staff. • Take necessary step as per DMP plan of the district collector	• District supply officer will arrange for distribution of essential commodity to the affected areas through Gujarat • State civil supply corporation & NGO's. • Final Report/Case Study • Lessons Learned

Roles and Responsibilities of Different Key Departments	Before Emergency	During Emergency	After Emergency
			meeting.
Mamlatdar	• In case of flood, cyclone, war, earthquake, Industrial, transport, water & air pollution, pipeline etc. disaster / emergency and for mitigation of effect, he will prepare plan for incident control group of DCG. • Will perform general roll before emergency as stated in district off site emergency plan. • As vice chairman of incident control group of DCG will look out overall all the function at incident place through their members and team. • Will keep office open with staff as control room in case of disaster / emergency i.e. flood, cyclone etc. will provide to and for information to disaster control room / district authority.	• As per instruction of District Collector or SDM or message received from other source of flood, cyclone, war, earthquake, industrial, transport, water and Air pollution, pipeline etc. disaster / emergency will send respective member of to combat and to mitigate effect at incident place. He will proceed towards incident place and will look out overall function i.e. • Evacuation and rescue operation • Fire / Toxic control and toxic monitoring • Public warning and communication • Traffic control, security, law & order, cordon of area • Medical treatment at first aid center, causality center • Disease control • Demolition, Reconstruction and rehabilitation • Transport • Public relation and mass	• Will look out overall the function of incident place • Rescue • Health & Medical treatment of victims • Traffic security law and order • Toxic and disease control • Rehabilitation • Relief and Shelter • Will perform general roll after emergency as stated in IC group of district off site emergency plan. • Will provide cash dolls, shanty house, building relief, house grocery relief, and death relief.

Roles and Responsibilities of Different Key Departments	Before Emergency	During Emergency	After Emergency
		media communication - Relief and shelter - Will inform progress report of emergency to SDM of district authority from incident place.	Will assess the damage occurred in city area due to disaster emergency
Taluka Development Officer – TDO	- With the village level team warning disseminate to the community - Keep staff ready for relief and damage assessment. - To coordinate & collect information of resources & equipments from line departments, stakeholders & village.	- Taluka Development Officer will provide their staff e.g. VDMC team for public information and evacuation operation to DSP/SDM in case of flood, cyclone, heavy rainfall or other disaster / emergency. - To coordinate & support with stakeholders for resources & equipments to avail for relief & rescue teams.	- Will arrange for relief and safe shelter camps in the rural areas based on DMP - Will provide cash dolls, shanty house/ building relief, house grocery relief, death relief, food, water, clothes, utensils etc. - Will assess the damage occurred due to Disaster emergency with staff & Group members.
District municipal officer & Chief Officer	Nagarpalika operated hospitals keep ready state with Operation Theatre, equipments and medical facilities	Nagarpalika shall do rescue operation with well equipped equipment and trained staff.	Nagarpalika will restore drainage system in

Roles and Responsibilities of Different Key Departments	Before Emergency	During Emergency	After Emergency
Nagarpalika	in working condition - Nagarpalika shall keep approach road of water sources, pumps in working condition, water leakage will be prevented through pipe, pipe joints and valve. Water storage tank will keep clean and will keep water without unwanted impurities - Nagarpalika shall maintain good fire fighting facility and rescue equipments. - Nagarpalika will provide bus, mini bus, trucks, and trigger, earth moving machinery for evacuation and rescue operation and transferring people from nagarpalika area. - Nagarpalika will keep their mobile public address system in working condition to give information to public.	- Nagarpalika shall provide good medical treatment to victims in case of emergency in their hospital. - Nagarpalika shall provide fire tender for fire fighting operating.	affected area. - Nagarpalika will restore pure drinking water in affected area. - Whenever possible, he will arrange for transportation of dead body through special vehicles. - Immediate start Sanitation work and give update work progress report to collector. - Coordinate with mamlatdar and liaison officer of the taluka.

➤ **CIVIL SUPPLIES DEPARTMENT**

- Arrangement to provide food and clothing as necessary, to the evacuees and all others involved in emergency controlling operations.

➤ **ANIMAL HUSBANDRY DEPARTMENT**

- Arrange for taking care of cattle - especially milch animals living in affected zone.
- If evacuation of cattle is required, identify the evacuation area and shelter.
- Transport arrangements for evacuation.
- Fodder, drinking water arrangements for cattle.
- Arrange for veterinary doctor.

3.3.2. DISTRICT POLICE DEPARTMENT

Communicate and co-ordinate with

- MAH unit.
- DEA.
- Fire Services.
- Transport authorities.
- Medical Department.
- Media.
- Civil Defence and Home Guards.
- Local Army establishment as required.
- Warn and advice the people in the affected area.
- Regulate and divert traffic.
- Arrange for evacuation.
- Maintain law and order in the area.
- Ensure protection of life and property of evacuees.
- Deal sternly with people exploiting opportunism in wake of a disaster.

Roles and Responsibilities of Different Departments	Before Emergency	During Emergency	After Emergency
Superintendent of Police	• Will keep their wireless set, public address system in working condition to warn public about disaster. • As per instruction of district collector or message of possible emergency received from other source to or feel him/her self for possible emergency, He/she will do operation such as Evacuation public warning,	• Will perform general roll during emergency as stated in District. • Will keep their wireless set, public address system in working condition to inform public. • As per instruction of district collector or message received from other source, He will do operation of Evacuation &	• Will arrange funeral process of human body. • Will provide security to protect properties in effected area. • Will perform general roll after emergency as stated in District • Will assess the human death. • Will lodging of FIR & doing of the panchanama if required in the

Roles and Responsibilities of Different Key Departments	Before Emergency	During Emergency	After Emergency
	traffic control, cordon of area etc. required in possible affected areas of the district. • Prepare departmental Disaster Management Plan and submit copy to collector.	Rescue, Public warning, Communication Control, Traffic Control, Security law & order, cordon of area, Funeral etc. required in affected area of the district.	affected area.

➤ CIVIL DEFENCE

- Co-ordinate with Police authorities.
- Extend help in evacuation.
- Arrange for round the clock security arrangements in the affected and evacuation areas.
- Safeguard the properties and belongings of evacuees.

Roles and Responsibilities of Different Key Departments	Task to be performed Before / During / After Emergency
Civil defence	Civil Defence Inspector will conduct meeting and will do proper planning for mitigation of effect in case of chemical emergency. will also train the large amount of people to mitigate the effect of chemical emergency. will provide staff and trained persons for rescue operation.

➤ HOME GUARDS

- Co-ordinate with Police authorities.
- Extend help in evacuation.
- Arrange for round the clock security arrangements in the affected and evacuation areas.

- Safeguard the properties and belongings of evacuees.

Roles and Responsibilities of Different Key Departments	Task to be performed Before / During / After Emergency
Home Guard Commandant	The District Home Guard Commander will assist D.S.P. for Public Information and evacuation through their Home guards in case of emergency. Shall make available the required number of home guards as and when ordered by the Collector /Superintendent of Police as well as keep the updated list of swimmers for rescue work.

3.3.3 FIRE SERVICE DEPARTMENT

- Perform fire-fighting operations by deploying men and appliances.
- Perform rescue operation in the affected area.
- Communicate and co-ordinate with Police, Medical Department of necessary information.
- Keep knowledge on appropriate response to different chemical emergency scenarios.
- Keep adequate stock and resource information on necessary means, material, appliances required to deal with particular emergency situations with updated details of suppliers and stockists.

- **Note: Details of Fire Brigade/ fire Fighter is as Annexure 6.**

3.3.4 MEDICAL DEPARTMENT

- Arrange for preparing casualties to be sent to government/private hospitals.
- Set up temporary medical camp and ensure medical facilities at affected location and neighbourhood.
- Keep knowledge on appropriate response to different cases of toxic consumption and injuries.
- Set up temporary mortuary, identification of dead bodies and post-mortem.

Note: Gir Somnath District Health Facility Details as Annexure 7, 8, 9, 10, 11, 15 & 16.

Roles and Responsibilities of Different Key Departments	Before Emergency	During Emergency	After Emergency
CDHO And Civil Surgeon	• In case of disaster / emergency, he/she will prepare plan for health & medical treatment and toxicity & disease control monitoring and submit to the collector. • Will keep adequate quantity of medicines and maintain Operation Theatre, equipments, medical facilities in working condition • Will keep list of hospitals, available doctors & paramedical staff, available medical faculties, list of medical stores, list of medical	• As per instruction of District collector or message received from other sources disaster / emergency he will do operation of Health & • Medical treatment & Toxicity & Disease control / monitoring etc. required in affected areas of the district with their staff group members & their staff as requires with available equipment & facilities. • Will perform health & medical control as well as toxicity & disease controlling & monitoring.	• Will provide lime, bleaching powder, vaccine to avoid spreading diseases • Will send medical team to the affected areas for treating the victims of the emergency. • Will take all possible steps to prevent then spread of disease, toxicity and epidemic. • Will arrange to

Roles and Responsibilities of Different Key Departments	Before Emergency	During Emergency	After Emergency
	stockiest in the district. • Will keep list of all chemical antidotes and about their quick availability in small & large quantities of them in district, country or abroad. • Will keep medical team ready along with the required drugs i.e. chlorine tablets, ORS powder etc. for possible affected areas. • Will maintain Ambulance in working condition with updated location list. • Prepare trained medical team for chemical disaster.	• Will arrange providing vaccine, antidotes & medical treatment to victims. • Will ask more help from state, central Govt. through district authority in disaster /emergency. • Will take all possible steps to prevent the spread of disease, toxicity and epidemic.	educate the affected population about the health related aspects.

3.3.5. INDUSTRIAL SAFETY AND HEALTH DEPARTMENT

- Provide necessary direction to MAH unit and assistance to DEA, Fire Department, Medical Department among others
- Seek help from and involve assistance of Technical Experts of relevant and appropriate expertise and specialization
- Initiate, facilitate and provide for investigation into the accident

Roles and Responsibilities of Different Key Departments	Before Emergency	During Emergency	After Emergency
Dy. Director Industrial Safety & Health(DISH)	• Deputy Director Safety & Health will conduct meeting of District Crisis Group / Local Crisis Group and will do proper planning for mitigation of effect in case of chemical accident. • Will prepare offsite emergency plan under guidance of collector. • Will ensure disaster preparedness in factories and safety aspect in industries during inspection and regular visit. • Prepare updated Chemical database from Industries to face any chemical disaster and submit to the collector.	• Shall reach to the site and will assist & guide for incidence control in case of chemical / industrial disaster. will ensure the closer of supply lines of harmful chemical immediate in the affected area in case of fire or chemical disaster.	• Will investigate regarding accident of fire, toxic release etc. • Submit incident / situation report to collector. • In case of Natural disaster, submit safety assurance report of industrial area to the collector.

3.3.6. OCCUPIER OF MAH UNIT

- Possess up-to-date copy of Off-site Emergency Plan.
- Communicate promptly, any foreseeable disaster, to the DEA, Police, Fire Service and Inspector of Factories in-charge of the District.
- Communicate changes within the factory that may require inclusion or suitable modification in the off-site plan to the DEA (Maintenance Officer) of the Plan.
- Shall prepare and keep up to date on site emergency plan and detailing how major accidents will be deal with on the site.
- Copy of mock drill of the on site plan conducted every six months and make available to the concerned authority.
- Provide identified major accident hazards scenario.
- Take adequate steps to-
 - I. Prevent such major accidents and to limit their consequences to persons and the environment.
 - II. Provide to the persons working on the site with the information, training and equipment including antidotes necessary to ensure their safety.

3.3.7. TECHNICAL EXPERTS

- Promptly respond to provide the necessary technical advice to MAH unit, DEA, Factory Inspectors, Fire Department, Medical Department among others
- Provide on-phone help after properly understanding and assessing the situation
- Make visit to the site in co-ordination with DEA, Factory Inspector(s) to provide for appropriate technical assistance
- Aid assistance and facilitate functioning of the DCG.
- **Note: Technical experts details (Annexure – 3, 4 & 14).**

3.3.8. MUTUAL AID GROUPS

To quickly mobilize the resources required to emergency mitigation at the site or wherever required.

3.3.9. REGIONAL TRANSPORT AUTHORITY

- To investigate into the cause of road accident involving hazardous goods carrier and take necessary action

Roles and Responsibilities of Different Key Departments	Before Emergency	During Emergency	After Emergency
Regional Transport Officer ARTO	• Will keep up to date list of available vehicles i.e. buses, minibus, trucks, earth moving machineries, cranes etc. • List of travelers with vehicals.	• Will arrange to provide available vehicles i.e. buses, minibus, trucks, earthmoving machineries, cranes etc. to respective authority if needed in case of emergency • Will perform duties during emergency as directed by collector.	• Arrange and provide Vehicles for relief & rehabilitation work under guidance of collector.
Roles and Responsibilities of Different Key Departments	Task to be performed Before / During / After Emergency		
Divisional controller GSRTC	Will inform public through his control, also he will arrange buses if required for evacuation in case of disaster / emergency		

3.3.10. PWD, R&B & Water Supply Board

Roles and Responsibilities of Different Key Departments	Before Emergency	During Emergency	After Emergency
Executive Engineer R & B	• He will prepare plan for operations like • Demolition, Reconstruction & • Rehabilitation and also arrange the rehearsal of plan for such activities. • He will keep the list of available vehicle in the district as well as outside district i.e. trucks, triggers, crane, dumper, bulldozer, truck, JCB etc as required in case of disaster/ emergency and also ensure that it's in working condition • He will keep the list of available movable diesel generator set in the district as well as outside district.	• As per instruction of district collector or message received from other source for disaster/ emergency he will do operation of • Demolition, Reconstruction and Rehabilitation required in affected area, with their equipments and facilities. • He will arrange to provide vehicle for demolition & reconstruction. • He will perform general roll during • emergency as stated in district emergency plan • If required more help, he will ask from state &	• He will assess the damage to govt. property and will submit the report to district authority. He will immediate restore damage road for traffic movement. • He will restore government building for use i.e. hospitals, • He will work in coordination of line departments for restoring power, drinking water, telephone and communication system, and essential services.

Roles and Responsibilities of Different Key Departments	Before Emergency	During Emergency	After Emergency
		central Govt. through district Authority	

➤ **WATER SUPPLY BOARD**

- Arrange for supply of water to evacuees and all others involved in emergency control operations

➤ **PUBLIC WORKS DEPARTMENT**

- Ensure adequate water supply for fire- fighting
- Arrange for drinking water for evacuated persons at rallying posts, parking yards and evacuation centres Arrange water for cattle.

Roles and Responsibilities of Different Key Departments	Before Emergency	During Emergency	After Emergency
Executive Engineer GWSSB	• Will keep water resources, pumps in good working condition, water leakage will be prevented through pipes, pipe joints and valve. Water storage tank will keep clean and will keep water without unwanted impurities. • Prepare departmental disaster management plan and submit copy to the collector.	• Will keep drainage system in working condition. • Will provide pure drinking water. • Will provide dewatering pump in case of flood emergency. • Coordinate distribution of water and storage and provision of information on safe water use.	• Assess status and damage to water systems. will restore pure drinking water system in affected areas • Will conduct lessons learned meeting and submit report to the collector. • Prepare & implement long term mitigation project in Gir Somnath district.
Executive Engineer	• Prepare departmental disaster management	• Constant monitor Progress of	

Irrigation	plan and submit copy to the collector. Department will keep their wireless set always in working condition to inform govt. department/public in case of emergency.	dams/check dam level and inform to district collector control room. Constant monitor water flow of river and upper catchment areas rain and update information for further course of action during disaster.	
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3.3.11. ELECTRICITY BOARD

- Arrange for uninterrupted power supply to the plant, as required
- Arrange for lighting; at temporary medical camps etc
- Arrange for switching off power supply on request from District Authorities

Roles and Responsibilities of Different Key Departments	Before Emergency	During Emergency	After Emergency
Executive Engineer Electricity Department	• All safety arrangements should check. • He will keep surplus stock of equipments and arrangement for testing equipments urgently in case of emergency. • Prepare departmental disaster	• Will arrange to provided generator as and when required by District Collector. • Will keep electricity flow continuous and if required, stop electricity for safety purpose.	• Assess damage of Electricity property in case of disaster / emergency. • Coordination with govt. & private • Electricity companies for rehabilitation work and report to the collector.

Roles and Responsibilities of Different Key Departments	Before Emergency	During Emergency	After Emergency
	management plan and submit copy to the collector.		

3.3.12. POLLUTION CONTROL BOARD

- Project likely areas to be polluted.
- Carry out pollution assessment at suspected locations including soil, river and air assessment
- Ensure controlling of long-term pollution damage
- GPCB will ensure environment monitoring equipment in working condition and also perform the decontamination activity in affected area. GPCB will also solve the emergency due to water pollution.

Roles and Responsibilities of Different Key Departments	Task to be performed Before / During / After Emergency
GPCB(Gujarat Pollution Control Board)	GPCB will ensure environment monitoring equipment in working condition and also perform the decontamination activity in affected area. GPCB will also solve the emergency due to water pollution.

3.3.13. RAILWAYS

- Act as per the direction of DEA to stop incoming trains, if required
- Arrange for evacuation, if required

Roles and Responsibilities of Different Key Departments	Task to be performed Before / During / After Emergency
Superintendent of railway	Superintendent of Railways will stop railway as per instruction pass by District Collector or SDM in case any emergency & will provide railway train – goods train for public transfer and emergency work distribution.

3.3.14. MEDIA MANAGEMENT

The role of media, both print and electronic, in informing the people and the authorities during emergencies becomes critical, especially the ways in which media can play a vital role in public awareness and preparedness through educating the public about disasters; warning of hazards; gathering and transmitting information about affected areas; alerting government officials, helping relief organizations and the public towards specific needs; and even in facilitating discussions about disaster preparedness and response. During any emergency, people seek up-to-date, reliable and detailed information.

Jamnagar Collectorate office has established an effective system of collaborating with the media during emergencies. Both print and electronic media is regularly briefed at predetermined time intervals about the events as they occur and the prevailing situation on ground. A similar set up is also active at the Taluka Control room (i.e. Mamlatdar office).

3.4. OVERVIEW OF THE RESPONSIBILITIES FOR PREPAREDNESS ACTIVITIES

Prevention & Mitigation Activity	Primary Responsibility	Secondary Responsibility
Ensure safety of chemical storage vessels regulated by PESO	PESO	DISH
Ensure overall chemical safety of the unit including process safety, PPE, staff training, etc.	Industry	DISH
Ensure no or minimal environmental impact owing to operations and possible accidents at the site	GPCB	DISH
Reduce use of toxics through minimizing use and/or storage volumes	Industry	DISH
Implement risk management programs and install passive and active mitigation systems	Industry	DISH
Ensure onsite emergency plans for MAH units and Type A & Type B industries	DISH, PESO, GIDC,	Industry
Ensure onsite emergency plan for Hazardous Waste Management Facilities (TSDF)	Treatment, Storage and Disposal Facility (TSDF)	Regional Officer GPCB
Prepare onsite emergency plans and enforce MSIHC rules in intermediate, minor and private ports in addition to major ports	Respective Port Authority	Regional Officer GPCB, DISH
Plan sheltering in place and/ or evacuation programs with proper public warning systems	Revenue Department	Information Dept Local Bodies

3.5. INDUSTRIAL DISASTERS, FIRES AND CHEMICAL ACCIDENTS ACTION PLAN

3.5.1 LOCAL RESPONSE TO CHEMICAL EMERGENCY - EMERGENCY ORGANISATION STRUCTURE

The response to a chemical disaster is always local with resources segmented from district and state levels. Under MSIHC Rules, the LCG is the lowest level of group available at the industrial cluster level the DCG is the next level of response. In the case the LCG is not available; the DCG is the lowest level of response.

At the State level, agencies such the GSDMA, DISH, GPCB, PESO, GIDC etc. are responsible for regulation, planning, and management

The response plan detailed out in this report establishes a concept of operations and assigns specific functional responsibility to departments, agencies, and organizations within Gir Somnath for chemical and industrial disasters. Chemical disasters can be classified per their scales as: Minor, Moderate, Major and Catastrophic.

3.5.2. RESPONSE TO HAZCHEM TRANSPORTATION EMERGENCIES

The organization structure for response, concept of emergency operations, and roles and responsibility of key stakeholders remains almost the same in case of emergencies involving the transportation of hazardous chemicals. The special considerations while responding to transportation emergencies are:

Pipeline Transportation - In case of pipeline transportation the initial notification may be done by the occupier/owner of the pipeline or by the local community or by the contractor who caused the damage to the pipeline. Therefore, it is important that all pipelines nodes and routes clearly display the emergency contact information in case of any accident with the pipeline. Once the initial

notification of an accident is obtained the response operations are similar to other chemical accidents.

Road Transportation -In case of an emergency involving a road tanker carrying hazardous chemical, the driver of the tanker is expected to be well-trained to handle emergency situations and have up-to-date contact information. The consigner and consignee may also make these calls. The tanker must display the emergency information panel and driver should carry the Transport Emergency Card or TREM Card which has detailed instructions on response actions for fire, spillage or leakage. The driver should take the first protection actions by stopping traffic and general citizens from approaching the accident site until police arrive for help. The driver can try to stop the leak (if any) only if he is adequately trained and equipped to do so. The police officer on site will most likely be the first IC until a more qualified response team arrives. The most important action by the police is to cordon off the site of the accident, divert and regulate traffic, and evacuate/shelter in place citizens in close proximity on a priority basis. It is also important that untrained and unequipped first responders should not try to stop the leak or enter the hot zone and should instead wait for a qualified response.

3.5.3. EMERGENCY RESPONSE & EVACUATION GUIDE OF HAZARDOUS CHEMICAL

3.5.3.1. CHLORINE

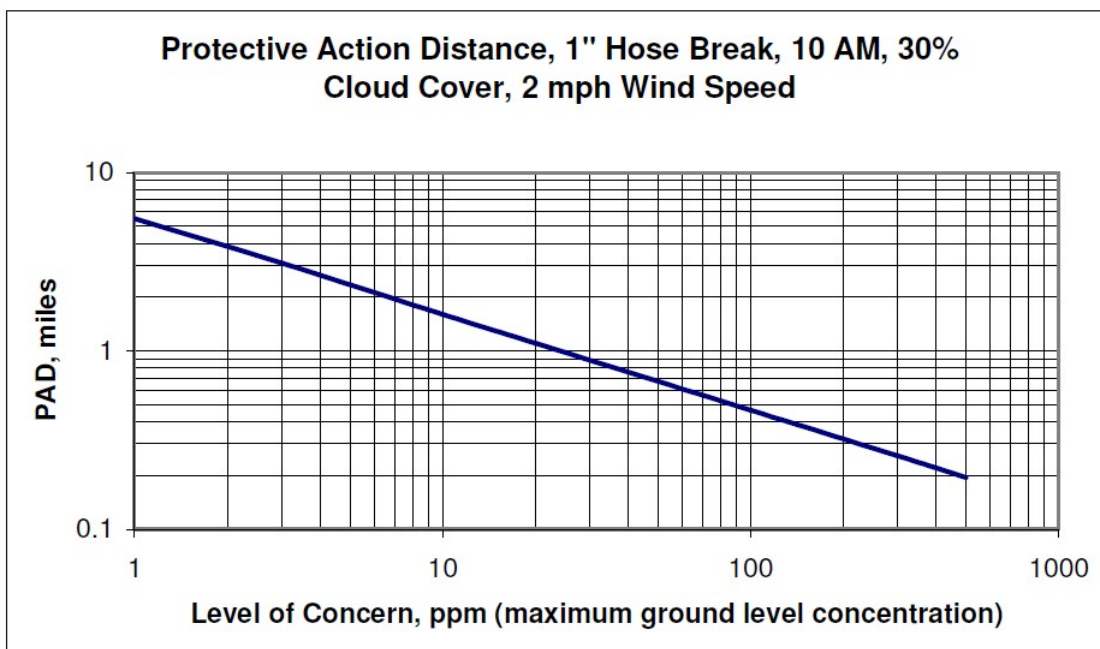
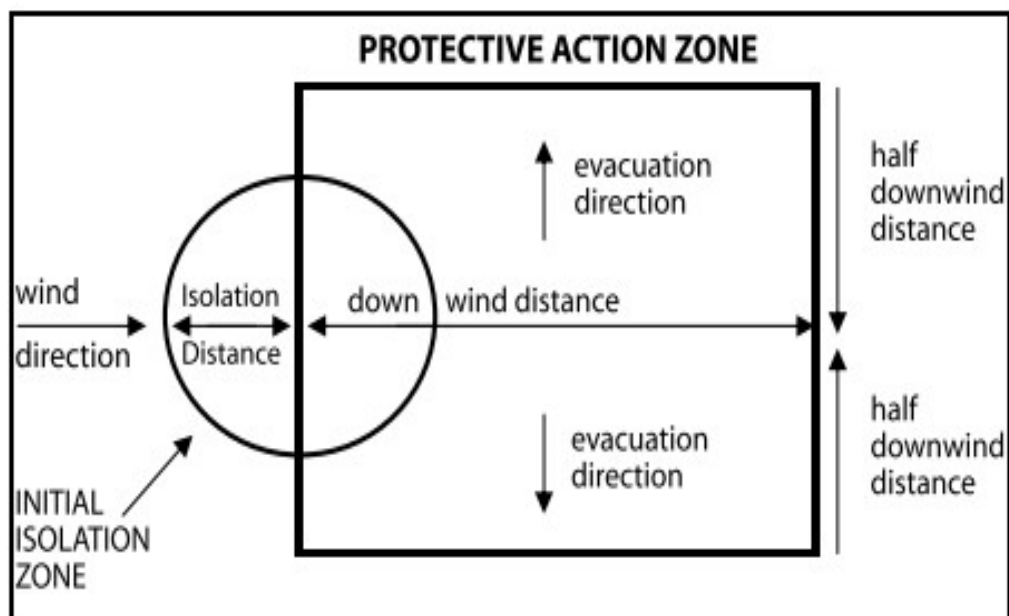
Formula: Cl₂

Yellow/ Green Colour, Gas, Pungent Odour, Corrosive (Chlorine gas is heavier than air and Dispersion is slow)

Flammable	:	NO
Flash Point	:	N/A
LEL- UEL	:	N/A
Toxic	:	Yes
IDLH	:	10 PPM
TLV	:	01 PPM

A. General Response Action

- On-SITE: Stop Chlorine Leakage, if possible safely
- Wear self contained Breathing Apparatus (SCBA) and use Chlorine emergency kit
- INFORM people to stay confined indoor with door & window tightly shut and ventilators & ACs off.
- SHELTER AND CONFINE un-housed people to an indoor area outside likely cloud travel path.
- Use water spray / fog to disperse and dilute vapours
- Collect runoff for disposal as potential hazardous waste.

B. Evacuation Zone Dimensions

Sr. No	Mass of Release (Tonners)	Approx. Distance (m) (in the direction of wind)	Valnerable (in the direction of wind)	Approx. time to reach Max. Vulnerable Dist. (Min)
1	0.5	622		4
2	0.9	3100		18

C. Fire

- Chlorine is non flammable, so the cascading effects in case of fire explosion is absent. Hence no Domino Effect.
- However, It may ignite or explode on contact with combustible materials.

Suggested Action:

- Use water spray / fog as extinguishing medium.
- Do not use dry chemicals, carbon dioxide or Halogenated extinguishing agents
- For Large Fires- Flood with fine water spray.

D. Medical ::

Danger

- Poisonous if inhaled. Fatality may be caused due to inhalation when concentration in air is greater than 10 PPM (IDLH)
- Low level exposure to chlorine in air will cause eye/ skin / airway irritation, sore throat, and cough.
- At higher levels of exposure, sign and symptoms may progress to chest tightness, wheezing, dyspnoea, and bronchospasm.
- Low level exposures to chlorine gas will cause eye and skin irritation. Higher exposures may result in severe chemical burns or ulcerations. Exposure to compressed liquid chlorine may cause frostbite of the skin and eyes.

Suggested Action:

- Inhalational chlorine poisoning can be treated with supportive care and can include administration of humidified oxygen, bronchodilators, and airway management.
- Pulmonary edema may be delayed and therefore patients should be monitored for up to 24 hours following severe inhalation exposures.

Antidotes: explained in plan .

Pollution ::

- A leak of chlorine vapours poses a significant air pollution hazard
- Chlorine is heavier than air and dispersion is slow. Hence state of emergency will last longer.

E. Chemical Information :

Chemical Reactivity:

Reactivity with Water:

Chlorine is sparingly soluble in water. The Water solubility of chlorine is 0.7% @ 20 > C.

Reactivity with Common Material:

Chlorine is aggressive to certain non metallic material like natural rubber and many plastics, therefore equipment and hoses must be suitable for chlorine.

Chlorine is chemically stable. It is incompatible with Strong oxidizers.

It does not react with common material but may react with oxidizing material.

Olefinic impurities may lead to narcotics effects or it may act like a simple asphyxiate.

Polymerisation:

Hazardous polymerization will not occur.

Combustion Products :

N.A. since chlorine is not flammable gas.

Properties:

- Physical State at 15 Deg. C and 1 Atm. Pressure: Gas
 - TLV: 0.5 PPM
 - IDLH: 10 ppm
 - Molecular weight: 70.906
 - Boiling Points: -34.0 Deg C
 - Freezing Points: -101 Deg C
 - Vapour Pressure: 5168 mm Hg @ 21 deg.c
 - Vapour Density: (air=1) 2.49
 - Liquid Density: (Water=1): 1.56 @ -34. Deg C
 - Liquid Vapour conversion: 1:450

3.5.3.2. AMMONIA**Formula:** NH₃

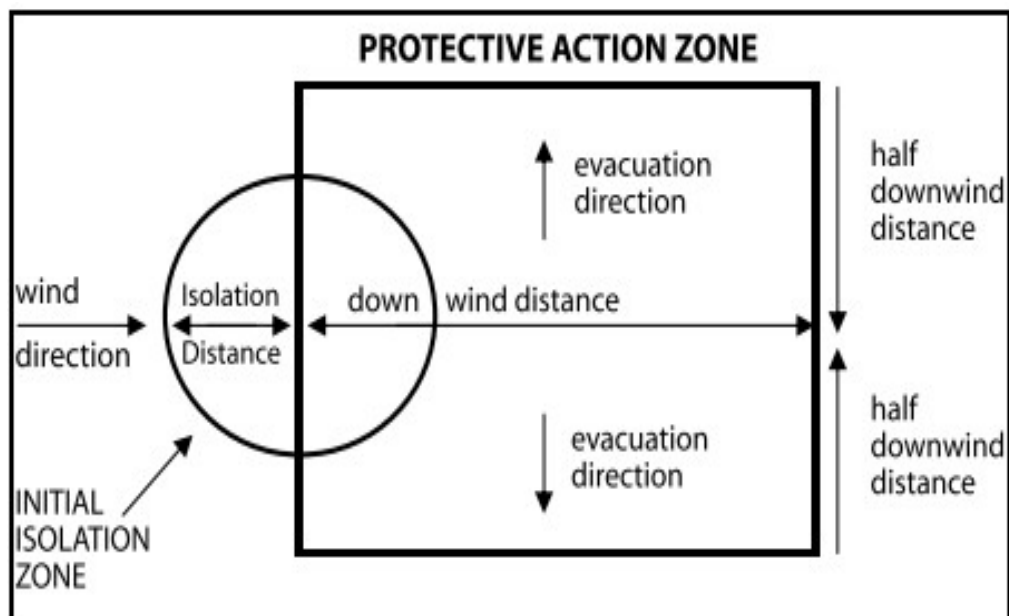
Colourless gas or liquid with pungent odour

Flammable:	Air – Ammonia mixture is	inflammable
Flash Point:	N/A	
LEL- UEL:	16% - 25%	
Toxic:	Yes	
IDLH:	300 PPM	
TLV:	25PPM	

I. General Response Action

- On-SITE: Stop Ammonia Leakage, if possible safely
- Wear self contained Breathing Apparatus (SCBA) and use Ammonia emergency kit
- Stay upwind, out of low areas, and ventilate closed spaces before entering. Evaluate the affected area to determine whether to evacuate or shelter-in-place by taping windows and doors, shutting off outside air intakes (attic fans, etc.), and placing a wet towel or cloth over the face (if needed). Earth-ground and bond all lines and equipment associated with the ammonia system.
- Electrical equipment should be non-sparking or explosion proof.
- Use water spray / fog to disperse and dilute vapours
- Wear PVC Suit, Goggles, Hand gloves

II. Evacuation Zone Dimensions



Sr. No	Mass of Release (Tonners)	Approx. Valnerable Distance (m) (in the direction of wind)	Approx. time to reach Max. Vulnerable Dist. (Min)
1	5	500 m	3
2	10	10000 m	40

III. Fire

- Ammonia is inflammable. Fire hazards of ammonia are moderate.
- Ammonia forms flammable mixture with air within certain limits (16- 25%) by vol.
- Fire hazard increases in contact with oil or other combustible materials.

Suggested Action:

- To extinguish the fire use CO₂, DCP or water sprays.
- Cool the leaking cylinder with large amt. of water.
- To control the fire, stop the flow of the gas if possible.

IV. Medical

Danger

- Skin Contact – Irritation, Burn may be very painful.
- Eye Contact; Highly painful irritation of eye & eyelids
- Watering of eye.
- Serious lesions in eyes.
- Inhalation – Irritation of nose, eyes and throat.
- Difficulty in breathing
- Sudden death.
-

Suggested Action:

- Immediately remove the victim from the affected area & take him to the nearest shower.
- Immediately administer medical oxygen under low pressure using a pulmotor.

Antidotes: Atropine Solun.

V. Pollution

- Ammonia is harmful to aquatic life in very low concentrations and may be hazardous if it enters water intakes.
- Local health and wildlife authorities, as well as operators of water intakes in the vicinity, should be notified of water releases.
- Ammonia does not concentrate in the food chain.
- The conversion of ammonia to nitrites/nitrates by bacteria in aquatic systems can reduce the concentration of dissolved oxygen (referred to as nitrogenous oxygen demand).
- Effect on water treatment process: Chlorination will produce chloramines, which are more readily detected by taste and odor.

VI. Chemical Information

A) Chemical Reactivity:

Reactivity with Water:

Chlorine is rapidly soluble in water. When ammonia reacts with water, it forms Ammonium Hydroxide
($\text{NH}_3 + \text{H}_2\text{O} \rightarrow \text{NH}_4\text{OH}$)

B) Reactivity with Common Material:

Ammonia is highly reactive with Sodium, Potassium at ordinary temp.

C) Polymerisation:

Hazardous polymerization will not occur.

D) Combustion Products :

Hydrogen at very high temperatures: 1544oF (840oC).

E) Properties:

- Physical State at 15 Deg. C and 1 Atm. Pressure: Gas
- TLV: 25 PPM
- IDLH: 300 ppm
- Molecular weight: 17.03
- Boiling Points: -33 Deg C at 1 atm
- Freezing Points: -78Deg C
- Vapour Pressure: 7,600 mm Hg @ 25o C
- Vapour Density: (air=1) 0.597 @ 0o C
- Liquid Density: (Water=1): 0.6818
- Liquid Vapour conversion: 1:450

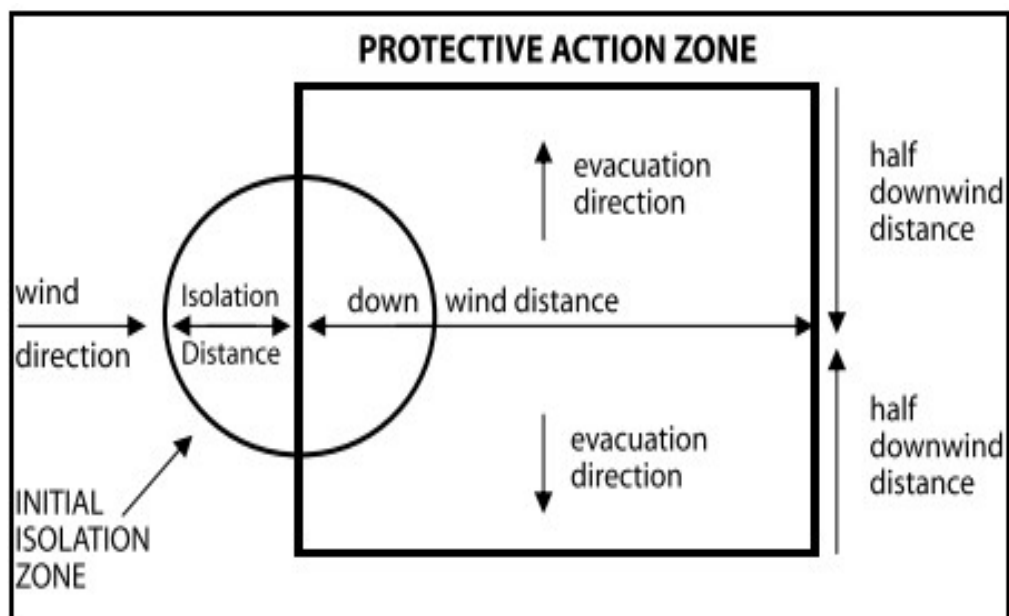
3.5.3.3. LPG**Formula: C_3H_8 – C_4H_{10}**

Colour less gas odourless

Flammable:	
Flash Point:	-104°C (-155°F)
LEL- UEL:	2.1 % & 9.5 %
Toxic:	---
IDLH:	PPM
TLV:	PPM

I. General Response Action

- On-SITE: keep container dry, keep away from heat and source of ignitions
- PPEs: Face shield, full suit and vapour respirator.

II. Evacuation Zone Dimensions

Sr.No	Mass of Release	Approx. Valnerable Distance (m) (in the direction of wind)	Approx. time to reach Max. Vulnerable Dist. (Min)
1	1200	5	<2

I. Fire

- Highly Inflammable & Explosive

Suggested Action:

- Avoid contact with oxidizers olefinic impurities may lead to narcotic effect or it may cut a simple as phyxicant
- Fire Hazard when exposed to heat or flame
- If fire is big keep surrounding areas cool by spraying water.

II. Medical ::

- **Routes of Entry :-** Inhalution, Skin concentration in air greater thus 10% causes dizziness in few minutes 1% conc. Give the same symptoms in 10 mins high conc.causes As phyxiation.
- Liquid on skin causes frostbite.

Suggested Action:

- Remove the victim to the fresh area.
- Provide artificial Resysctitation, Remove the wetted clothes
- Wash the affected area with water

Antidotes: N.A.

I. Pollution ::

- A leak of LPG poses a significant air pollution hazards
- May cause fire and explosion -a great environmental hazards

I. Chemical Information ::

A) Chemical Reactivity:

Reactivity with Water:

B) Reactivity with Common Material:

C) Polymerisation:

D) Combustion Products :

E) Properties:

- Physical State at 15 Deg. C and 1 Atm. Pressure: Gas
- TLV: PPM 1000
- IDLH: ... PPM
- Molecular weight.....
- Boiling Points: - -40.0 Deg C
- Freezing Points: -..... Deg C
- Vapour Pressure: 23 to 123 mm Hg @ 21 deg.c
- Vapour Density: (air=1)...: Lighter.

Liquid Density: (Water=1): 1.6 @ -34. Deg

3.6. MITIGATION MEASURES

INDUSTRIAL (CHEMICAL) MITIGATION MEASURES IN COORDINATION WITH DCG, DISTRICT AND STATE LEVEL AUTHORITIES.

Non structural Measures	Activities	Implementing Departments
Planning	Prepare an onsite and offsite emergency plan	Occupier, DISH
	Conduct mock drills as per the regulations	DCG, DISH and LCG
	Update the plan as per the requirement	Occupier, DISH
	Monitor similar activities in all the factories / industries	DISH and LCG
Capacity Building	Awareness generation to general public and medical professional residing near MAH factories for immediate steps	DCG LCG
	Organize training programmes, seminars and workshops (e.g. for drivers of HAZMAT transport, line departments officers, Mamlatdar etc)	DCG LCG
	List of experts / resource person/ subject specialist (District emergency Off site plan)	DCG, LCG
Medical	Listing of hazardous chemicals and gases.	Occupier, DCG, LCG, DISH, BHO
	Keep check on availability and validity of relevant antidotes for chemical hazards prevalent in District	Occupier, DCG, LCG, DISH,
	Workshops and trainings for medical professionals to handle potential chemical and industrial hazard	DCG, Occupier, LCG, DISH

Non structural Measures	Activities	Implementing Departments
Compliance	Environmental Protection Act, Factory Act, Mutual Aid SOPs	DISH , GPCB

At the District level, the District Crisis Management Group (DCG) is an apex body to deal with major chemical accidents and to provide expert guidance for handling them. DCG has members which includes District Collector, SDM and Dy. Collector, DDO, Dy. Director – Industrial Safety & Health, DSP, PI, Fire Superintendent of the City Corporations or important Municipalities, Chief District Health Officer, Civil Surgeon, SE, Chief Officer, Dy. Chief Controller of Explosives, Commandant – SRPF, Dy. Director – Information, Manager etc

4.0 Natural Calamities

The Indian subcontinent is highly prone to natural disasters, which can also trigger chemical disasters. Damage to phosphoric acid sludge containment during the Orissa super cyclone in 1999 and the release of acrylonitrile at Kandla Port, during an earthquake in 2001, are some of the recent examples.

4.1 TYPES OF NATURAL CALAMITIES & ITS ACTION PLAN:

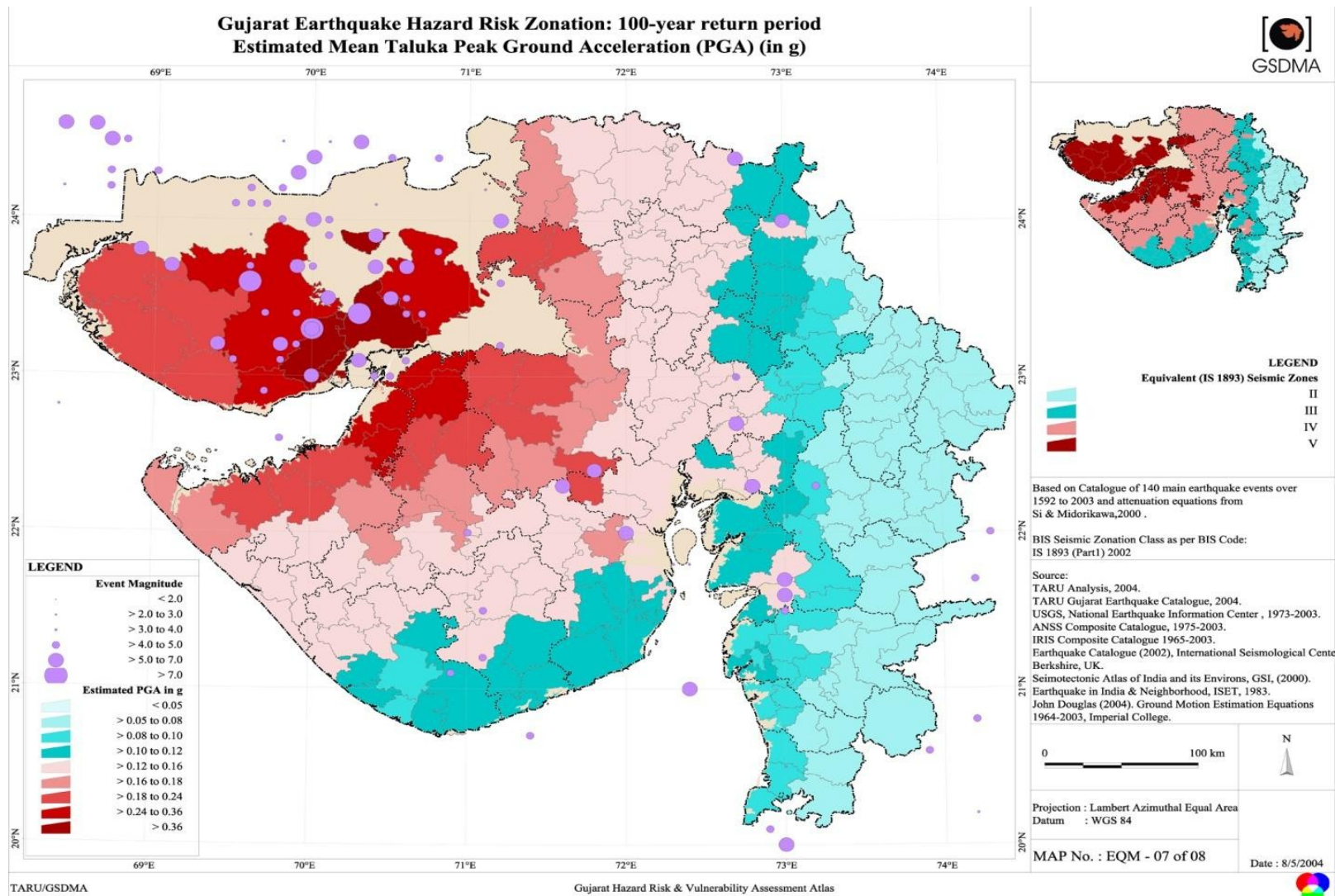
1) Earthquake

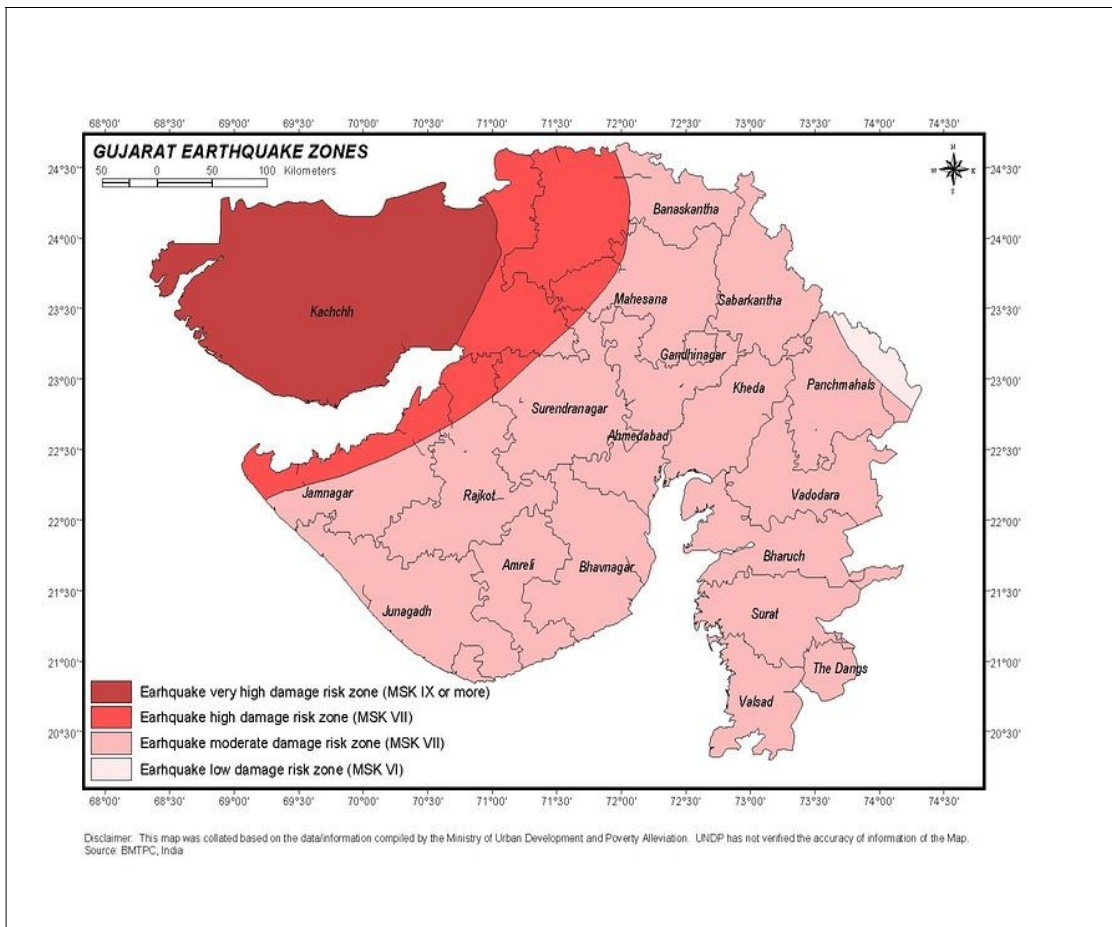
As per Indian Seismic Zone Map, Gujarat region is lies in three zones- Zone III, IV and V. Kachchh region (about 300km x 300km) lies in zone V where earthquakes of magnitude 8 can be expected. A belt of about 60-70 km width around this zone covering areas of North Saurashtra and areas bordering Eastern part of Kachchh lie in zone IV

The rest of Gujarat lies in zone III where intensity 7 can be expected due to moderate local earthquakes or strong Kachchh earthquakes.

The cities of Ahmedabad, Bharuch, Rajkot, and Bhavnagar fall into the severe intensity zone, while Bhuj and Jamnagar fall in the very severe intensity zone over this time frame.

1. Earth quake:





Thus taking the above in to consideration risk exposure can be considered as moderate. Whereas, seismic experts have opined that the Indian land mass is being constantly compressed between the sea and Himalayas and thus the developed stresses are being released in the form of earthquakes in the least expected areas.

DURING EARTHQUAKE,

if indoors:

- Take cover under a piece of heavy furniture or against an inside wall and hold on.
- Stay inside.
- The most dangerous thing to do during the shaking of an earthquake is to try to leave the building because objects can fall on you.

DURING EARTHQUAKE, if outdoors:

- Move into the open, away from buildings, street lights, and utility wires.
- Once in the open, stay there until the shaking stops.

DURING EARTHQUAKE, if in a moving vehicle:

- Stop quickly and stay in the vehicle.
- Move to a clear area away from buildings, trees, overpasses, or utility wires.
- Once the shaking has stopped, proceed with caution. Avoid bridges or ramps that might have been damaged by the quake.

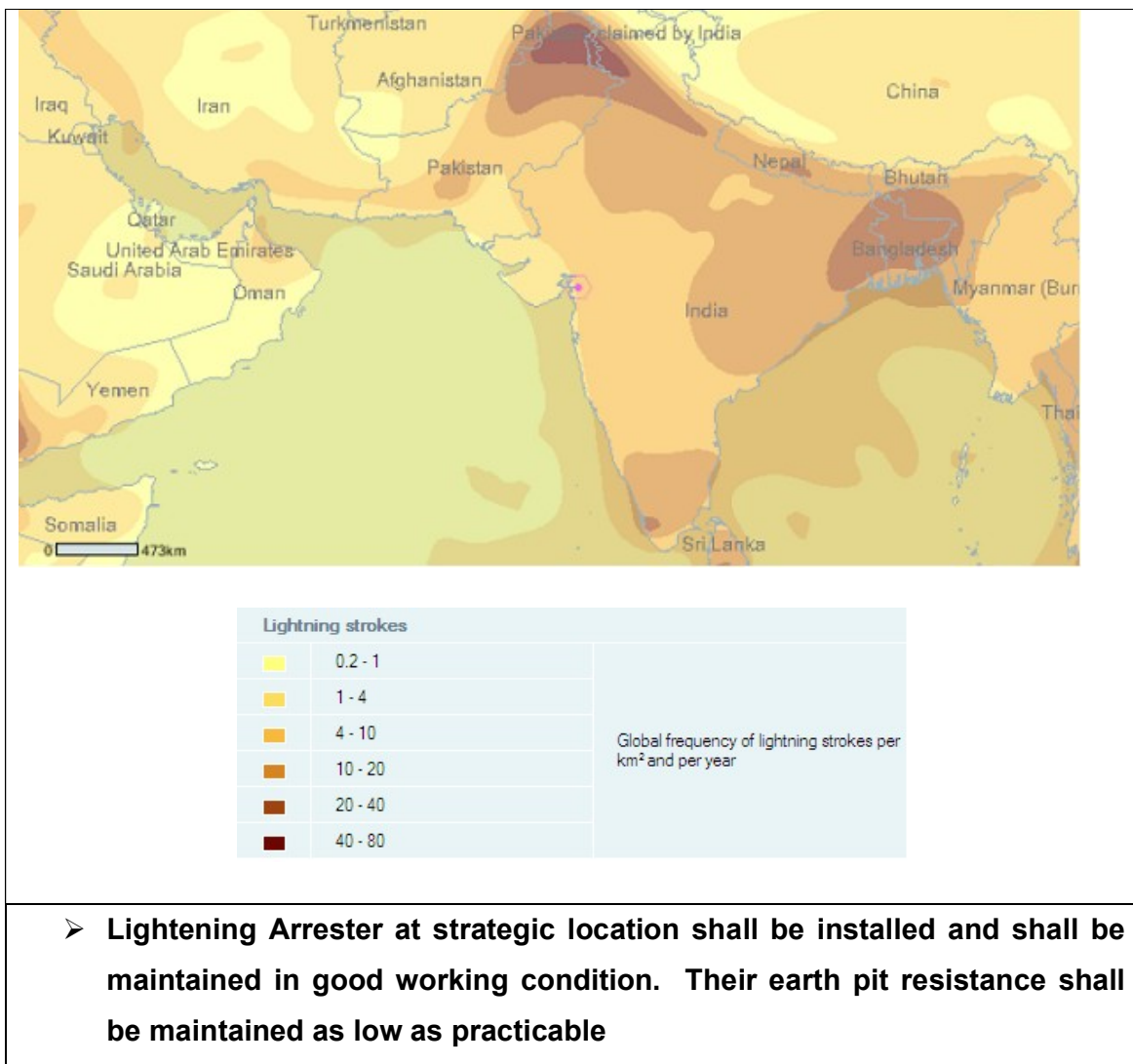
AFTER EARTHQUAKE

- Be prepared for aftershocks. Although smaller than the main shock, aftershocks cause additional damage and may bring weakened structures down. Aftershocks can occur in the first hours, days, weeks, or even months after the quake.
- Help injured or trapped persons.
- Give first aid where appropriate.
- Do not move seriously injured persons unless they are in immediate danger of further injury.
- Call for help.
- Listen to a battery-operated radio or television for the latest emergency information.
- Remember to help your neighbors who may require special assistance--infants, the elderly, and people with disabilities.
- Stay out of damaged buildings.
- Use the telephone only for emergency calls.
- Clean up spilled chemicals or other flammable liquids immediately. Leave the area if you smell gas or fumes.
- Provide temporary shelter to affected people
- Evacuation site should be safe, and easily accessible.
- Continue to provide essential services to the affected people i.e. food, water, clothing, sanitation and medical assistance

- The Site main controller to ensure the following in the relief camps:
 - i. Special emphasis on Hygiene and sanitation aspects should be given in relief camp sites.
 - ii. Separate area should be earmarked within the relief camp for storage of relief materials.
 - iii. Adequate manpower and transport facilities for the camp site.
 - iv. Arrangements to be made for trauma management.
 - v. Mobile medical units to be sent to remote areas with a view to provide medical assistance to the victims/injured.

Information centre should be established by the administration.

4.2. Lightening & Thunderstorm:



BEFORE

- Thunderstorm is invariably accompanied by lightening. A single stroke of lightening has 125, 000, 00 volts of electricity. That's enough power to light a 100-watt light bulb for more than 3 months, or enough to seriously hurt or to kill someone. Know what steps to take in the event of an oncoming thunder storm & lightening. Lightening is something you should not be careless about, so seek a safe shelter immediately! Be warned, lightening can and does strike just about any object in its path. When you see lightening, follow these safety rules.

INDOORS

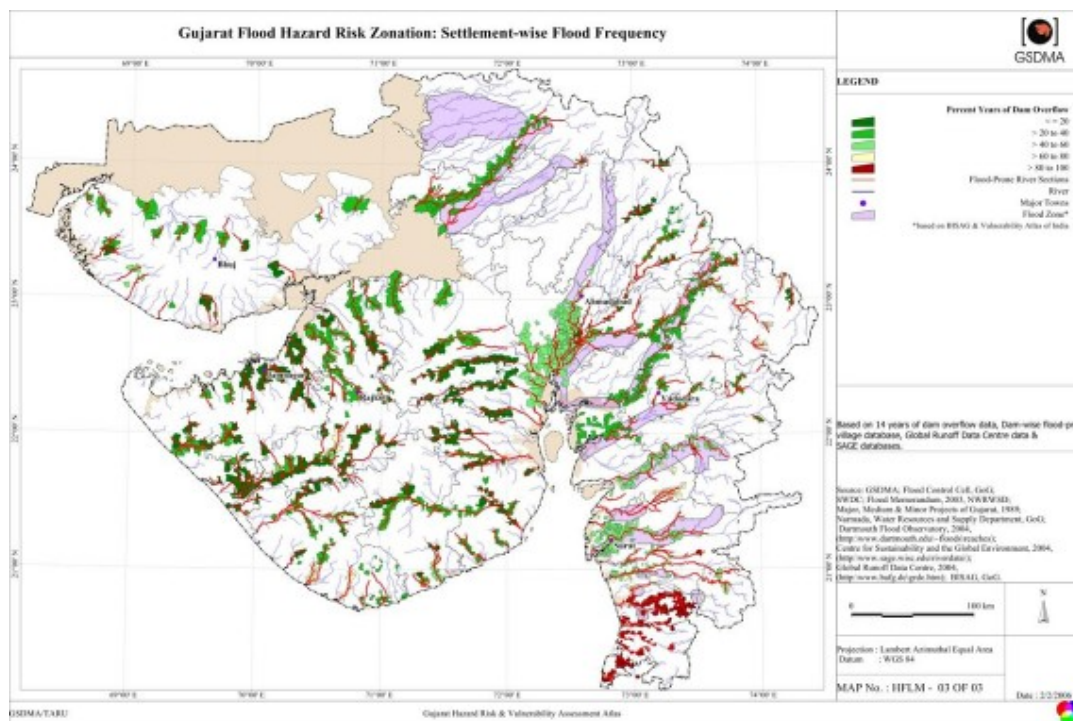
- Stay or go indoors! If you hear thunder, don't go outside unless absolutely necessary. Stand clear from windows, doors, and electrical appliances.
- Stay away from anything that could conduct electricity. This includes electric lines, Electric Instruments, wires etc and phones. Unplug appliances well before a storm strikes – never during.
- Don't use any plug-in electrical instruments. If lightening strikes your building they can conduct the charge to you.
- Don't use the telephone during the storm. Lightening may strike telephone lines outside. Use the telephone only for emergencies quickly. Avoid contact with piping including sinks, baths and faucets.

OUTDOORS

- When outdoors, seek shelter from lightening! Buildings are best for shelter, but if no buildings are available, you can find protection in a cave, ditch, or a campus. Trees are not good cover. Tall trees attract lightening. Never use a tree as a shelter.
- Stay in your vehicle if you are travelling, vehicles give you excellent lightening protection. Get in a hard topped car.
- If you can't find shelter avoid the tallest object in the area. If only isolated trees are nearby, your best protection is to crouch in the open, keeping twice as far away from isolated trees as they are high. Avoid areas that are higher than the surrounding landscape.

- Don't use metal object outside. Keep away from metal objects including bikes, electric or telephone poles, fencing, machinery etc.
- Get out of the water. Immediately get out and away from pools, lakes, and other bodies of water.
- When you feel the electrical charge – if your hair stands on end or your skin tingles- lightening may be about to strike near you. Immediately crouch down and cover your ears. Do not lie down or place your hands on the ground.
- Victims of lightening shock are administered CPM (Cardio pulmonary resuscitation) i.e. artificial respiration, if necessary. Seek medical aid.

4.3. Heavy Rain:



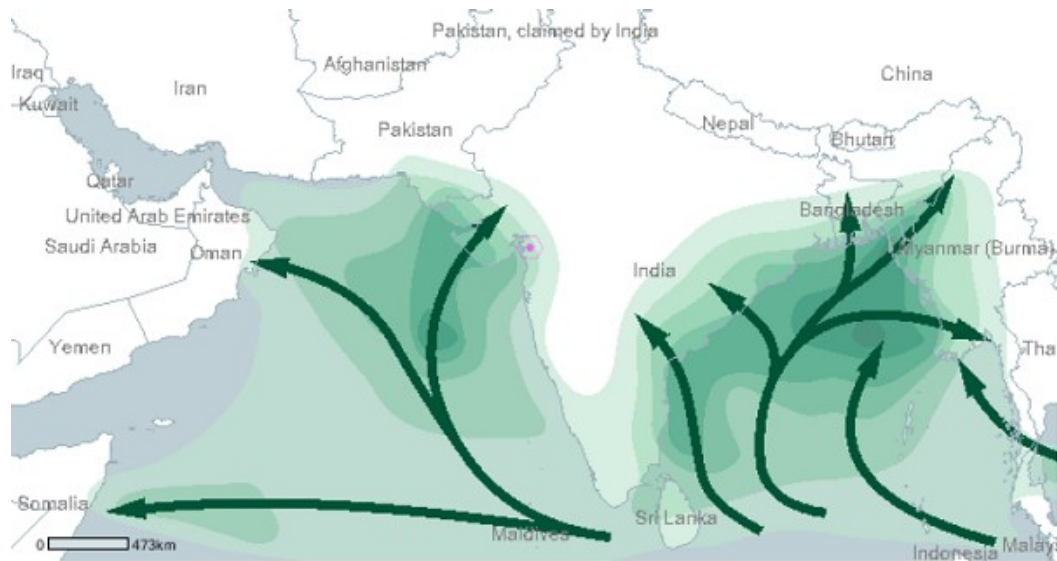
- Stay out of the basement.
- Stop all jobs outside.
- Heavy rain many times accompanies high-speed wind. Stop all work at height.

- Disconnection power supply to all electrical Machines in open yards.
- Cover all JB's\DBs where chances of water coming to it are there.
- Keep Gumboot, Raincoat and umbrellas ready.
- Keep all dewatering pumps ready in working order.
- Move valuable objects upstairs only if safe to do so, without straining yourself
- Keep yourself indoors and away from rivers and creeks
- Stay away from low/lying areas
- Avoid walking through a waterlogged area on foot; you can get swept away easily.
- Assemble everyone inside shelters or buildings.
- Close windows and blinds.
- Evacuate rooms that might bear the full force of the wind
- Avoid enclosures that have long roof spans.
- Keep the office radio tuned to a local station for current advisory information

4.4 Cyclone

Gujarat falls in the region of tropical cyclone. With the longest coast line of 1600 km in the country, it is highly vulnerable to associated hazards such as floods, storm surges etc. Most of the cyclones affecting the state are generated in the Arabian Sea. Two cyclonic storm seasons are experienced in Gujarat: May to June (advancing southwest monsoon) and September to November (retreating monsoon).





Tropical cyclone		
	Zone 0: 76 - 141 km/h	Probable maximum intensity with an exceedance probability of 10% in 10 years (equivalent to 'return period' of 100 years).
	Zone 1: 142 - 184 km/h	
	Zone 2: 185 - 212 km/h	
	Zone 3: 212 - 251 km/h	
	Zone 4: 252 - 299 km/h	
	Zone 5: > 299 km/h	
	Typical track directions	

- Looking to the moderate risk of cyclone, roof sheet / louvers sheet/ etc shall be kept secured and shall be checked regularly. Any loose material/ sheet etc shall not be kept on the terrace, height.
- Keep listening to the radio for updates and advice
 - Disconnect appliances
 - Stay inside well clear of windows, sheltering in the strongest part of the house (internal hallway, bathroom or cellar)

- Keep your emergency kit with you
- If the building begins to break up, protect yourself with a rug, mattress or blanket and shelter under a bench or table
- Not assume that the end of the cyclone means the danger has passed - wait for the 'all clear'
- Stay in your vehicle if caught on the road, with the car handbrake on and parked well clear of trees, power lines and possible flooding

4.5. Flood

The climatology of Gujarat is influenced by the Arabian Sea in the West and three hill ranges along its Eastern border. A long coastline makes parts of arid Saurashtra and Kutch occasionally experience very high rainfall. These occasional heavy rainstorms are responsible for most of the floods in the state.

All major rivers in the state pass through a wide stretch of the very flat terrain before reaching the sea. These flat lowlands of lower river basins are prone to flooding. Cities like Ahmedabad, Surat and Bharuch are located on the flat alluvial plains of large rivers.

Concentrated runoff resulted by heavy rainfall cause flash floods in the small river basin of Saurashtra and Kutch because of their fairly impervious catchments (rocky or black cotton soils) and steep sloping upper catchments.

Seasonality of Hazards

By understanding the approximate occurrence of hazard, the Gujarat state may remain prepared for the respective hazards by activating the relevant departments for the same. The table below is only indicative of the occurrence.

Hazards	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Cyclone												
Drought												
Earthquake												
Epidemic												
Fire												
Flood												
Heat Wave												
Industrial/ Chemical Disasters												
Road/ Train Accidents												
Stampede												
Terrorist Attack												
Tsunami												
Legend	High Occurrence				Moderate Occurrence				Low Occurrence			

5.0. POST EMERGENCY PLAN

5.1 REHABILITATION

The Incident Controller will not signal the end of the emergency until he is satisfied that all fires are extinguished and there is not of re-ignition. In case of gas escapes, the emergency will be declared ended only when the source of emission has been effectively isolated and gas clouds are disbursed. Even when the All Clear has been given, great care is needed when re-entering affected areas, and no work in connection with the salvage, collection of evidence or start up should be put in hand until a thorough examination of the area has been carried out. The statutory powers of the Factory Inspectors must be born in mind before evidence is disturbed. It is particularly important to avoid the introduction of possible sources of ignition, such as diesel engines, hand or power operated tools and flame-cutting equipment and so on until it has been established that no flammable materials remain whereby they could be ignited.

Re-entry procedure in the factory and affected or contaminated area in vicinity should be prescribed and followed. The security officer should know it and guide people accordingly.

Holistic rehabilitation post disaster includes many inter linked aspects. It is critical to address all need of affected population in order to achieve early recovery and to bring back normalcy to their lives.

➤ SOCIO-ECONOMIC REHABILITATION

Socio-economic rehabilitation is aimed at revamping the social and economic fabric to the pre-disaster or a better situation. It also addresses issues like that of livelihood restoration and generation. This is done by providing required training, skill, tools and equipment to restart the previous or new livelihood options.

Care should also be taken to address the needs of various socially and economically vulnerable groups like that of women, adolescent girls, old age persons, differently able persons, children, destitute, below poverty line population, scheduled castes, scheduled tribes, particularly vulnerable tribal groups, etc.

➤ **PSYCHOLOGICAL REHABILITATION**

Disasters often lead to long time stress and trauma due to loss of near and dear ones, injuries, loss of limbs, loss of housing and related property, trauma generated by facing the disaster and fearful sites, fear of repetition of the disaster, etc. If not addressed appropriately, it may lead to lifelong psychological fear and disorders, thus it is necessary to provide psycho-social first and psychological care to the affected population.

➤ **ENVIRONMENTAL REHABILITATION**

Environmental impacts of natural disasters can result in serious risk to life and livelihoods if not addressed. Environmental emergencies like uncontrolled, unplanned or accidental release of a substance into the environment not only impact human life in many ways but also damage environment to great extent which may be impossible or may take years to restore to original.

5.2. RECOVERY OPERATIONS

The procedures outlined in this section are intended for re-establishing normal operations at the earliest after an emergency. In addition, the procedure also provides for determining the cause of the accident, so that such incidents can be prevented in future.

➤ **This section is divided into five parts:**

1. Incident investigation
2. Establishing a recovery team.
3. Damage Assessment
4. Clean-up and restoration

5. Post-Emergency and Recovery Reporting.

5.2.1. INCIDENT INVESTIGATION

Incident investigation should be taken up to determine the cause of the emergency and the means of preventing any such occurrences again.

➤ **PROCEDURE**

The investigation team should immediately seal off the incident scene and commence its investigation to minimize the loss of any physical evidence.

The investigation of the scene should include,

1. Photographing the area.
2. Determining the point of origin of the Fire / Leak / Explosion, if applicable.
3. Note the position of valves, controls and devices.
4. Note any unusual items in the area or any damage that is inconsistent with the type of incident which is in-cognizable . Written or recorded statements are to be taken from all operators involved, potential witnesses and others who might have pertinent knowledge about the incident.

➤ **REPORT**

A final report is to be prepared to include the most probable cause(s) and recommended corrective measures. The report should consider:

1. Failure of equipment.
2. Failure of maintenance.
3. Failure of procedures.
4. Inadequate training.
5. Human error etc.

➤ **CORRECTIVE ACTIONS**

The investigation team is also responsible for conducting a review of response activities during the emergency to evaluate the adequacy of training, equipment and procedures.

All the concerned departments are responsible for ensuring that all corrective actions to prevent recurrence of the incident are taken and to ensure better responses to emergencies, if any in future.

5.2.2. RECOVERY TEAM

➤ **PURPOSE**

In order to facilitate the restoration of normal operations of the company after an emergency, a team is to be constituted by In-charge to manage recovery activities, including damage assessment.

➤ **ORGANIZATION**

The Recovery Team's organization will vary depending on the nature of the incident and the extent of recovery operations. As a general rule, however, individuals representing Maintenance, Safety, Quality Control, Accounts, Engineering etc., should be involved.

The recovery team is responsible for damage assessment, clean-up and salvage operations and the restoration of normal Depot operations.

A primary function of the recovery team will be to assess the damage to company structures, equipment and materials. The damage to off-site areas and environment will also be assessed along with civil authorities.

5.2.3. CLEAN-UP AND RESTORATION OPERATIONS

As soon as incident investigations are completed and restoration plans have been made, clean-up and restoration activities should commence.

➤ DAMAGED EQUIPMENT

Temporary storage facilities will be established for damaged equipment to facilitate inspection by insurance personnel. Prior to restoration of normal operation, all affected equipment is to be tested and checked according to procedures established.

➤ POST-EMERGENCY RECOVERY REPORTS

The officer-in-charge of Safety is hold review sessions with emergency response personnel to evaluate:

1. The adequacy of emergency response procedures.
2. The adequacy of the investigation of the cause of the incident.
3. Summaries the post-emergency activities.

6.0. MAINTENANCE PLAN

6.1 INTRODUCTION

Plan maintenance is a dynamic process of updating the plan on a periodic basis. The backbone of maintaining the plan is carrying out mock drills and updating the plan based on lessons learnt thereof. This is a method of identifying the gaps and putting in place a system to fill the same. Regular updating of stakeholder details, contact numbers and resource inventory is another inherent and essential function of plan maintenance.

The District Administration, Jamnagar constituted a special committee under the Supernumerary Assistant Collector, with designated nodal officers for the same in 2013 to undertake an overall updation exercise of the DDMP. Vulnerabilities newly brought to the attention of the district administration as a result of the disasters in Jamnagar in the last year and lessons learnt have been incorporated. Detailed meetings with Line Departments and Nodal officers have also brought forth important lessons for Disaster Risk Mitigation and Reduction. These will be incorporated in this plan, and put up for discussion for dovetailing with development plans in the district. This will ensure that the element of Disaster Mitigation achieves due attention in all-important aspects of administration.

6.2. PLAN TESTING

The Commissioner of Relief and the Collector shall prepare, review and update the District level Disaster Management plan as provided for in the GSDMA Act (Section 22 (1) (C)). He/She shall also ensure that disaster management drills and rehearsals are carried out periodically.

While updating the plan the following aspects need to be considered by the Collector every year:

- i) Critical analysis of the outcome of exercises & mock drills as part of plan testing.
- ii) Incorporation of lessons learnt in the updated plan as a result of recommendations received from different stakeholders and as a result of mock drill exercises conducted.
- iii) Regular updation of the resource inventory and key infrastructure available in the district.

After plan testing and incorporation of lessons learnt, the Collector should send a copy of the revised and updated plan to the following officials:

- (a) Chief Secretary, Government of Gujarat
- (b) Chief Executive Officer, Gujarat State Disaster Management Authority
- (c) Principal Secretary, Revenue Department
- (d) Head of all Line Departments
- (e) State Emergency Operation Center
- (f) District Emergency Operation Center
- (g) Taluka Officers
- (h) ERCs
- (i) IMD
- (j) CWC/ACWC

The main objectives of plan testing are to:

- (i) Determine the feasibility and compatibility of back up facilities and procedures.
- (ii) Identity areas in the plan that need modification.
- (iii) Identify training needs of key stakeholders.

- (iv) Assess the ability of the organization/department to respond to disaster threats.

All departments that have specific roles and responsibilities in the DMP must have a system to ensure that all Officers of their departments who have a specific role to play are fully conversant with their responsibilities/tasks.

6.3. DEBRIEFING AND EVALUATION-MOCK DRILLS

- After the mock exercise, debriefing and evaluation is very important. It is of critical importance that insights are collected from participants and use them to modify the plan.
- Debriefing is very effective as it is carried out immediately after the exercise. It also includes documentation in terms of recommendations and improvements of the plan.
- The lessons learned from the mock exercise are likely to be similar to those from real events. The only major difference is that exercises are controlled events, specifically designed to test procedures and they can be repeated again and again until sound/workable arrangements are in place.

6.4. REVIEW / UPDATING OF PLAN

The Disaster Preparedness and Response Plan should be reviewed and updated regularly, based on inputs as under:

- (a) Drills and Rehearsals
- (b) Recommendations from all Depts. in their Annual DM Report
- (c) Lessons learnt from Disasters in other Districts, States and countries
- (d) Directions from GSDMA, Ministry of Home Affairs, NDMA, Government etc...

7.0 ANNEXURES

ANNEXURE –1 CONTROL ROOMS CONTACT NUMBERS FOR DISASTER INFORMATION

SR.NO.	AUTHORITY	ADDRESS	CONTACT NO.
1.	State Control Room	Gandhinagar	1077
2.	Disaster Emergency Control Rroom	Jamnagar	0288-2553404

ANNEXURE -2 DIRECTORY OF KEY RESPONDERS IN THE DISTRICT

Sr. No.	Authority	Address	Telephone (O, R, M)
1.	District Collector (DEA)	District Collector Office, Jamnagar	(O) 0288- 2555869 Mo. 9978406210
2.	Resi. Additional Collector	District Collector Office Jamnagar	(O) 0288- 2550284 Mo. 9978405210
3.	Dy. Director Of Industrial Safety And Health -DISH	Office Of Deputy Director Of Industrial Health & Safety, saat Rasta Circle, Jada Building, Jamnagar	(O)0288-2678206 (M) 9879102225
4.	District Development Officer - DDO	Jamnagar	(O)0288-2553901 9978406235
5.	Prant Office Jamnagar	District Collector Office Jamnagar	(O)0288-2552130 Mo. 9978405342
6.	Prant Office Dhrol	Dhrol	(O) 02897 222311
7.	Prant Office Lalpur	Lalpur	(O) 02895 272346
8.	Superintendent of Police	Police station, Jamanagar	(O)0288 2554203 (M) 9978405071
9.	Municiple Commissioner, JMC	Jamnagar	(O)0288 2552321 9313443300

Sr. No.	Authority	Address	Telephone (O, R, M)
10.	Dy. Sp Jamnagar City	Jamnagar	(O) 0288 2552940 (M) 99784 08191
11.	Dy. SP Headquarter	Jamnagar	(O)0288 2553017 (M) 9978408189
12.	Chief Fire Officer	Jamnagar	(O) 0288 -2672208 (M) 9879531101
13.	Dist. Health Officer	Jamnagar	(O) 0288- 2671097 Mo. 7567880001
14.	Additional Dist. Health Officer	Jamnagar	(O)0288-2670382
15.	Pollution Control Board (Regional Officer)	Regional Officer GPCB Jamnagar	(O)0288-2752366, (M)7574827580
16.	Transport Provider Regional Transport Officer	Jamnagar	(O) (0288) 2672100 9427556875
17.	Dy. Director Information	Jamnagar	(O)0288- 2679234 9426985625
18.	Asst. Director, Fisherish	Jamnagar	(O) 0288 2567882 9825452992
19.	District Supply Officer	Jamnagar	(O) 0288 2553897 7567022435

Sr. No.	Authority	Address	Telephone (O, R, M)
20.	District Agriculture Officer	Jamnagar	(O) 0288-2556119 9427454535
21.	Dy. Director - Animal Husbandry	Jamnagar	(O) 0288-2678424 9825840584
22.	Executive Engineer - R&B	Jamnagar	(O) 0288-2550362 7069832770
23.	Executive Engineer - Irrigation Division	Jamnagar	(O) 0288-2670688 9427247132
24.	Supritendent Engg PGVCL	Jamnagar	(O) 0288 2550301 9925209912
25.	Health Supritendent, GG Hospital	Jamnagar	(O) 0288 2554629 9426923307
26.	Dy. Controller, Civil Defense	Jamnagar	(O) 0288 2540371 9979399977
27.	Divison Director, ST Division	Jamnagar	(O) 0288 2572188 6359918548
28.	Port Officer, GMB	Jamnagar	(O) 0288 2711805 9099694747
29.	Dy. Chief Controller of Explosive, Vadodara	Vadodara	(O)0265 2225259

ANNEXURE – 3 DISTRICT CRISIS GROUP- Jamnagar (DCG)

Sr. No	Designation of Authority	Designation in DCG	Contact Number	
			Office	Mobile
1	District Collector	Chair Person	0288 2555869	9978406210
2	Dy. Director Industrial Safety & Health	Member Secretary	0288-2678206	98791 02225
3	Municipal Commissioner, JMC	Member	0288 2552321	9313443300
4	Chief Fire Officer	Member	0288-2672208	(M) 9879531101
5	District Information Officer	Member	(0)0288- 2679234	9426985625
6	District Energy Officer	Member	0288- 2550301	9925209912
7	Controller of Explosives (Deputy Chief Controller of Explosives, Vadodara)	Member	0265 2225259	-
8	District Health Officer	Member	0288- 2671097	7567880001
9	Deputy Superintendent Of Police	Member	0288 2552940	99784 08191
10	Representative Of Pollution Control Board	Member	0288-2752366,	7574827580
11	District Agriculture Officer	Member	0288-2556119	9427454535

Sr. No	Designation of Authority	Designation in DCG	Contact Number	
			Office	Mobile
12	Divison Director, GSRTC Division	Member	0288 2572188	6359918548
13	Port Officer, GMB	Member	0288 2711805	9099694747
14	Regional Transport Officer	Member	02882672100	9427556875
15	Dy.Controller, Civil Defense	Member	0288 2540371	9979399977
16	Expert From Industry- Fire Chief RIL Jamnagar	Member	0288-4011193	99982 15963
17	Expert From Industry- HSE&F Chief RIL Padana	Member	0288 4022190	99989 87222
18	Expert From Industry- EOL, Vadinar	Member	02833-662405	99099 08685
19	Expert From Industry – GSFC Sikka	Member	0288- 3019297	99798 53438
20	Expert From Industry – Bharat Oman Refinery	Member	-	8283069222

ANNEXURE: - 4 CHEMICALS GENERALLY USED IN JAMNAGAR DISTRICT

Sr No	Name of Chemical	Colour	Odour	Haza-rds	Haz Chem	Haz. Comb- ustion Product
1	Crude	Dark Brown	Foul	Fire, Toxic	NA	Flammable, Explosive
2	Naphtha	Colourless	Sweet Aromatics	Fire, Toxic	NA	Explosive
3	Gasoline	Pale yellow	Foul	Fire, Toxic	NA	Highly combustible
4	Methanol	Colourless	Sweet aromatic	Toxic, Flammable	2 PE	Flammable
5	Benzene	Colourless	Foul	Fire, Toxic	3 WE	Moderately explosive
6	Tame Product	Pale yellow	Foul	Fire, Toxic	NA	Highly combustible
7	Heavy Slope Oil	Dark brownish	Diesel like	Fire, Toxic	NA	Highly combustible
8	Solvent / Heavy Aromatics	Colourless gas	Sweet		NA	
9	Diesel - HSD	Pale yellow	Fuel oil type	Fire, Toxic	3 Z	Flammable
10	Kerosene – LAB	Pale yellow	Strongly characteristic	Toxic	3 Y	Flammable
11	Paraxylene	Colourless	Sweet	Fire, Toxic	NA	Flammable
12	Ortho Xylene	Colourless	Sweet	Fire, Toxic	NA	Flammable
13	ATF	Pale yellow	Petrol like	Flammable	NA	Flammable
14	LPG	Colourless gas	Mercaptan added fro odour	Explosive	NA	Extremely explosive
15	Propylene	Colorless gas	Sweet	Explosive	NA	Highly Flammable
16	LSWR	Drak Brown	Diesel like	Fire	NA	Highly Flammable

17	Vacuum Residue	Dark Brown	Diesel like	Fire	NA	Flammable
18	Chlorine	Yellowish	irratating	Toxic	2 XE	Non flammable
19	Ammonia	Colorless gas	Pungent	Toxic	2 PE	Moderately flammable

ANNEXURE –5 LESSON LEARNT FROM MOCK DRILL

Mock Drills

Mock drills are exercises to test the effectiveness of plan. Mock drills must be carried out at periodic intervals as specified in the MSIHC rules (i.e. once in a year). The lessons drawn from Mock drills must be used to improve the plan. The Mock drill reports shall be filed in this chapter. The notes of changes made in the plan drawing lessons from the mock drills shall be recorded in this plan

Lessons from Mock Drills

Sr	Off-Site Emergency Reference with Mockdrill Report No	Notes of Changes made in the Plan	Remarks

ANNEXURE –6 MOCK DRILL REPORT FORMAT

MOCK DRILL REPORTING

Date: _____

1. Mock Drill No: _____
2. Mock Drill Scenario Description:

3. Summarised Observations from the Observers.

Sr. No.	Response Agency	Response	Observation and Comments	Remarks
1.				
2.				
3.				
4.				
5.				

4. Lessons to be drawn from the event

- a. Resource Gap: _____

- b. Communication Gap: _____

- c. Others: _____

5. Action Plan.

Sr. No.	Agency	Action To Be Taken	Target Date
1.			
2.			
3.			

Secretary of DCG

Chair Person of DCG

ANNEXURE - 7 MATERIAL SAFETY DATA SHEET

1.0. CHLORINE- MSDS

MSDS OF CHLORINE
Section 1: PRODUCT IDENTIFICATION
Chemical Name : Chlorine Trade Name : Liquid Chlorine Synonyms : Liquefied chlorine gas, chlorine gas, chlor, Molecular chlorine, diatomic chlorine, Cl
Section 2: COMPOSITION / INGREDIENTS
Liquid Chlorine, % : 99.99 % by volume Chemical Formula : Cl ₂ Molecular Weight : 70.90 g/mole CAS Registry No. : 7782-50-5
Section 3: HAZARDS IDENTIFICATION
EXPOSURE TO THIS PRODUCT IS : Highly toxic agent via inhalation and ingestion. Primarily an intense respiratory irritant and a major potential hazard upon contact to skin and eyes. Sufficient concentration of the gas irritates the mucous membranes. It can cause pulmonary edema. Liquid chlorine in contact with skin will cause frostbite, smarting of the skin and first-degree burns on short exposure; may cause secondary burns on long exposure. Vapors will cause severe irritation of eyes and throat and can cause eye and lung injury. Vapors cannot be tolerated even at low concentrations. In extreme cases, difficulty of breathing may increase to the point where death can occur from suffocation. The characteristic, penetrating odor of chlorine gas gives warning of its presence in the air.
Section 4: FIRST AID MEASURES
GENERAL: Prompt treatment of anyone overcome or seriously exposed to chlorine, is of utmost importance. The patient should be removed from contaminated area. Obtain medical assistance as soon as possible. CONTACT WITH SKIN OR MUCOUS MEMBRANES: Immediately wash contaminated skin and clothing with copious amounts of water for a minimum of 15 minutes. Contaminated clothing should be removed under the shower and the chlorine should be washed off with very large quantities of water. Skin areas should be washed

with large quantities of soap and water. Never attempt to neutralize chlorine with chemicals. Salves and ointment should not be applied unless directed by a physician. Call or see a physician. (If victim has also inhaled chlorine, first aid for inhalation should be given first).

CONTACT WITH EYES: Immediately flush eyes with large amount of running water for at least 15 minutes even if minute quantities of liquid chlorine enter the eyes. Never attempt to neutralize with chemicals. The eyelids should be held apart during this period to ensure contact of water with accessible tissues of the eyes and lids. Call a physician, preferably and eye specialist, at once. If physician is not immediately available, the eye irrigation should be continued for a second period of 15 minutes. No oils or oily ointments, or any medications should be instilled unless ordered by the physician.

INHALATION: Remove victim from source of exposure. If breathing has not ceased, the patient should be placed in a comfortable position and be kept warm and remain at rest until medical help arrives. If breathing stops, administer artificial respiration. If available, oxygen should be administered. Call a physician.

INGESTION: Not pertinent, ingestion unlikely (chlorine is agas above -34.5°C).

Section 5 FIRE FIGHTING MEASURES

Autoignition Point : Not Applicable

Flash Point : Not Flammable

Flammability/Explosive limits : Not Flammable

Fire/Explosion Hazards: Toxic products are generated when combustibles burn with chlorine, although gas is notflammable.

Fire Prevention/ Extinguishing Media : Not Applicable

Section 6: ACCIDENTAL RELEASE MEASURES

IN CASE OF SPILL OR RELEASE ;

Move people from the area. Move upwind. Avoid contact with acid. Stop leaks if safe to do so. Reposition container if this will reduce or stop leakage. If leak continues, remove leaking container from vehicle or move other materials from vehicle away from container. Never use water on a chlorine leak. Water will make the leak worst. If efforts to control leak fails, and the leakage continues, suitable provision should be available with all Chlorine from the leaking containers. Chlorine maybe absorbed in solution of caustic soda, soda ash or hydrated lime.

Section 7: HANDLING AND STORAGE

Storage Requirements: Protect against physical damage. Store outdoors or indoors in a well-ventilated, detached, or segregated area of noncombustible construction.

Incompatible Materials: Store away from heat. Separate from combustible, organic, or easily oxidizable materials and especially isolate from acetylene, ammonia, hydrogen, hydrocarbons, ether, turpentine, and finely divided metals.

Containers: 50Kg, 68Kg and 1 Ton cylinders

Use Instructions: Wear suitable protective clothing, gloves and eye/face protection. In case of insufficient ventilation, wear suitable respiratory equipment.

EMERGENCY PROCEDURE for all emergencies – Shut off vehicle engine and any electrical equipment. Move people from immediate area; keep upwind. Consider initial evacuation distance of 100 meters in all directions. Send messenger, notify fire brigade telling them location, material, quantity, UN number and emergency contact as well as condition of vehicles and damaged observed. Do not move vehicle if movement could cause spillage. Warn traffic.

Section 8: EXPOSURE CONTROLS AND PROTECTION

Ventilation: Use only in well-ventilated areas.

Protective Equipment for the eyes and skin :

Splash proof and face shield goggles, disposable latex/rubber apron, PVC rain suits, rubber boots with pant legs over boots.

Respiratory Protection Requirements: NIOSH/MSHA approved respirator should be used.

Precautionary Hygiene/health/control measures :

Chlorine is not a serious industrial hazard if workers are adequately instructed and supervised in proper means of handling it. Avoid contact with skin, eyes, and clothing.

Do not breathe mist or vapor. Wash thoroughly after handling. Safety showers and eye wash fountains should be available in storage and handling area. Any protective clothing contaminated with hydrochloric acid should be removed immediately and thoroughly laundered before wearing again.

Section 9: PHYSICAL AND CHEMICAL PROPERTIES

STATE : Gas at normal condition, liquefied compressed gas (as shipped)

APPEARANCE : Greenish yellow gas, amber liquid in pressured container

ODOR : characteristic choking/ pungent

BOILING POINT : -34 0C = -29 0F at 1 atmosphere

FREEZING POINT : - 1010C = -1500F

SPECIFIC GRAVITY : Liquid = 1.467 at 00C, 1.424 at 150C Vapor (Gas) = 2.4

CRITICAL PRESSURE : 76.05 atm = 1118 psia

CRITICAL TEMPERATURE: 1440C = 2910F

SOLUBILITY IN WATER: slightly soluble

Section 10: STABILITY AND REACTIVITY

Stability: Stable.

Hazardous polymerization will not occur.

Hazardous decomposition product: will not decompose.

Reactivity with water: Forms a corrosive solution. Weak solutions of hydrochloric acid and hypochlorous acids are formed. Highly corrosive in the presence of moisture.

Reactivity with metals: Reacts vigorously with most metals at high temperature. Copper may burn spontaneously.

Reactions with other elements: Unites with most elements under specific conditions. These reactions may be extremely rapid.

Reactions with Inorganic Compounds: Forms soda and lime bleaches (hypochlorites). Reacts with hydrogen sulfide, ammonia or ammonium compounds.

Reactions with Organic Compounds: May form chlorinated derivatives and hydrogen chloride.

Section 11: TOXICOLOGICAL INFORMATION

ACUTE TOXICITY: When a sufficient concentration of chlorine gas is present, it will irritate the mucous membranes, the respiratory system and the skin. Large amounts cause irritation of eyes, coughing and labored breathing. If the duration of exposure or the concentration of chlorine is excessive, general excitement of the person affected, accompanied by restlessness, throat irritation, and sneezing and copious salivation results. The symptoms of exposure to high concentrations are retching and vomiting, followed by difficult breathing. Chlorine produces no systemic effect. All symptoms and signs result directly or indirectly from the local irritant action.

CHRONIC TOXICITY: Low concentrations of chlorine gas in the air may have a minor irritating effect or may produce slight symptoms after several hours exposure, but careful examination of persons repeatedly exposed to such conditions reportedly have shown no chronic effect.

Reproductive Effects/Cancer Information: No data available

Section 12: ECOLOGICAL INFORMATION

ECOTOXICITY DATA: Combination of chlorine with ammonia, organic matter, and cyanide may be detrimental to fish life.

WATER-POLLUTION RISK CLASSIFICATION: Harmful to aquatic life in very low concentrations

Section 13: DISPOSAL CONSIDERATIONS

Add to large volume of concentrated reducer (hypo, a bisulfite, or a ferrous salt and acidify with 3M H₂SO₄). When reduction is complete, add soda ash or dilute HCl to neutralize.

Dispose of in accordance with all Government and Local regulations regarding health and safety.

Section 14: TRANSPORT INFORMATION

Transportation of Dangerous Goods

TDG Classification: Do not ship by air.

DOT Hazard Classification: Nonflammable gas;

Label : Nonflammable gas and poison

DOT Shipping Name : Liquefied Chlorine Gas ID: UN 1017

Section 15: REGULATORY INFORMATION

No data available

Section 16: OTHER INFORMATION

References:

1. Manufacturing Chemists' Association, 1825 Connecticut Avenue, N.W. Washington, D.C. 20009 Chemical Safety Data Sheet No. SD 80 "Chlorine" (1970)
2. Dangerous Properties of Industrial Material Report, Vol. 9, No. 4, 1989 "Chlorine"
3. "Chlorine Manual" Mabuhay Vinyl Corporation, Iligan City

2.0. AMMONIA- MSDS

MSDS OF AMMONIA			
Section 1 : CHEMICAL PRODUCT			
Product Name: Anhydrous Ammonia Chemical Family: Inorganic Nitrogen Compound Synonyms: Ammonia, Liquid Ammonia, Nitro-Sil, Spirit of Hartshorn, NH ₃ Formula: NH ₃ Product Use: Fertilizers; Fibers and Plastics; Explosives; Animal Feed; SCR NO _x Control			
Section 2: COMPOSITION/INFORMATION ON INGREDIENTS			
Ingredient Name/CAS Number Concentration Exposure Limits			
Ammonia 99-100% 25 ppm TWA			
#7664-41-7 35 ppm STEL			
50 ppm PEL			
300 ppm IDLH			
Section 3: HAZARDS IDENTIFICATION			
EMERGENCY OVERVIEW			
Colorless gas and liquid (liquid under pressure). Vapor is toxic and irritating to eyes, nose, throat and skin. Liquid will burn skin and eyes and cause frostbite. Vapor is flammable under limited conditions. Use water to control fire and disperse vapors. Do not put water on liquid ammonia.			
NFPA Hazard Classification			
Health Hazard (Blue) 3			
Flammability (Red) 1			
Reactivity (Yellow) 0			
POTENTIAL HEALTH EFFECTS			
Primary Routes of Entry: Inhalation, skin contact/absorption and eye contact.			
General Acute Exposure: Anhydrous ammonia reacts with moisture in mucosal surfaces (eyes, skin, and respiratory tract) to produce ammonium hydroxide, which may cause caustic injury. The severity of injury depends upon the concentration and duration of exposure. The extent of injury ranges from mild cough to laryngeal edema and life-threatening pulmonary edema.			

Inhalation:

Acute Exposure: Ammonia is toxic and a severe irritant of the respiratory tract. It may cause a running nose, coughing, chest pain, cessation of respiration and death. It may cause severe breathing difficulties, which may be delayed in onset. ADDITIONAL MEDICAL

INFORMATION: Bronchospasm, laryngitis, tracheitis, wheezing, dyspnea, and laryngeal stridor may be noted. Mucosal burns to the tracheobronchial tree, Pulmonary Edema, and associated hypoxemia frequently occur following exposure to concentrated ammonia.

Skin:

Acute Contact: Ammonia is a severe irritant of the skin. Skin exposure to high concentrations of the gas may cause burning and blistering. Contact with liquid may cause severe skin burns. ADDITIONAL MEDICAL INFORMATION: Concentrated ammonia may produce liquefaction necrosis and deep penetrating burns.

Eye:

Acute Contact: Exposure to the eyes (>700 ppm) may cause temporary or permanent blindness. ADDITIONAL MEDICAL INFORMATION: Eye exposure may result in conjunctivitis, lacrimation and/or corneal irritation. Total corneal epithelial loss may occur.

Neurologic:

Acute Exposure: An altered mental status (coma) may be seen, but is not characteristic unless hypoxemia occurs.

Gastrointestinal:

Acute Exposure: Nausea and vomiting occurs frequently following ingestion. Swelling of the lips, mouth, and larynx, and oral or esophageal burns may occur if concentrated ammonia solutions are ingested.

Genitourinary:

Acute Exposure: Urinary retention may occur.

Note to the Physician: Pneumonitis should be anticipated after inhalation or ingestion. If severe exposure is suspected, observe for 48-72 hours for delayed pulmonary edema.

Carcinogenicity:

NTP: Not Listed

IARC:..... Not Listed

OSHA:..... Not Regulated

Medical Conditions Aggravated by Exposure: Chronic respiratory or skin disease

Section 4: FIRST AID MEASURES

First Aid for Eyes: Immediately flush eyes with copious amounts of tepid water for at least 15 minutes. If irritation, pain, swelling, excessive tearing, or light sensitivity persists, the patient should be seen in a health care facility and referral to an ophthalmologist considered.

First Aid for Skin: Immediately flush exposed area with copious amounts of tepid water for at least 15 minutes followed by washing area thoroughly with soap and water. The patient should be seen in a health care facility if irritation or pain persists.

First Aid for Inhalation: Move patient to fresh air. Monitor for respiratory distress. If cough or difficulty in breathing develops, evaluate for respiratory tract irritation, bronchitis, or pneumonitis. If trained to do so administer supplemental oxygen with assisted ventilation as required. Administer artificial respiration if patient is not breathing.

First Aid for Ingestion: Call a physician. If conscious, give the patient 4 to 8 ounces of milk or water to drink immediately. Do not induce vomiting.

Caution: Clothing frozen to the skin should be thawed before being removed.

Section 5: FIRE FIGHTING MEASURES

Flash Point: Not Applicable

Lower Flammable Limit: 15.5 % Volume in Air

Upper Flammable Limit: 27.0 % Volume in Air

Autoignition Temperature: 1204° F (651° C)

Extinguishing Media: Stopping the flow of gas rather than extinguishing the fire is Usually the best procedure to follow when escaping gas is burning.

Small Fire: Dry chemical or CO₂

Large Fire: Water spray, fog or foam

Special Fire Fighting Procedures:

- a. Do not get water inside container.
- b. Move container from fire area if you can do it without risk.
- c. Apply cooling water to sides of containers that are exposed to flames until well after fire is out. Stay away from ends of tanks due to exploding potential when tanks are involved in a fire.
- d. Isolate area until gas has dispersed.
- e. Use water spray or foam to control vapors.
- f. Positive pressure self-contained breathing apparatus (SCBA) should be used when

there is a potential for inhalation of vapors and/or fumes.

g. Chemical protective clothing that is safe for use with ammonia involved in a fire should be worn.

CAUTION:

a. With proper training, structural fire fighter's protective clothing and SCBA used in conjunction with water spray will provide limited protection for short-term exposure to ammonia vapors.

b. Liquid ammonia may cause protective equipment to become brittle.

c. Use of welding or flame cutting equipment on or in ammonia container is not recommended unless all ammonia has been purged, rinsed with water, and any oil residue removed.

Runoff from fire control or dilution water may cause pollution.

Section 6: ACCIDENTAL RELEASE MEASURES

Spill or Leak Measures: Stop leak if you can do so without risk. Keep unnecessary people away, isolate hazard area and deny entry. Stay upwind, out of low areas, and ventilate closed spaces before entering. Evaluate the affected area to determine whether to evacuate or shelter-in-place by taping windows and doors, shutting off outside air intakes (attic fans, etc.), and placing a wet towel or cloth over the face (if needed). With proper training, self-contained breathing apparatus (SCBA) and structural firefighter's protective clothing used in conjunction with water spray will provide limited protection in outdoor releases for short-term exposure. Fully encapsulating, vapor-protective clothing should be worn for spills and leaks with no fire. Use water spray or foam to control vapors. Mixing of water and liquid ammonia will increase vaporization rate. Do not put water on liquid ammonia unless more than 100 volumes of water are available for each volume of liquid ammonia.

CAUTION:

a. Personal protective clothing may become brittle when exposed to liquid ammonia.

b. Runoff from vapor control or dilution may cause pollution.

Determining Spill Size: Generally, a small spill is one that involves a single, small container (55-gallon capacity or less), or a small (non-continuing) leak from a larger tank or vessel.

Small Spill:

a. Flush area with flooding amounts of water.

b. First isolate 100 feet in all directions and then protect persons downwind 0.1 miles during daylight and 0.1 miles at night.

Large Spill:

a. Dike far ahead of liquid spill for later disposal.

- b. Follow local emergency protocol for handling.
- c. First isolate 200 feet in all directions, then protect persons downwind 0.4 miles during daylight and 1.4 miles at night.

Section 7: HANDLING AND STORAGE

Follow the current ANSI-K61.1 Standard, "Safety Requirements for the Storage and Handling of Anhydrous Ammonia", or applicable Ammonia Manufacturing Industry Standards. (See Section 15 for information on Equipment, Pressure Vessels and Testing).

Handling Precautions: Use proper personal protective equipment when working with or around ammonia. See Section 8.

Section 8: EXPOSURE CONTROLS, PERSONAL PROTECTION

Respiratory Protection Requirements:

<25 ppm: No protection required.

25 to 35 ppm: Protection required if the daily TWA is exceeded.

35 to 50 ppm: Protection required if exposed for more than 15 minutes.

50 to 250 ppm: Minimum of an air-purifying respirator equipped with ammonia canister(s) or cartridge(s).

250 to 300 ppm: Minimum of a full-face air-purifying respirator equipped with ammonia canister(s) or cartridge(s).

>300 ppm: A fresh air supply system must be used (i.e. positive pressure self contained breathing apparatus).

Skin Protection Requirements: Skin protection is required for exposure to liquid, mist, and > 1000 ppm of ammonia gas or vapors. Neoprene or rubber gauntlet-type gloves, ammonia resistant clothing (overalls, jacket, and boots) or vapor suit, as required.

Eye Protection Requirements: Use chemical (indirectly vented) goggles when there is a potential for contact with liquid or mist. A full-face shield is recommended in addition to goggles for added protection.

Other Protective Equipment: Safety shower and eyewash fountain should be provided in the ammonia handling area. In agricultural distribution, provide easily accessible shower and/or at least 100 gallons of clean water in open top container (check regulations). When transporting, provide at least 5 gallons of readily accessible, clean water and personal protective equipment.

Engineering Controls: Maintain adequate ventilation to keep ammonia concentrations below applicable standards when possible.

NOTE: See Section 2 for regulatory exposure limits.

Section 9: PHYSICAL AND CHEMICAL PROPERTIES

Physical Form: Gas (liquid under pressure)

Color: Colorless gas and liquid, forms white vapor in contact with moisture

Odor: Strong pungent penetrating odor, ammonia.

Boiling Point: -28.1o F (-33o C) at 1 atm

Melting point: -107.9o F (-78o C)

Ph: Approximately 12.0 (neat)

Solubility: 510 - 530 g/L @ 20o C

Specific Gravity: 0.6818 @ -33.35o C and 1 atm

Vapor Density: 0.597 @ 0o C (0.60 @ 60o F)

Vapor Pressure: 7,600 mm Hg @ 25o C (93 psig @ 60o F)

% Volatile by Volume: 100

Molecular Weight: 17.03

Density: 0.696 g/L @ 20o C (5.14 lb./gal. @ 60o F)

Critical Temperature: 271o F (133o C)

Critical Pressure: 1636 psia

Section 10: STABILITY AND REACTIVITY

Stability: This is a stable material.

Hazardous Polymerization: Will not occur.

Decomposition: Hydrogen is released on heating above 850o F (454o C). The decomposition temperature may be lowered to 575o F (300o C) by contact with certain metals such as nickel. At 12900 F (690o C) or in the presence of an electric spark, ammonia decomposes into nitrogen and hydrogen gases, which may form a flammable mixture in the air.

Incompatibilities:

- a. Ammonia has potentially explosive or violent reactions with interhalogens, strong oxidizers, Nitric Acid, Fluorine, and Nitrogen Oxide.
- b. Ammonia forms sensitive explosive mixtures with air and hydrocarbons, Ethanol and Silver Nitrate, and Chlorine; and explosive products are formed by the reaction of ammonia with Silver Chloride, Silver Oxide, Bromine, Iodine, Gold, Mercury, and

Tellurium Halides.

c. Ammonia is incompatible or has potentially hazardous reactions with Silver, Acetaldehyde, Acrolein, Boron, Halogens, Perchlorate, Chloric Acid, Chlorine Monoxide, Chlorites, Nitrogen Tetroxide, Tin, and Sulfur.

NOTE: The incompatibilities above are a partial list taken from two books by Sax & Lewis: "Dangerous Properties of Industrial Materials", 7th. ed., 1989 and "Hawley's Condensed Chemical Dictionary", 11th. ed. 1987, both published by Van Nostrand Reinhold Company, New York. It is recommend that if additional information is required, the reader refer to these and other published information.

Section 11: TOXICOLOGICAL INFORMATION

Toxicity

Acute Inhalation Toxicity

LC50 Rat, mouse: 4,200 - 19,060 mg NH₃/m³ (1 hr)

Acute Toxicity, Other Routes

LC50 Rat, mouse: 45.5 - 195.1 mg NH₃/kg bw (1 hr intravenous)

Corrosiveness / Irritation

Skin Irritation / Corrosion: Corrosive to skin

Eye Irritation / Corrosion: Subacute and chronic exposure to 200 – 1,000 ppm produced eye damage. 100 – 200 ppm produced moderate to severe irritation.

Repeated Dose Toxicity

Rats, guinea pigs, rabbits, etc: No mortality (Inhalation up to 770 mg/m³)

Genetic Toxicity in vitro

Salmonella typhimurium, etc: Negative (Bacterial gene mutation assay)

Chick fibroblasts: Induced chromosomal clumping, polyploidy, and arrested spindle formation. No data showing that ammonia is mutagenic in mammals. (Cytogenetic assay)

Genetic Toxicity in vivo

Drosophila melanogaster: No evidence for mutagenicity

Carcinogenicity

All: No carcinogenic effects

Toxicity to Reproduction

Pig: Temporarily depressed mean daily gain (MDG) at 35 mg/kg in gilts (One generation study)

Human Experience

Inhalation, human volunteers: Nasal and pulmonary irritation at concentrations of

about 100 ppm and higher.

Ecotoxicity

Acute Toxicity to Fish

LC50 Many species: 0.09 – 3.51 mg un-ionized NH₃/L (96 hr)

Acute Toxicity to Aquatic Invertebrates

LC50 Daphnia magna: 2.94 mg un-ionized NH₃-N/L (48 hr)

Toxicity to Aquatic Plants

LOEC Benthic diatoms: 0.5 – 1.0 mg N/L (Up to 25 days)

LOEC Chlorella vulgaris: 500 mg N/L (21 days)

Toxicity to Bacteria

EC50 Photobacterium phosphoreum: 1.49 mg un-ionized NH₃/L (5 min)

Chronic Toxicity to Fish

NOEC Many species: 0.025 – 1.2 mg un-ionized NH₃/L (Varied 12 days – 5 years)

Chronic Toxicity to Aquatic Invertebrates

NOEC Daphnia magna and others: 0.163 – 0.42 mg un-ionized NH₃/L (Varied 21 days – 76 weeks)

Toxicity to Terrestrial Plants

LOEC Many species : 3 – 250 ppm (Varied 4 min – 16 hrs)

Toxicity to Other Non-Mammalian Terrestrial Species

LD50 G. Domesticus: 2.72 mM (1 hr injections)

Section 12: ECOLOGICAL INFORMATION

- a. Ammonia is harmful to aquatic life in very low concentrations and may be hazardous if it enters water intakes.
- b. Local health and wildlife authorities, as well as operators of water intakes in the vicinity, should be notified of water releases.
- c. Waterfowl toxicity may occur at elevated concentrations.
- d. Ammonia does not concentrate in the food chain.
- e. The conversion of ammonia to nitrites/nitrates by bacteria in aquatic systems can reduce the concentration of dissolved oxygen (referred to as nitrogenous oxygen demand).

Effect on water treatment process: Chlorination will produce chloramines, which are more readily detected by taste and odor.

Note: See Ecotoxicity information in section 11.

Section 13: DISPOSAL CONSIDERATIONS

Reclaim as fertilizer if possible. Waste must be disposed of in accordance with federal, state, and local environmental control regulations.

Section 14: TRANSPORTATION INFORMATION

U.S. DOT and Canadian TGD Act
Shipping Name. Ammonia, anhydrous
Shipping Class/Division: 2.2 (U.S.); 2.3 (8) (Canada)
Hazard Class: Non-Flammable Gas (U.S.); Toxic Gas
Product Identification Number (PIN): UN1005
DOT Placard: Non-Flammable Gas 2.2, color: green (U.S.);
Class 2.3 or UN1005, color: white (Canada)
DOT Special Provision: 13, "Inhalation Hazard"
OSHA Label Required.; Yes
RQ (Reportable Quantity): 100 pounds
STCC Number: 4904210

Section 15: REGULATORY INFORMATION

Controlled Products Regulations Classification: A: Compressed Gas; E: Corrosive

OSHA: This product is considered a hazardous material under criteria of the Federal OSHA Hazard Communication Standard 29 CFR 1910.1200 (Toxic; Corrosive), and is listed as a Highly Hazardous Chemical subject to the requirements of the Process Safety Management Standard 29 CFR 1910.119.

CAA Chemical Accident Prevention: Ammonia is considered a regulated substance subject to the Chemical Accident Prevention provisions of 40 CFR Part 68. The threshold quantity for this substance is 10,000 lbs.

SARA TITLE III:

- a. EHS (Extremely Hazardous Substances) List: Listed (EPA, 1992a)
- b. SARA RQ (Reportable Quantity): 100 pounds
- c. TPQ (Threshold Planning Quantity): 500 pounds
- d. Regulation: "Emergency Planning and Notification" - 40 CFR Part 355

(Appendices A and B).

e. Section 313: “Specific Toxic Chemical Listings” - 40 CFR Part 372

Ammonia is subject to the reporting requirements of Section 313 “Specific Toxic Chemical Listings” 40 CFR Part 372. Terra is required by 40 CFR 372.45 to notify certain customers as to which of its mixture or trade name products contain those chemicals. The purpose of that notification is to ensure that facilities that may be subject to the reporting requirements of Section 313 and that use products of unknown formulation will have knowledge that they are receiving products that contain chemicals subject to those reporting requirements.

CERCLA Hazardous Substances List:

a. CERCLA RQ (Reportable Quantity): 100 pounds

b. Regulation: “Designation, Reportable Quantities, Notification” - 40 CFR 302

TSCA Inventory: Listed (RTECS)

Chemical Facility Anti-Terrorism Standard (CFATS) / 6 CFR Part 27:

Ammonia (anhydrous) is listed in Appendix A as a Chemical of Interest (COI) due to threat of “Release” Screening Threshold Quantity (STQ): 10,000 pounds

Equipment, Pressure Vessels, Testing, Etc.: All equipment used to handle, store, transfer or apply anhydrous ammonia must be properly engineered, constructed and maintained in compliance with all applicable regulations and standards. Pressure vessels, piping and appurtenances should be regularly inspected and tested using methods designed to reveal external and internal deterioration or defects that may impair the integrity of the equipment such that an unintended release of anhydrous ammonia may result. Consult with your State

Department of Agriculture and other experts, as applicable, concerning the methods that would be most appropriate given the particular circumstances. Refer to 29 CFR 1910.111, Storage and Handling of Anhydrous Ammonia; 29 CFR 1910.119, Process Safety Management of Highly Hazardous Materials; and the current ANSI standard K61.1, Safety Requirements for the Storage and Handling of Anhydrous Ammonia, for additional information.

Section 16: OTHER INFORMATION

The information and recommendations herein are taken from data contained in independent, industry recognized references including but not limited to NIOSH, OSHA, ANSI, NFPA, DOT ERG, the TFI Product Testing Program, Global Engineering Documents, MEDITEXT, HAZARDTEXT, SARATEXT, CHRIS, OHM/TADS, and IRIS. Terra Industries Inc. makes no guarantee, warranty or other representation concerning this substance, since conditions of its use are beyond the control of the company. Terra Industries Inc. disclaims any liability for loss or damage incurred in connection with the use of this substance.

3.0. CARBON DISULFIDE- MSDS

MSDS OF CARBON DISULFIDE	
Section 1: Chemical Product and Company Identification	
Product Name: Carbon disulfide Catalog Codes: SLC4312, SLC1522 CAS#: 75-15-0 RTECS: FF6650000 TSCA: TSCA 8(b) inventory: Carbon disulfide CI#: Not available. Synonym: Chemical Formula: CS ₂	

Section 2: Composition and Information on Ingredients		
Composition:		
Carbon disulfide	75-15-0	100
Toxicological Data on Ingredients: Carbon disulfide: ORAL (LD50): Acute: 3188 mg/kg [Rat]. 2780 mg/kg [Mouse]. VAPOR (LC50): Acute: 12500 ppm 4 hour(s) [Rat].		

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 (permeator). 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: Extremely hazardous in case of skin contact (irritant), of eye contact (irritant),

of ingestion, of inhalation. Very hazardous in case of skin contact (permeator).
CARCINOGENIC EFFECTS: Not available. **MUTAGENIC EFFECTS:** Not available.

TERATOGENIC EFFECTS: Not available. **DEVELOPMENTAL TOXICITY:** Not available. The substance is toxic to kidneys, the nervous system, liver. Repeated or prolonged exposure to the substance can produce target organs damage. 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. 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 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. 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: 90°C (194°F)

Flash Points: CLOSED CUP: -30°C (-22°F). (Setaflash)

Flammable Limits: LOWER: 1.3% UPPER: 50%

Products of Combustion: Not available.

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

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.

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 away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapour/spray. 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:

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: 20 CEIL: 30 (ppm) TWA: 60 CEIL: 90 (mg/m³) Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Not available.

Taste: Not available.

Molecular Weight: 76.14 g/mole

Color: Clear Colorless.

pH (1% soln/water): 7 [Neutral.]

Boiling Point: 46.3°C (115.3°F)

Melting Point: -111.6°C (-168.9°F)

Critical Temperature: Not available.

Specific Gravity: 1.2632 (Water = 1)

Vapor Pressure: 297.6 mm of Hg (@ 20°C)

Vapor Density: 2.63 (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: Very slightly soluble in cold 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: Not available.

Corrosivity: Non-corrosive in presence of glass.

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:

WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 2780 mg/kg [Mouse]. Acute toxicity of the vapor (LC50): 12500 ppm 4 hour(s) [Rat].

Chronic Effects on Humans: The substance is toxic to kidneys, the nervous system, liver.

Other Toxic Effects on Humans:

Extremely hazardous in case of skin contact (irritant), of ingestion, of inhalation.

Very hazardous in case of skin contact (permeator).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:

Embryotoxic and/or foetotoxic in animal. Human: passes through the placenta, excreted in maternal milk. Risk of spontaneous abortion in human. Causes sperm abnormalities in human. Menstrual disorders in human.

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 more

toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: Class 3: Flammable liquid.

Identification: : Carbon Disulfide : UN1131 PG: II

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:

California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Carbon disulfide California prop. 65: This product contains the following ingredients for which the State of California has found to cause reproductive harm (female) which would require a warning under the statute: Carbon disulfide California prop. 65: This product contains the following ingredients for which the State of California has found to cause reproductive harm (male) which would require a warning under the statute: Carbon disulfide California prop. 65: This product contains the following ingredients for which the State of California has found to cause birth defects which would require a warning under the statute: Carbon disulfide Pennsylvania RTK: Carbon disulfide Massachusetts RTK: Carbon disulfide TSCA 8(b) inventory: Carbon disulfide SARA 302/304/311/312 extremely hazardous substances: Carbon disulfide SARA 313 toxic chemical notification and release reporting: Carbon disulfide CERCLA: Hazardous substances.: Carbon disulfide

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS:

CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-1A: Material causing immediate and serious toxic effects (VERY TOXIC). CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):

R11- Highly flammable. R38- Irritating to skin. R41- Risk of serious damage to eyes.

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 4

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.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall ScienceLab.com be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if ScienceLab.com has been advised of the possibility of such damages.

4.0. HYDROGEN- MSDS

Section 1: PRODUCT IDENTIFICATION
PRODUCT NAME: Hydrogen, compressed CHEMICAL NAME: Hydrogen FORMULA: H ₂ SYNONYMS: None

Section 2: COMPOSITION/INFORMATION ON INGREDIENTS
Hydrogen is sold as pure product >99% CAS NUMBER: 1333-74-0 EXPOSURE LIMITS: OSHA: None ACGIH: Simple asphyxiant

Section 3: HAZARD IDENTIFICATION
EMERGENCY OVERVIEW Hydrogen is a flammable, colorless, odorless, compressed gas packaged in cylinders at high pressure. It poses an immediate fire and explosive hazard when concentrations exceed 4%. It is much lighter than air and burns with an invisible flame. High concentrations that will cause suffocation are within the flammable range and must not be entered. POTENTIAL HEALTH EFFECTS INFORMATION: INHALATION: Asphyxiant. It should be noted that before suffocation could occur, the lower flammability limit of hydrogen in air would be exceeded possibly causing both an oxygen-deficient and explosive atmosphere. Exposure to moderate concentrations may cause dizziness, headache, nausea and unconsciousness. Exposure to atmospheres containing 8-10% or less oxygen will quickly bring about unconsciousness without warning leaving individuals unable to protect themselves. Lack of sufficient oxygen may cause serious injury or death. EYE CONTACT: None

SKIN CONTACT: None

CHRONIC EFFECTS: None

OTHER EFFECTS OF OVEREXPOSURE: None

EXPOSURE INFORMATION:

ROUTE OF ENTRY: Inhalation

TARGET ORGANS: None

EFFECT: Asphyxiation (suffocation)

SYMPTOMS: Exposure to an oxygen-deficient atmosphere (<19.5%) may cause dizziness,

drowsiness, nausea, vomiting, excess salivation, diminished mental alertness, loss of consciousness, and death.

MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE: None

CARCINOGENIC POTENTIAL: Hydrogen is not listed by NTP, OSHA or IARC.

Section 4: FIRST AID

INHALATION: Persons suffering from lack of oxygen should be removed to fresh air. If victim is not breathing, administer artificial respiration. If breathing is difficult, administer oxygen. Obtain prompt medical attention.

SKIN CONTACT: None

EYE CONTACT: None

INGESTION: None

NOTES TO PHYSICIAN: None

Section 5: FIRE AND EXPLOSION

FLASH POINT:

AUTOIGNITION:

FLAMMABLE LIMITS:

Flammable gas
74%

565.5_C (1050_F)

LOWER: 4% **UPPER:**

EXTINGUISHING MEDIA: CO₂, dry chemical, water spray or fog for surrounding area. Do not extinguish until hydrogen source is shut off.

HAZARDOUS COMBUSTION PRODUCTS: None

SPECIAL FIRE FIGHTING INSTRUCTIONS: Evacuate all personnel from danger area. Immediately cool container with water spray from maximum distance, taking care not to extinguish flames. If flames are accidentally extinguished, explosive re-ignition may occur. Stop flow of gas if without risk while continuing cooling water spray.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Burns with a pale blue, nearly

invisible flame.

Hydrogen is easily ignited with low-ignition energy, including static electricity. Hydrogen is lighter than air and can accumulate in the upper sections of enclosed spaces. Pressure in a container can build up due to heat, and it may rupture if pressure relief devices should fail to function.

Section 6: ACCIDENTAL RELEASE MEASURES

Evacuate immediate area. Eliminate any possible sources of ignition, and provide maximum explosion protection of ventilation. Shut off source of hydrogen, if possible. If leaking from cylinder, or valve, call the Air Products' emergency phone number. The presence of a hydrogen flame can be detected by approaching cautiously with an outstretched straw broom to make the flame visible.

Section 7: HANDLING AND STORAGE

STORAGE:

Specific requirements are listed in NFPA 50A. Cylinder storage locations should be wellprotected, well-ventilated, dry, and separated from combustible materials. Cylinders should never knowingly be allowed to reach a temperature exceeding 125 _F (52 _C). Cylinders of hydrogen should be separated from oxygen cylinders or other oxidizers by a minimum distance of 20 ft., or by a barrier of noncombustible material at least 5 ft. high having a fire resistance rating of at least _ hour. Cylinders should be stored upright with valve protection cap in place and firmly secured to prevent falling or being knocked over. Protect cylinders from physical damage; do not drag, roll, slide or drop. Use a suitable hand truck for cylinder movement. Post "No Smoking or Open Flames" signs in the storage areas. There should be no sources of ignition. All electrical equipment should be explosion proof in the storage and use areas. Storage areas must meet national electric codes for class 1 hazardous areas.

HANDLING:

Do not "open" hydrogen cylinder valve before connecting it, since self-ignition may occur. Hydrogen is the lightest gas known and may collect in the top of buildings with out proper ventilation. It may leak out of a system which is gas-tight for air or other gases. Leak check system with leak detection solution, never with flame. If user experiences difficulty operating cylinder valve, discontinue use and contact supplier. Use only approved CGA connections. DO NOT USE ADAPTERS. Never insert an object (e.g., wrench, screwdriver, pry bar, etc.) into valve cap openings. Doing so may damage valve, causing a leak to occur. Use an adjustable strap wrench to remove over-tight or rusted caps. Never strike an arc on a compressed gas cylinder or make a cylinder a part of an electrical circuit.

SPECIAL PRECAUTIONS:

Use piping and equipment adequately designed to withstand pressures to be encountered. Use a check valve or other protective apparatus in any line or piping from the cylinder to prevent reverse flow.

Section 8: PERSONAL PROTECTION/EXPOSURE CONTROLS

ENGINEERING CONTROLS:

Provide natural or explosion-proof ventilation adequate to ensure hydrogen does not reach its lower explosive limit of 4%.

RESPIRATORY PROTECTION:

General Use: None

Emergency Use: Air supplied respirators are required in oxygen-deficient atmospheres. Before entering area you must check for flammable or oxygen-deficient atmospheres.

PROTECTIVE GLOVES: Work gloves are recommended when handling cylinders.

EYE PROTECTION: Safety glasses are recommended when handling cylinders.

OTHER PROTECTIVE EQUIPMENT: Safety shoes are recommended when handling cylinders

Section 9: PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE AND STATE: Colorless gas at normal temperature and pressure.

ODOR: Odorless

MOLECULAR WEIGHT: 2.016

BOILING POINT (1 atm): -423.0 °F (-252.8 °C)

SPECIFIC GRAVITY (Air =1): 0.06960

FREEZING POINT/MELTING POINT: -434.5 °F (-259.2 °C)

VAPOR PRESSURE (at 70 F): Not applicable

GAS DENSITY (At 70 F (21.1 C) and 1 atm): 0.00521 lb/ft³
(0.08342 kg/m³)

SOLUBILITY IN WATER (Vol/Vol at 60 F (15.6 C)): 0.019

SPECIFIC VOLUME (At 70 F (21.1 C) and 1 atm): 192 ft³
/lb (11.99m³/kg)

Section 10: REACTIVITY/STABILITY

CHEMICAL STABILITY: Stable

CONDITIONS TO AVOID: None

INCOMPATIBILITY (Materials to Avoid): Oxidizing agents. Some steels are susceptible to hydrogen embrittlement at high pressures and temperatures.

REACTIVITY:

A) **HAZARDOUS DECOMPOSITION PRODUCTS:** None

B) **HAZARDOUS POLYMERIZATION:** Will not occur.

Section 11: TOXICOLOGICAL INFORMATION

Hydrogen is a simple asphyxiant.

Section 12: ECOLOGICAL INFORMATION

No adverse ecological effects are expected. Hydrogen does not contain any Class I or Class II ozone depleting chemicals (40 CFR Part 82). Hydrogen is not listed as a marine pollutant by DOT (49 CFR Part 171).

Section 13: DISPOSAL

WASTE DISPOSAL METHOD:

Do not attempt to dispose of residual or unused product in the cylinder.

Return to supplier for safe disposal.

Residual product within process system may be vented at a controlled rate, to the atmosphere through a vent stack that discharges to an elevated point. This stack should be in an isolated area away from ignition sources

Section 14: TRANSPORTATION

DOT/IMO SHIPPING NAME: Hydrogen, compressed

HAZARD CLASS: 2.1 (Flammable Gas)

IDENTIFICATION NUMBER: UN1049

PRODUCT RQ: None

SHIPPING LABEL(s): Flammable gas.

PLACARD (When required): Flammable gas.

SPECIAL SHIPPING INFORMATION: Cylinder should be transported in a secure upright position in a well ventilated truck.

NEVER TRANSPORT IN PASSENGER COMPARTMENT OF A VEHICLE.

Shipment of compressed gas cylinders which have not been filled with the owner's consent is a violation of Federal law (49 CFR Part 173.301 (b)).

Section 15: REGULATORY INFORMATION

OSHA - OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION:

29 CFR 1910.119: Process Safety Management of Highly Hazardous Chemicals. Requires facilities to develop a process safety management program based on Threshold Quantities (TQ) of highly hazardous chemicals.

Hydrogen is not listed in Appendix A as a highly hazardous chemical. However, any process that involves a flammable gas on site in one location, in quantities of 10,000 pounds (4,553 kg) or greater is covered under this regulation unless it is used as fuel.

Section 16: OTHER INFORMATION

OTHER INFORMATION:

NFPA RATINGS:

HEALTH: = 0

FLAMMABILITY: = 4

REACTIVITY: = 0

SPECIAL: = SA

HMIS RATINGS:

HEALTH: = 0

FLAMMABILITY: = 4

REACTIVITY: = 0

(CGA recommends this to designate simple asphyxiant)

5.0. SULFURIC ACID- MSDS

Section1: Chemical Product and Company Identification	
Product Name:	Sulfuric acid
Synonym:	Oil of Vitriol; Sulfuric Acid
Chemical Name:	Hydrogen sulfate
Chemical Formula:	H ₂ -SO ₄
CAS#:	7664-93-9

Section 2: Composition and Information on Ingredients		
Composition:		
Name	CAS #	% by Weight
Sulfuric acid	7664-93-9	95 - 98
Toxicological Data on Ingredients: Sulfuric acid: ORAL (LD50): Acute: 2140 mg/kg [Rat.]. VAPOR (LC50): Acute: 510 mg/m 2 hours [Rat]. 320 mg/m 2 hours [Mouse].		

Section 3: Hazard Identification
Potential Acute Health Effects:Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (irritant, corrosive), of ingestion, of inhalation. 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:CARCINOGENIC EFFECTS: Classified 1 (Proven for human.) by IARC, + (Proven.) by OSHA. Classified A2 (Suspected for human.) by ACGIH. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to kidneys, lungs, heart, cardiovascular system, upper respiratory tract, eyes, 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:

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: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion:

Products of combustion are not available since material is non-flammable. However, products of decomposition include fumes of oxides of sulfur. Will react

with water or steam to produce toxic and corrosive fumes. Reacts with carbonates to generate carbon dioxide gas. Reacts with cyanides and sulfides to form poisonous hydrogen cyanide and hydrogen sulfide respectively.

Fire Hazards in Presence of Various Substances: Combustible materials

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: Not applicable.

Special Remarks on Fire Hazards:

Metal acetylides (Monocesium and Monorubidium), and carbides ignite with concentrated sulfuric acid. White Phosphorous + boiling Sulfuric acid or its vapor ignites on contact. May ignite other combustible materials. May cause fire when sulfuric acid is mixed with Cyclopentadiene, cyclopentanone oxime, nitroaryl amines, hexalithium disilicide, phosphorous (III) oxide, and oxidizing agents such as chlorates, halogens, permanganates.

Special Remarks on Explosion Hazards:

Mixtures of sulfuric acid and any of the following can explode : p - nitrotoluene , pentasilver trihydroxydiaminophosphate, perchlorates, alcohols with strong hydrogen peroxide, ammonium tetrahydroxychromate, mercuric nitrite, potassium chlorate, potassium permanganate with potassium chloride, carbides, nitro compounds, nitrates, carbides, phosphorous, iodides, picrates, fulminates, dienes, alcohols (when heated) Nitramide decomposes explosively on contact with concentrated sulfuric acid. 1,3,5-Trinitrohexahydro-1,3,5-triazine + sulfuric acid causes explosive decomposition.

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, reducing agents, combustible materials, organic materials, metals, acids, alkalis, moisture. May corrode metallic surfaces. Store in a metallic or coated fiberboard drum using a strong polyethylene inner package.

Storage:

Hygroscopic. Reacts. violently with water. 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:

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 STEL: 3 (mg/m³) [Australia] Inhalation TWA: 1 (mg/m³) from OSHA (PEL) [United States] Inhalation TWA: 1 STEL: 3 (mg/m³) from ACGIH (TLV) [United States] [1999] Inhalation TWA: 1 (mg/m³) from NIOSH [United States] Inhalation TWA: 1 (mg/m³) [United Kingdom (UK)] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid. (Thick oily liquid.)

Odor: Odorless, but has a choking odor when hot.

Taste:Mar ked acid taste. (Strong.)

Molecular Weight: 98.08 g/mole

Color: Colorless.

pH (1% soln/water): Acidic.

Boiling Point:

270°C (518°F) - 340 deg. C Decomposes at 340 deg. C

Melting Point: -35°C (-31°F) to 10.36 deg. C (93% to 100% purity)

Critical Temperature: Not available.

Specific Gravity: 1.84 (Water = 1)

Vapor Pressure: Not available.

Vapor Density: 3.4 (Air = 1)

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water.

Solubility:

Easily soluble in cold water. Sulfuric is soluble in water with liberation of much heat.
Soluble in ethyl alcohol.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability:

Conditions to Avoid: Incompatible materials, excess heat, combustible material materials, organic materials, exposure to moist air or water, oxidizers, amines, bases. Always add the acid to water, never the reverse.

Incompatibility with various substances:

Reactive with oxidizing agents, reducing agents, combustible materials, organic materials, metals, acids, alkalis, moisture.

Corrosivity:

Extremely corrosive in presence of aluminum, of copper, of stainless steel(316). Highly corrosive in presence of stainless steel(304). Non-corrosive in presence of glass.

Special Remarks on Reactivity:

Hygroscopic. Strong oxidizer. Reacts violently with water and alcohol especially when water is added to the product. Incompatible (can react explosively or dangerously) with the following: Acetic Acid, Acrylic Acid, Ammonium

Hydroxide, Cresol, Cumene, Dichloroethyl Ether, Ethylene Cyanohydrin, Ethyleneimine, Nitric Acid, 2-Nitropropane, Propylene Oxide, Sulfolane, Vinylidene Chloride, Diethylene Glycol Monomethyl Ether, Ethyl Acetate, Ethylene Cyanohydrin, Ethylene Glycol Monoethyl Ether

Acetate, Glyoxal, Methyl Ethyl Ketone, dehydrating agents, organic materials, moisture (water), Acetic anhydride, Acetone, cyanohydrin, Acetone+nitric acid, Acetone + potassium dichromate, Acetonitrile, Acrolein, Acrylonitrile, Acrylonitrile +water, Alcohols + hydrogen peroxide, ally compounds such as Allyl alcohol, and Allyl Chloride, 2-Aminoethanol, Ammonium hydroxide, Ammonium triperchromate, Aniline, Bromate + metals, Bromine pentafluoride, n-Butyraldehyde, Carbides, Cesium acetylene carbide, Chlorates, Cyclopentanone oxime, chlorinates, Chlorates + metals, Chlorine trifluoride, Chlorosulfonic acid, 2-cyano-4-nitrobenzenediazonium hydrogen sulfate, Cuprous nitride, p-chloronitrobenzene, 1,5-Dinitronaphthlene + sulfur, Diisobutylene, p-dimethylaminobenzaldehyde, 1,3-Diazidobenzene, Dimethylbenzylcarbinol + hydrogen peroxide,

Epichlorohydrin, Ethyl alcohol + hydrogen peroxide, Ethylene diamine, Ethylene glycol and other glycols, , Ethylenimine, Fulminates, hydrogen peroxide, Hydrochloric acid, Hydrofluoric acid, Iodine heptafluoride, Indane + nitric acid, Iron, Isoprene, Lithium silicide, Mercuric nitride, Mesityl oxide, Mercury nitride, Metals (powdered), Nitromethane, Nitric acid + glycerides,

p-Nitrotoluene, Pentasilver trihydroxydiaminophosphate, Perchlorates, Perchloric acid, Permanganates + benzene, 1- Phenyl-2-methylpropyl alcohol + hydrogen peroxide, Phosphorus, Phosphorus isocyanate, Picrates, Potassium tert-butoxide, Potassium chlorate, Potassium Permanganate and other permanganates, halogens, amines, Potassium Permanganate + Potassium chloride, Potassium Permanganate + water, Propiolactone (beta)-, Pyridine, Rubidium acetylene carbide, Silver permanganate, Sodium, Sodium carbonate, sodium hydroxide, Steel, styrene monomer, toluene + nitric acid, Vinyl acetate, Thallium (I) azidodithiocarbonate, Zinc chlorate, Zinc Iodide, azides, carbonates, cyanides, sulfides, sulfites, alkali hydrides, carboxylic acid anhydrides, nitriles, olefinic organics, aqueous acids, cyclopentadiene, cyano-alcohols, metal acetylides,

Hydrogen gas is generated by the action of the acid on most metals (i.e. lead, copper, tin, zinc, aluminum, etc.). Concentrated sulfuric acid oxidizes, dehydrates, or sulfonates most organic compounds.

Special Remarks on Corrosivity:

Non-corrosive to lead and mild steel, but dilute acid attacks most metals. Attacks many metals releasing hydrogen. Minor corrosive effect on bronze. No corrosion data on brass or zinc.

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): 2140 mg/kg [Rat.]. Acute toxicity of the vapor (LC50): 320 mg/m³ 2 hours [Mouse].

Chronic Effects on Humans:

CARCINOGENIC EFFECTS: Classified 1 (Proven for human.) by IARC, + (Proven.) by OSHA. Classified A2 (Suspected for human.) by ACGIH. May cause damage to the following organs: kidneys, lungs, heart, cardiovascular system, upper respiratory tract, eyes, teeth.

Other Toxic Effects on Humans:

Extremely hazardous in case of inhalation (lung corrosive). Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (corrosive), of ingestion, .

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:

Mutagenicity: Cytogenetic Analysis: Hamster, ovary = 4mmol/L Reproductive effects: May cause adverse reproductive effects based on animal data. Developmental abnormalities (musculoskeletal) in rabbits at a dose of 20 mg/m³ for 7 hrs.(RTECS) Teratogenecity: neither embryotoxic, fetotoxic, nor teratogenetic in mice or rabbits at inhaled doses producing some maternal toxicity

Special Remarks on other Toxic Effects on Humans:

Acute Potential Health Effects: Skin: Causes severe skin irritation and burns. Continued contact can cause tissue necrosis. Eye: Causes severe eye irritation and burns. May cause irreversible eye injury. Ingestion: Harmful if swallowed. May cause permanent damage to the digestive tract. Causes gastrointestinal tract burns. May cause perforation of the stomach, GI bleeding, edema of the glottis, necrosis and scarring, and sudden circulatory collapse(similar to acute inhalation). It may also cause systemic toxicity with acidosis. Inhalation: May cause severe irritation of the respiratory tract and mucous membranes with sore throat, coughing, shortness of breath, and delayed lung edema. Causes chemical burns to the respiratory tract. Inhalation may be fatal as a result of spasm, inflammation, edema of the larynx and

bronchi, chemical pneumonitis, and pulmonary edema. Cause corrosive action on mucous membranes. May affect cardiovascular system (hypotension, depressed cardiac output, bradycardia). Circulatory collapse with clammy skin, weak and rapid pulse, shallow respiration, and scanty urine may follow. Circulatory shock is often the immediate cause of death. May also affect teeth(changes in teeth and supporting structures - erosion, discoloration). Chronic Potential Health Effects: Inhalation: Prolonged or repeated inhalation may affect behavior (muscle contraction or spasticity), urinary system (kidney damage), and cardiovascular system, heart (ischemic heart leisons), and respiratory system/lungs(pulmonary edema, lung damage), teeth (dental discoloration, erosion). Skin: Prolonged or repeated skin contact may cause dermatitis, an allergic skin reaction.

Section 12: Ecological Information

Ecotoxicity: Ecotoxicity in water (LC50): 49 mg/l 48 hours [bluegill/sunfish].

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:

Sulfuric acid may be placed in sealed container or absorbed in vermiculite, dry sand, earth, or a similar material. It may also be diluted and neutralized. Be sure to consult with local or regional authorities (waste regulators) prior to any disposal. Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Class 8: Corrosive material

Identification: : Sulfuric acid UNNA: 1830 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:

Illinois toxic substances disclosure to employee act: Sulfuric acid New York release reporting list: Sulfuric acid Rhode Island RTK hazardous substances: Sulfuric acid Pennsylvania RTK: Sulfuric acid Minnesota: Sulfuric acid Massachusetts RTK: Sulfuric acid New Jersey: Sulfuric acid California Director's List of Hazardous Substances (8 CCR 339): Sulfuric acid Tennessee RTK: Sulfuric acid TSCA 8(b) inventory: Sulfuric acid SARA 302/304/311/312 extremely hazardous substances: Sulfuric acid SARA 313 toxic chemical notification and release reporting: Sulfuric acid CERCLA: Hazardous substances.: Sulfuric acid: 1000 lbs. (453.6 kg)

Other Regulations:

OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications: WHMIS (Canada):

CLASS D-1A: Material causing immediate and serious toxic effects (VERY TOXIC).

CLASS E: Corrosive liquid.

DSCL (EEC):

R35- Causes severe burns. S2- Keep out of the reach of children. S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S30- Never add water to this product. S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 0

Reactivity: 2

Personal Protection:

National Fire Protection Association (U.S.A.): Health: 3

Flammability: 0

Reactivity: 2

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.

Section 16: Other Information**References:**

-Material safety data sheet emitted by: la Commission de la Santé et de la Sécurité du Travail du Québec. -The Sigma-Aldrich Library of Chemical Safety Data, Edition II. -Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987.

Other Special Considerations: Not available.

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their

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6.0. HYDROCHLORIC ACID- MSDS

MSDS OF HYDROCHLORIC ACID		
Section 1: Chemical Product and Company Identification		
Product Name: Hydrochloric acid Catalog Codes: SLH1462, SLH3154 CAS#: Mixture. RTECS: MW4025000 TSCA: TSCA 8(b) inventory: Hydrochloric acid CI#: Not applicable. Synonym: Hydrochloric Acid; Muriatic Acid Chemical Name: Not applicable. Chemical Formula: Not applicable.		
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.

Serious Ingestion: Not available.

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 flammable 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 Hydrogen 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 $\text{AgClO}_4 + \text{CCl}_4$ Alcohols + hydrogen cyanide, Aluminum Aluminum-titanium alloys (with HCl vapor), 2-Amino ethanol, Ammonium hydroxide, Calcium carbide CaC_2 Chlorine + dinitroanilines (evolves gas), Chlorosulfonic acid Cesium carbide Cesium acetylene carbide, 1,1-Difluoroethylene Ethylene diamine Ethylene imine, Fluorine, HClO_4 Hexalithium disilicide H_2SO_4 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, U_3P_4 , 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.)

Taste: Not available.

Molecular Weight: Not applicable.

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)

Critical Temperature: Not available.

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

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

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.

Instability Temperature: Not available.

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 exothermic reaction. Hydrogen chloride causes aldehydes and epoxides to violently polymerize.

Hydrogen chloride or Hydrochloric Acid in contact with the following 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, platinum, 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 (fetotoxicity). 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/conjunctivitis, 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 laryngeal burning, and irritation, pain and inflammation, coughing, sneezing, choking sensation, hoarseness, laryngeal spasms, upper respiratory tract edema, chest pains, as well as 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, vomiting (with "coffee ground" emesis), diarrhea, thirst, difficulty swallowing, salivation, chills, fever, uneasiness, shock, strictures and

stenosis (esophageal, 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 can also

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.

Section 14: Transport Information

DOT Classification: Class 8: Corrosive material

Identification: : Hydrochloric acid, solution UNNA: 1789 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:

Connecticut hazardous material survey.: Hydrochloric acid Illinois toxic substances disclosure to employee act: Hydrochloric acid Illinois chemical safety act: Hydrochloric acid New York release reporting list: Hydrochloric acid Rhode Island RTK hazardous substances: Hydrochloric acid Pennsylvania RTK: Hydrochloric acid Minnesota: Hydrochloric acid Massachusetts

RTK: Hydrochloric acid Massachusetts spill list: Hydrochloric acid New Jersey: Hydrochloric acid New Jersey spill list:

Hydrochloric acid Louisiana RTK reporting list: Hydrochloric acid Louisiana spill reporting: Hydrochloric acid California

Director's List of Hazardous Substances: Hydrochloric acid TSCA 8(b) inventory:

Hydrochloric acid TSCA 4(a) proposed test rules: Hydrochloric acid SARA 302/304/311/312 extremely hazardous substances: Hydrochloric acid SARA 313 toxic chemical notification and release reporting: Hydrochloric acid CERCLA: Hazardous substances.: Hydrochloric acid: 5000 lbs. (2268 kg)

Other Regulations:

OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS:

CLASS D-2A: Material causing other toxic effects (VERY TOXIC). CLASS E: Corrosive liquid.

DSCL (EEC):

R34- Causes burns. R37- Irritating to respiratory system. S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

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.

Section 16: Other Information

References:

-Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987. -SAX, N.I.

Dangerous Properties of Industrial Materials. Toronto, Van Nostrand Reinold, 6e ed. 1984. -The Sigma-Aldrich Library of Chemical Safety Data, Edition II. -Guide de la loi

et du règlement sur le transport des marchandises dangereuses au Canada.

Centre de conformité international Ltée. 1986.

Other Special Considerations: Not available.

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7.0. SODIUM HYDROXIDE- MSDS

MSDS OF SODIUM HYDROXIDE		
Section 1: Chemical Product and Company Identification		
Product Name: Sodium hydroxide Catalog Codes: SLS3298, SLS1081, SLS2503, SLS3925, SLS1705 CAS#: 1310-73-2 RTECS: WB4900000 TSCA: TSCA 8(b) inventory: Sodium hydroxide CI#: Not available. Synonym: Caustic Soda Chemical Name: Sodium Hydroxide Chemical Formula: NaOH		
Section 2: Composition and Information on Ingredients		
Composition:		
Name	CAS #	% by Weight
Sodium hydroxide	1310-73-2	100
Toxicological Data on Ingredients: Sodium hydroxide LD50: Not available. LC50: Not available.		
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, of inhalation. The amount of tissue damage depends on length of contact. Eye contact can result in corneal damage or blindness. Skin contact can produce inflammation and blistering. Inhalation of dust will produce irritation to gastro-intestinal or respiratory tract, characterized by burning, sneezing and coughing. Severe over-exposure can produce lung damage, choking, unconsciousness or 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:

CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells.

TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to mucous membranes, upper respiratory tract, skin, eyes. Repeated or prolonged exposure to the substance can produce target organs damage. Repeated exposure of the eyes to a low level of dust can produce eye irritation. Repeated skin exposure can produce local skin destruction, or dermatitis. Repeated inhalation of dust can produce varying degree of respiratory irritation or lung 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 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 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: 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: 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 heat.

Fire Fighting Media and Instructions: Not available

Special Remarks on Fire Hazards:

sodium hydroxide + zinc metal dust causes ignition of the latter. Under proper conditions of temperature, pressure and state of division, it can ignite or react violently with acetaldehyde, allyl alcohol, allyl chloride, benzene-1,4-diol, chlorine trifluoride, 1,2 dichlorethylene, nitroethane, nitromethane, nitroparaffins, nitropropane, cinnamaldehyde, 2,2-dichloro-3,3-dimethylbutane.

Sodium hydroxide in contact with water may generate enough heat to ignite adjacent combustible materials. Phosphorous boiled with NaOH yields mixed phosphines which may ignite spontaneously in air. sodium hydroxide and cinnamaldehyde + heat may cause ignition. Reaction with certain metals releases flammable and explosive hydrogen gas.

Special Remarks on Explosion Hazards:

Sodium hydroxide reacts to form explosive products with ammonia + silver nitrate. Benzene extract of allyl benzenesulfonate prepared from allyl alcohol, and benzene sulfonyl chloride in presence of aqueous sodium hydroxide, under vacuum distillation, residue darkened and exploded. Sodium Hydroxide + impure tetrahydrofuran, which can contain peroxides, can cause serious explosions. Dry mixtures of sodium hydroxide and sodium tetrahydroborate liberate hydrogen explosively at 230-270 deg. C. Sodium Hydroxide reacts with sodium salt of trichlorophenol + methyl alcohol + trichlorobenzene + heat to cause an explosion.

Section 6: Accidental Release Measures

Small Spill:

Use appropriate tools to put the spilled solid in a convenient waste disposal container. If necessary: Neutralize the residue with a dilute solution of acetic acid.

Large Spill:

Corrosive 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. Call for assistance on disposal.

Neutralize the residue with a dilute solution of acetic acid. 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. Do not breathe dust. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If you feel unwell, seek medical attention and show the label when possible. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, reducing agents, metals, acids, alkalis, moisture.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area. Hygroscopic. Deliquescent.

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. Synthetic apron. Vapor and 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. Vapor and 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.

Exposure Limits:

STEL: 2 (mg/m³) from ACGIH (TLV) [United States] TWA: 2 CEIL: 2 (mg/m³) from OSHA (PEL) [United States] CEIL: 2 (mg/m³) from NIOSH Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Deliquescent solid.)

Odor: Odorless.

Taste: Not available.

Molecular Weight: 40 g/mole

Color: White.

pH (1% soln/water): 13.5 [Basic.]

Boiling Point: 1388°C (2530.4°F)

Melting Point: 323°C (613.4°F)

Critical Temperature: Not available.

Specific Gravity: 2.13 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water.

Solubility: Easily soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials, moisture, moist air

Incompatibility with various substances:

Highly reactive with metals. Reactive with oxidizing agents, reducing agents, acids, alkalis, moisture.

Corrosivity: Not available.

Special Remarks on Reactivity:

Hygroscopic. Much heat is evolved when solid material is dissolved in water. Therefore cold water and caution must be used for this process. Sodium hydroxide solution and octanol + diborane during a work-up of a reaction mixture of oxime and diborane in tetrahydrofuran is very exothermic, a mild explosion being noted on one occasion. Reactive with water, acids (mineral, non-oxidizing, e.g. hydrochloric, hydrofluoric acid, muriatic acid, phosphoric), acids (mineral, oxidizing e.g. chromic

acid, hypochlorous acid, nitric acid, sulfuric acid), acids (organic e.g. acetic acid, benzoic acid, formic acid, methanoic acid, oxalic acid), aldehydes (e.g. acetaldehyde, acrolein, chloral hydrate, formaldehyde), carbamates (e.g. carbanilate, carbofuran), esters (e.g. butyl acetate, ethyl acetate, propyl formate), halogenated organics (dibromoethane, hexachlorobenzene, methyl chloride, trichloroethylene), isocyanates (e.g. methyl isocyanate), ketones (acetone, acetophenone, MEK, MIBK), acid chlorides, strong bases, strong oxidizing agents, strong reducing agents, flammable liquids, powdered metals and metals (i.e. aluminum, tin, zinc, hafnium, raney nickel), metals (alkali and alkaline e.g. cesium, potassium, sodium), metal compounds (toxic e.g. beryllium, lead acetate, nickel carbonyl, tetraethyl lead), nitrides (e.g. potassium nitride, sodium nitride), nitriles (e.g. acetonitrile, methyl cyanide), nitro compounds (organic e.g. nitrobenzene, nitromethane), acetic anhydride, chlorohydrin, chlorosulfonic acid, ethylene cyanohydrin, glyoxal, hydrosulfuric acid, oleum, propiolactone, acrylonitrile, phosphorus pentoxide, chloroethanol, chloroform-methanol, tetrahydroborate, cyanogen azide, 1,2,4,5 tetrachlorobenzene, cinnamaldehyde. Reacts with formaldehyde hydroxide to yield formic acid, and hydrogen.

Special Remarks on Corrosivity: Very caustic to aluminum and other metals in presence of moisture.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:

LD50: Not available. LC50: Not available.

Chronic Effects on Humans:

MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. May cause damage to the following organs: mucous membranes, upper respiratory tract, skin, eyes.

Other Toxic Effects on Humans:

Extremely hazardous in case of inhalation (lung corrosive). Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (corrosive), of ingestion, .

Special Remarks on Toxicity to Animals:

Lowest Published Lethal Dose: LDL [Rabbit] - Route: Oral; Dose: 500 mg/kg

Special Remarks on Chronic Effects on Humans: May affect genetic material. Investigation as a mutagen (cytogenetic analysis)

Special Remarks on other Toxic Effects on Humans:

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 product itself and its products of degradation are not toxic.

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.

Section 14: Transport Information

DOT Classification: Class 8: Corrosive material

Identification: : Sodium hydroxide, solid UNNA: 1823 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:

Illinois toxic substances disclosure to employee act: Sodium hydroxide Illinois chemical safety act: Sodium hydroxide New York release reporting list: Sodium hydroxide Rhode Island RTK hazardous substances: Sodium hydroxide Pennsylvania RTK: Sodium hydroxide Minnesota: Sodium hydroxide Massachusetts RTK: Sodium hydroxide New Jersey: Sodium hydroxide Louisiana spill reporting: Sodium hydroxide California Director's List of Hazardous Substances: Sodium hydroxide TSCA 8(b) inventory: Sodium hydroxide CERCLA: Hazardous substances.: Sodium hydroxide: 1000 lbs. (453.6 kg)

Other Regulations:

OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada): CLASS E: Corrosive solid.

DSCL (EEC):

R35- Causes severe burns. S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.

S37/39- Wear suitable gloves and eye/face protection. S45- In case of accident or if

you feel unwell, seek medical advice immediately (show the label where possible).

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 0

Reactivity: 2

Personal Protection: j

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 0

Reactivity: 1

Specific hazard:

Protective Equipment:

Gloves. Synthetic apron. Vapor and dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall ScienceLab.com be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if ScienceLab.com has been advised of the possibility of such damages.

8.0. NITRIC ACID - MSDS

MSDS of NITRIC ACID		
Section 1: Chemical Product and Company Identification		
Product Name: Nitric acid, 70% Synonym: Nitric Acid, 70% Chemical Name: Not applicable. Chemical Formula: Not applicable.		
Section 2: Composition and Information on Ingredients		
Composition:		
Name	CAS #	% by Weight
Water	7732-18-5	30
Nitric acid, fuming	7697-37-2	70
Toxicological Data on Ingredients: Nitric acid, fuming: VAPOR (LC50): Acute: 244 ppm 0.5 hours [Rat]. 344 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). 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. Prolonged exposure may result in skin burns and ulcerations. Over-exposure by inhalation may cause respiratory irritation. 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: CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to lungs, mucous membranes, upper respiratory tract, skin, eyes, 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. 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: 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 combustible materials**Explosion Hazards in Presence of Various Substances:**

Explosive in presence of reducing materials, of metals, of alkalis. Slightly explosive in presence of combustible materials. Nonexplosive in presence of open flames and sparks, of shocks.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards:

Flammable in presence of cellulose or other combustible materials. Phosphine, hydrogen sulfide, selenide all ignite when fuming nitric acid is dripped into gas. Phosphine ignites in concentrated nitric acid. Nickel tetraphosphide ignites with fuming nitric acid. Contact with metals may evolve flammable hydrogen gas. A jet of ammonia will ignite nitric acid vapor. Cellulose may be converted to the highly flammable nitrate ester on contact with the vapor of nitric acid as well as the liquid itself.

Special Remarks on Explosion Hazards: Reacts explosively with metallic powders, carbides, cyanides, sulfides, alkalies and turpentine. Can react explosively with many reducing agents. Arsine, phosphine, tetraborane all oxidized explosively in presence of nitric acid. Cesium and rubidium acetylides explode in contact with nitric acid. Explosive reaction with Nitric Acid + Nitrobenzene + water. Detonation with Nitric Acid + 4-Methylcyclohexane. The addition of warm fuming nitric acid to phosphine causes explosion. Addition of water to nitration mixture diluted with an equal volume of water can cause a low order explosion. Cyclopentadiene reacts explosively with fuming nitric acid. Mixtures of fuming nitric acid and acetonitrile are high explosives. (Nitric acid, fuming)

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. Oxidizing material. Poisonous liquid. Stop leak if without risk. Absorb with DRY earth, sand or other noncombustible material. Do not get water inside container. Avoid contact with a combustible material (wood, paper, oil, clothing...). Keep substance damp using water spray. 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. Keep away from heat. Keep away from sources of ignition. Keep away from combustible 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 reducing agents, combustible materials, organic materials, metals, acids, 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. Separate from acids, alkalies, reducing agents and combustibles. See NFPA 43A, Code for the Storage of Liquid and Solid Oxidizers. Do not store above 23°C (73.4°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:

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: 2 STEL: 4 (ppm) from ACGIH (TLV) [United States] TWA: 2 STEL: 4 from OSHA (PEL) [United States] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Acrid. Disagreeable and choking. (Strong.)

Taste: Not available.

Molecular Weight: Not applicable.

Color: Colorless to light yellow.

pH (1% soln/water): Acidic.

Boiling Point: 121°C (249.8°F)

Melting Point: -41.6°C (-42.9°F)

Critical Temperature: Not available.

Specific Gravity: 1.408 (Water = 1)

Vapor Pressure: 6 kPa (@ 20°C)

Vapor Density: 2.5 (Air = 1)

Volatility: Not available.

Odor Threshold: 0.29 ppm

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether.

Solubility: Easily soluble in cold water, hot water. Soluble in diethyl ether.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials

Incompatibility with various substances: Highly reactive with alkalis. Reactive with reducing agents, combustible materials, organic materials, metals, acids.

Corrosivity:

Extremely corrosive in presence of aluminum, of copper, of brass. Non-corrosive in presence of glass, of stainless steel(304), of stainless steel(316)

Special Remarks on Reactivity:

A strong oxidizer. Reacts violently with alcohol, organic material, turpene, charcoal. Violent reaction with Nitric acid + Acetone and Sulfuric acid. Incompatible with combustible materials, metallic powders, hydrogen sulfide, carbides, aldehydes, cyanides, chromic acid, hydrogen sulfide, metals, metal powders, organic solvents, acetic acid, alcohols. Nitric Acid will react with water or steam to produce heat and toxic, corrosive and flammable vapors. (Nitric acid, fuming)

Special Remarks on Corrosivity:

In presence of traces of oxides, it attacks all base metals except aluminum and special chromium steels. It will attack some forms of plastics, rubber, and coatings. Nitric Acid corrodes almost all metals except gold, and white gold, forming nitrates. No corrosive effect on bronze. No corrosivity data for zinc, and steel

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:

LD50: Not available. LC50: Not available.

Chronic Effects on Humans:

Contains material which may cause damage to the following organs: lungs, mucous membranes, upper respiratory tract, skin, eyes, teeth.

Other Toxic Effects on Humans:

Extremely hazardous in case of inhalation (lung corrosive). Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (corrosive), of ingestion, .

Special Remarks on Toxicity to Animals:

LDL - Lowest Published Lethal Dose [Human] - Route: Oral; Dose: 430 mg/kg (Nitric acid, fuming)

Special Remarks on Chronic Effects on Humans:

May cause adverse reproductive effects based on animal data (effects on newborn, fetotoxicity) Special Remarks on other Toxic Effects on Humans: Acute Potential Health Effects: Skin: Severely irritates skin. Causes skin burns and may cause deep and penetrating ulcers of the skin with a characteristic yellow to brownish discoloration. May be fatal if absorbed through skin. Eyes: Severely irritates eyes. Causes eye burns. May cause irreversible eye injury. Ingestion: May be fatal if swallowed. Causes serious gastrointestinal tract irritation or burns with nausea, vomiting, severe abdominal pain, and possible "coffee grounds" appearance of the vomitus . May cause perforation of the digestive tract. Inhalation: May be fatal if inhaled. Vapor is extremely hazardous. Vapor may cause nitrous gas poisoning. Effects may be delayed. May cause irritation of the mucous membranes and respiratory tract with burning pain in the nose and throat, coughing, sneezing, wheezing, shortness of breath and pulmonary edema. Other symptoms may include nausea, and vomiting. Chronic Potential Health Effects: Repeated inhalation may produce changes in pulmonary function and/or chronic bronchitis. It may also affect behavior (headache, dizziness, drowsiness, muscle contraction or spasticity, weakness, loss of coordination, mental confusion), and urinary system (kidney failure,

decreased urinary output after several hours of uncorrected circulatory collapse). Repeated exposure may cause discoloration and/or erosion of teeth (dental enamel). Eye irritation and respiratory tract signs and symptoms resembling those of frequent upper respiratory viral infections have been associated with chronic nitric acid exposure.

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.

Section 14: Transport Information

DOT Classification: Class 8: Corrosive material

Identification: Nitric acid (Nitric acid, fuming) UNNA: 2031 PG: II

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:

New York release reporting list: Nitric acid, fuming Rhode Island RTK hazardous substances: Nitric acid, fuming Pennsylvania RTK: Nitric acid, fuming Florida: Nitric acid, fuming Minnesota: Nitric acid, fuming Massachusetts RTK: Nitric acid, fuming New Jersey: Nitric acid, fuming TSCA 8(b) inventory: Water; Nitric acid, fuming SARA 302/304/311/312 extremely hazardous substances: Nitric acid, fuming SARA 313 toxic chemical notification and release reporting: Nitric acid, fuming 70% CERCLA: Hazardous substances.: Nitric acid, fuming: 1000 lbs. (453.6 kg);

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall ScienceLab.com be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if ScienceLab.com has been advised of the possibility of such damages.

9.0. LPG- MSDS

MSDS OF LPG			
Section 1: IDENTIFICATION OF THE MATERIAL AND SUPPLIER			
Other Names	Propane, butane, propene or a combination of these products		
Uses	As an energy source in the residential, commercial and automotive markets. A feedstock for the petrochemical industry and as refrigerant.		
Section 2: HAZARDS IDENTIFICATION			
NOT CLASSIFIED AS HAZARDOUS ACCORDING TO ASCC (NOHSC) CRITERIA. CLASSIFIED AS A DANGEROUS GOOD BY THE CRITERIA OF THE ADG CODE.			
Section 3: COMPOSITION / INFORMATION ON INGREDIENTS			
Main Components	LP Gas	Composition in	68476 – 85 – 7
	Propane	accordance with the appropriate LPG	0074 – 98 – 6
	Propene	Australia specifications	115 – 07 – 1
	n-Butane	and state regulations	106 – 97 – 8
Minor Components	Iso-Butane		75 – 28 – 5
	Ethane		74 – 84 – 0
	1,3-Butadiene	<0.1%	106 – 99 –
	0 Odourant: 25ppm	Ethyl Mercaptan	Approx 75 – 08 – 1
Section 4: FIRST AID MEASURES			
In all cases seek medical attention and see the Elgas Super Cold Contact Injuries Hospital Information Sheet for further information and procedures.			
Eye	Treatment for cold burns: Immediately flush with tepid water or with sterile saline solution. Hold eyelids apart and irrigate for 15 minutes. Seek medical attention.		
Inhalation	Remove from area of exposure immediately. Be aware of possible explosive atmospheres.		
	If victim is not breathing apply artificial respiration and seek urgent medical attention. Give oxygen if available. Keep warm and rested.		

Skin Cold burns: Remove contaminated clothing and gently flush affected areas with warm water (30 C) for 15 minutes.

Apply non-adhesive sterile dressing and treat as for a thermal burn. For large burns, immerse in warm water for 15 minutes.

DO NOT apply any form of direct heat. Seek immediate medical attention.

Ingestion For advice, contact a Poisons Information Centre on 13 11 26 (Australia Wide) or a doctor. Ingestion is considered unlikely due to product form.

Advice to Doctor Treat symptomatically. Severe inhalation over exposure may sensitise the heart to catecholamine induced arrhythmias. Do not administer catecholamines to an overexposed person.

Section 5: FIRE FIGHTING MEASURES

Flammability Highly flammable.

Heating to decomposition produces acrid smoke and irritating fumes.

Product will add fuel to a fire.

Eliminate all ignition sources including cigarettes, open flames, spark producing switches / tools, heaters, naked lights, pilot lights, mobile phones etc. when handling.

Fire and

Explosion

Highly flammable.

Temperatures in a fire may cause cylinders or pressure vessels to rupture and pressure relief devices to be activated (venting).

Call Fire Brigade. This product will add fuel to a fire.

Cool cylinders and vessels exposed to fire by applying water from a protected location and with water spray directing spray primarily onto the upper surface.

Do not approach any LPGas container suspected of being hot.

Extinguishing Stop flow of gas if safe to do so, such as by closing valves or by activating

Emergency Shutdown Systems. If the gas source cannot be isolated, do not extinguish the flame, since re-ignition and explosion could occur.

Await arrival of emergency services.

Drench and cool cylinders or vessels with water spray from protected area at a safe distance.

If it is absolutely necessary to extinguish the flame, use only a dry chemical powder extinguisher.

Do not move cylinders for at least 24 hours. Avoid shock and bumps to cylinders. Evacuate the area of persons not fighting the fire.

Carbon oxides (CO, CO₂) fumes may be produced should burning occur especially within an enclosed space (ie causing a deficiency of oxygen).

Fire fighters should wear full protective clothing and be aware of the risk of possible explosion (especially in a confined space). Flashback may occur along vapour trail.

Where possible, remove cool cylinders from the path of the fire. Do not re-use a fire-exposed vessel or cylinder – seek advice of supplier.

Hazchem Code 2YE (as defined in ADG7 published in 2007)
2WE (as defined in ADG6 published in 1998)

Section 6: ACCIDENTAL RELEASE MEASURES

Spillage As this product has a very low flash point any spillage or leak is a fire and / or explosion hazard. If a leak has not ignited, stop gas flow, isolate sources of ignition and evacuate personnel.

Ensure good ventilation.

Liquid leaks generate large volumes of heavier than air flammable vapour which may travel to remote sources of ignition (eg along drainage systems).

Where appropriate, use water spray to disperse the gas or vapour and to protect personnel attempting to stop leakage.

Vapour may collect in any confined space.

Gas Cylinders If the cylinder is leaking, eliminate all potential ignition sources and evacuate area of personnel. Inform manufacturer / supplier of leak.

If safe to enter the area, wear appropriate PPE and carefully move the cylinder to a well ventilated remote area, then allow to discharge.

Do not attempt to repair leaking valve or cylinder fusible plugs.

For vessels operate the Emergency Shutdown System (where fitted) and proceed as above.

Section 7: HANDLING AND STORAGE

Precautions for Safe Handling

Avoid inhalation of vapour.

Avoid contact with liquid and cold storage containers.

When handling cylinders wear protective footwear and suitable gloves.

Always ensure that cylinders are within test date, are fit for use and are leak checked prior to use.

Do not fill dented, gouged or rusty containers (refer AS2337.1). Only fill cylinders to 80% fill level (ullage tube via decanting or mass via mechanical filling).

The maximum fill level for vessels is dependent upon their size and location as detailed in AS / NZS 1596.

Avoid contact with eyes.

Class 2.1 Flammable Gas products may only be loaded in the same vehicle or packed in the same freight container with the classes of products as permitted in the ADG Code (see references).

Cylinders shall only be transported in an upright, secure position in accordance with the National Road Transport Commission Load Restraint Guide and shall not be dropped.

Conditions for Safe Storage

Store and use only in equipment / containers designed for use with this product.

Store and dispense only in well ventilated areas away from heat and sources of ignition.

Do not enter storage vessels. If entry to a vessel is necessary, contact the supplier.

Cylinders and vessels must be properly labelled. Do not remove warning labels.

LPGas cylinders shall be stored in accordance with the requirements of the ADG Code, AS 4332 and AS/NZS1596.

Do not store in pits and basements where vapour may collect.

Store cylinders securely in an upright position. Note: forklift cylinders may be stored horizontally.

Store away from incompatible materials particularly oxidising agents. Check vessels and cylinders are clearly labelled.

Do not contaminate cylinders or vessels with other products.

Other Information

Product spilt on clothing may give rise to delayed evaporation and subsequent fire hazard.

Check for leaks by sound and smell and by locating with soapy water or with approved detection devices.

Use only equipment and pipe work designed and approved (where applicable) for LPG Gas applications.

Ensure that cylinders cannot be struck by forklift vehicles or by dropped or rolled objects, etc.

Refer to Australian state and territory Dangerous Goods regulations.

Section 8: EXPOSURE CONTROLS / PERSONAL PROTECTION

Ventilation Maintain adequate ventilation.

Confined areas (eg tanks) should be adequately ventilated and gas tested and must

NEVER be entered unless under supervision via a Permit Procedure.

Exposure Standards Ingredient Name

LP Gas

Butane

Propane

Propylene

Occupational Exposure Limits

NOHSC

TWA: 1000 ppm 8 hour(s)

NOHSC

TWA: 1900 mg/m³ 8 hour(s)

TWA: 800 ppm 8 hour(s)

ACGIH TLV

TWA: 1000 ppm 8 hour(s)

ACGIH TLV

TWA: 500 ppm 8 hour(s)

PPE Wear suitable gloves and overalls to prevent cold burns and frostbite.

In filling operations wear protective clothing including impervious gloves, safety goggles or face shield.

All clothing should be of the anti-static, low flame spread type.

When handling cylinders wear protective footwear.

Section 9: PHYSICAL AND CHEMICAL PROPERTIES

PROPERTY	PROPANE		BUTANE	
Appearance	Colourless Gas		Colourless Gas	
Odour	Characteristic Odour		Characteristic Odour	
Chemical Formula	C ₃ H ₈		C ₄ H ₁₀	
Molecular Weight	44.1		58.1	
Boiling Point	-42 ⁰ C		-0.5 ⁰ C	
Density (kg/m ³)	Liquid at 15 ⁰ C	Gas at 101 kPa & 15 ⁰ C	Liquid at 15 ⁰ C	Gas at 101 kPa & 15 ⁰ C
	510	1.86	568	2.47
Relative Density:	0.510	1.53	0.568	2.00
water = 1.0				
air = 1.0				
Litres/tonne	1961	536000	1760	405000
m ³ /tonne	1.961	536	1.760	405
m ³ /m ³ of liquid	1.000	274	1.000	235

Specific heat of	2.512		2.386	
liquid (kJ/kg/ ⁰ C)				
Latent heat of	232		239	
vapourisation				
(MJ/m ³)				
(MJ/kg = GJ/t)	0.358		0.372	
Heat combustion	25000	93.3	28800	121.9
(MJ/m ³)				
(MJ/kg = GJ/t)	50.1	50.1	49.47	49.47
Volume of air		23.7		31.0
(m ³) needed to				
burn 1m ³ of gas				
Flash point		-104 ⁰ C		-60 ⁰ C
Ignition temp.		493-549 ⁰ C		482-538 ⁰ C
Max. flame temp.		1970 ⁰ C		1990 ⁰ C
Limits of		9.6		8.6
flammability in				
air (% by vol):				
upper %				
lower %		2.4		1.9
Other Properties:		Solubility (water): 0.07cm ³ / cm ³		
Other name/numbers:	LPGas Propane Butane IsoButane	UN 1075 UN 1978 UN 1011 UN 1969		

Section 10: STABILITY AND REACTIVITY

Reactivity Incompatible with oxidising agents, acids, heat and ignition sources. Do not use natural rubber flexible hoses. Also incompatible (potentially violently) with oxygen, halogens and metal halides.

Decomposition Products

Heating to decomposition produces acrid smoke and irritating fumes.

Section 11: TOXICOLOGICAL INFORMATION

Health Hazard Summary

Asphyxiant gas. Symptoms of exposure are directly related to displacement of oxygen from air.

Eye Non irritating. However, direct contact with evaporating liquid may result in severe cold burns with possible permanent damage.

Inhalation Non irritating – Asphyxiant. Effects are proportional to oxygen displacement.

Low vapour concentrations may cause nausea, dizziness, headaches and drowsiness. May have a narcotic effect if high concentrations of vapour are inhaled. High vapour

concentrations may produce symptoms of oxygen deficiency which, coupled with central nervous system depression, may lead to rapid loss of consciousness.

Abuse Under normal conditions of use the product is non hazardous, however abuse involving deliberate inhalation of very high concentrations of vapour can produce unconsciousness and / or result in a sudden fatality or brain damage.

Skin Non irritating. Contact with evaporating liquid or supercold vessels or pipes may result in frost-bite with severe tissue damage.

Ingestion Due to product form, ingestion is considered highly unlikely.

Toxicity Data PROPANE (74-98-6) ISOBUTANE (75-28-5)

LC50 (Inhalation) : 50,000 ppm LC50 (Inhalation): 57pph/15 min (rat)

Section 12: ECOLOGICAL INFORMATION

Eco Toxicity Not toxic to flora, fauna or soil organisms.

Will not cause long term adverse effects in the environment and is not dangerous to the ozone layer.

Mobility Spillages are unlikely to penetrate the soil.

The product is likely to volatilise rapidly into the air.

Persistence / Degradability

Unlikely to cause long term adverse effects in the environment.

Bio accumulative Potential

This material is not expected to bio-accumulate.

Other Ecological Information

Unlikely to cause long term effects in the aquatic environment.

Section 13: DISPOSAL CONSIDERATIONS

Waste Disposal

Cylinders should be returned to the manufacturer or supplier for disposal.

Empty cylinders or vessels may contain some remaining product.

Hazard warning labels are a guide to the safe handling of empty packaging and should not be removed. LPGas cylinders or vessels should NEVER be inadvertently disposed of in any land fill facility without being rendered visually and physically unusable before disposal.

'EMPTY' container warning: 'empty' containers can sometimes retain residue (liquid and / or vapour) and can be dangerous.

DO NOT PRESSURISE, CUT, WELD, BRAZE, SOLDER, DRILL, GRIND OR EXPOSE SUCH CONTAINERS TO HEAT, FLAME, SPARKS AND OTHER SOURCES OF IGNITION THEY MAY EXPLODE AND CAUSE INJURY OR DEATH.

Do not attempt to clean.

Legislation Dispose of in accordance with relevant legislation.

Section 14: TRANSPORT INFORMATION

Transport Transport of LPGas is controlled in accordance with the requirements of the

ADG Code and the Load Restraint Guide.

UN Number 1075

Shipping Name PETROLEUM GASES, LIQUEFIED

DG Class 2.1

Subsidiary Risk(s) None Allocated

Packing Group None Allocated

Hazchem Code See Section 5

Section 15: REGULATORY INFORMATION

AICS All chemicals listed on the Australian Inventory of Chemical Substances (AICS).

Poison Schedule

A poison schedule number has not been allocated to this product using the criteria in the Standard for the Uniform Scheduling of Drugs and Poisons (SUSDP).

Section 16: OTHER INFORMATION

Principal Retail Centres

10.0. NAPHTHA- MSDS

MSDS OF NAPHTHA		
Section 1: Chemical Product and Company Identification		
Product Name: Naphtha, VM&P Catalog Codes: SLN2473 CAS#: 8030-30-6 TSCA: TSCA 8(b) inventory: Naphtha, VM&P CI#: Not applicable. Synonym: VM&P Naphtha; Benzin; Naphtha; Naphtha, Solvent; Petroleum Distallates (Naphtha) Chemical Name: Not available. Chemical Formula: Not available.		
Section 2: Composition and Information on Ingredients		
Composition:		
Name	CAS #	% by Weight
Naphtha, VM&P	8030-30-6	100
Toxicological Data on Ingredients: Naphtha, VM&P: ORAL (LD50): Acute: 5 mg/kg [Rat]. DERMAL (LD50): Acute: 3 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. Slightly hazardous in case of skin contact (permeator). Severe over-exposure can result in death.		
Potential Chronic 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). CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance is toxic to skin, eyes, central nervous system (CNS). The substance may be toxic to blood, kidneys, lungs, the nervous system, mucous membranes, peripheral nervous system, gastrointestinal tract, upper respiratory tract, ears.		

Section 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. 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. Seek 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: 232°C (449.6°F)

Flash Points: CLOSED CUP: 10°C (50°F).

Flammable Limits: LOWER: 1.4% UPPER: 12.6%

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances:

Highly flammable in presence of open flames and sparks. Flammable in presence of heat, of oxidizing materials.

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: Vapor may travel considerable distance to source of ignition and flash back.

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. 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/ 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. 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: 400 (ppm) from ACGIH (TLV) [United States] [1999] STEL: 300 (ppm) [California] TWA: 300 (ppm) [Canada] TWA: 100 (ppm) from OSHA (PEL) [United States] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Petroleum odor (Slight.)

Taste: Not available.

Molecular Weight: Not available.

Color: Clear Colorless.

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

Boiling Point: 86°C (186.8°F)

Melting Point: -73°C (-99.4°F)

Critical Temperature: Not available.

Specific Gravity: 0.75 (Water = 1)

Vapor Pressure: 1.4 kPa (@ 20°C)

Vapor Density: 3.8 (Air = 1)

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, methanol, diethyl ether, n-octanol, acetone.

Solubility:

Easily soluble in methanol, diethyl ether, acetone. Soluble in n-octanol. Very slightly soluble in hot water. Insoluble in cold 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 considered to be corrosive for metals and glass.

Special Remarks on Reactivity: Not available.

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): 5 mg/kg [Rat]. Acute dermal toxicity (LD50): 3 mg/kg [Rabbit].

Acute toxicity of the vapor (LC50): 3400 4 hours [Rat].

Chronic Effects on Humans:

Causes damage to the following organs: skin, eyes, central nervous system (CNS). May cause damage to the following organs: blood, kidneys, lungs, the nervous system, mucous membranes, peripheral nervous system, gastrointestinal tract, upper respiratory tract, ears.

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: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans: Moderately toxic and narcotic in high concentrations.

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 more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: CLASS 3: Flammable liquid.

Identification: : Petroleum distillate, n.o.s., (Naphtha) UNNA: 1268 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:

Rhode Island RTK hazardous substances: Naphtha, VM&P Pennsylvania RTK: Naphtha, VM&P Florida: Naphtha, VM&P Minnesota: Naphtha, VM&P Massachusetts RTK: Naphtha, VM&P New Jersey: Naphtha, VM&P TSCA 8(b) inventory: Naphtha, VM&P

Other Regulations:

OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications: WHMIS (Canada):

CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-2B: Material causing other toxic effects

(TOXIC).

DSCL (EEC):

R11- Highly flammable. R27/28- Very toxic in contact with skin and if swallowed. R36/38- Irritating to eyes and skin. S1/2- Keep locked up and out of the reach of children. S28- After contact with skin, wash immediately with plenty of [***] S36/37- Wear suitable protective clothing and gloves. S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible). S46- If swallowed, seek medical advice immediately and show this container or label.

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: 0

Specific hazard: Protective Equipment:

Gloves (impervious). Synthetic apron. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References: Not

Other Special Considerations: Not available.

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall ScienceLab.com be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if ScienceLab.com has been advised of the possibility of such damages.