

CHLORINE FACTS



Hazardous Substances Emergency Events Surveillance (HSEES) System

Synonyms: Chlorine, Cl₂, Chlorine gas, Chlorine bleach, Sodium hypochlorite

CAS Number: 7782-50-5

DOT Numbers: UN1017

RTECS Number: FO2100000

Hazard rating	NFPA	
HEALTH	4 = Lethal	
FLAMMABILITY	0 = Minimal	
REACTIVITY	0 = Stable	
OXIDIZER POISONOUS GASES ARE PRODUCED IN FIRE CONTAINERS MAY EXPLODE IN FIRE		

Characteristics:

- ◆ Yellow-green gas.
- ◆ Pungent odor, heavier than air.
- ◆ Reacts with water and in solution is a strong acid and corrosive.
- ◆ Containers may explode in a fire.
- ◆ Contact from liquefied compressed gas may cause frostbite to skin and eyes.
- ◆ Incompatibilities and reactivities: Acetylene, alcohols, ammonia, arsenic, bases, bismuth, boron, calcium, activated carbon, carbon disulfide, ether, fuel gas, glycerol, hydrazine, hydrogen, iodine, methane, oxomonosilane, potassium, propylene, silicon, sulfur, turpentine or finely divided metals. **MANY REACTIONS MAY CAUSE A FIRE OR EXPLOSION.**

Uses and Potential Exposures:

- ◆ Used in the paper, pulp, and textile industries for bleaching cellulose.

- ◆ Used for odor control and as a disinfectant and demulsifier in the treatment of drinking water, swimming pools, and sewage.
- ◆ Used as bleaching and cleaning agents, and as a disinfectant in homes, laundries, dishwashers, and cleaning powders.
- ◆ Used in food processing of meat, fish, vegetables and fruit, and cleaning dairy equipment.
- ◆ Used in the production of adhesives, batteries containing lithium or zinc, chlorinated solvents, cosmetics, drugs, hydraulic fluids, lubricants, pesticides, polymers, refrigerants, and resins.
- ◆ Used as a fluxing, purification, and extraction agent in metallurgy.

Exposure Routes:

- ◆ Inhalation
- ◆ Ingestion (solution)
- ◆ Skin and/or eye contact

PREVENT GENERATION OF MISTS!

Chlorine exposure levels and associated health impact in acute (< 15 minutes) exposure situations:

Concentration	Health Effects
0.08 ppm	Readily detectable odor
0.5 - 7 ppm	Eye, nose, and throat irritation, sneezing, salivation, general excitement, and restlessness, normally no lasting effect with short term exposure. Liquid exposure may cause frostbite, dermatitis. Chronic exposure to low levels may result in chloracne, tooth enamel corrosion, coughing, severe chest pain, sore throat, hemoptysis, and susceptibility to tuberculosis.
1.00 ppm	Immediately dangerous to life and health (IDLH)
> 29 ppm	Inhalation may cause severe irritation (burning) of mucus membranes in eyes, ears, nose, and throat, choking, coughing, substernal pain; nausea, vomiting; headache, dizziness, syncope; pulmonary edema, reactive airways dysfunction syndrome (RADS); chemical pneumonia, hypoxemia, death. Note: Effects may not manifest until a few hours have passed. Physical exertion will aggravate lung edema.

Recommended and permissible occupational exposure limits for chlorine:

Concentration	Recommendations
0.5 ppm	<i>Threshold Limit Value – Time Weighted Average (TLV-TWA)[®]</i> * the time-weighted average concentration for a conventional 8-hour workday and a 40-hour workweek, to which it is believed that nearly all workers may be repeatedly exposed, day after day, without adverse effect.
1.0 ppm	<i>Threshold Limit Value - Short-Term Exposure Limit (TLV-STEL)[®]</i> * is defined as a 15-minute TWA exposure that should not be exceeded at any time during a workday, even if the 8-hour TWA is within the TLV-TWA. Exposures above the TLV-TWA up to the TLV-STEL should not be longer than 15 minutes and should not occur more than four times per day. There should be at least 60 minutes between successive exposures.
1.0 ppm	<i>Permissible Exposure Limit (PEL)[†]</i> The permissible airborne contaminant concentration weighted over an 8-hour work day, as determined from breathing-zone air samples, over which the employee may not be exposed.

*American Conference of Governmental Industrial Hygienists (ACGIH) guidelines

†Occupational Safety and Health Administration (OSHA) guidelines

Personal Protective Equipment (PPE) Guidelines:

Note: Workplace controls are better than PPE.

- ◆ Wear fully encapsulating, vapor protective clothing for spills and leaks with no fire. Wear chemical protective clothing specifically recommended by the manufacturer. Wear positive pressure self-contained breathing apparatus (SCBA).
- ◆ Structural firefighter protective clothing provides limited protection in fire situations, ONLY; not effective in spill situations.

Chlorine Handling and Storage:

- Avoid contact with strong bases, combustible, and reducing substances, including acetylene, ethylene, hydrogen, ammonia, and finely divided metals.
- Store chlorine in tightly closed containers in a cool, dry, well-ventilated areas.

Disposal Methods:

1. Ventilation.
2. NEVER direct water jet on liquid. Remove gas with a fine water spray or fog. Use complete protective clothing, including self-contained breathing apparatus.
3. Do NOT let this chemical enter the environment.

NIOSH respirator recommendations:

Concentration (ppm)	Recommendations	AFP
Emergency or planned entry into unknown concentrations (10 ppm) IDLH	▶ Self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.	10,000
Escape	▶ Air-purifying, full-facepiece respirator (gas mask) with chin-style, front- or back-mounted chlorine vapor canister. ▶ Escape-type, self-contained breathing apparatus.	50
Up to 10 ppm	▶ A powered, air-purifying respirator with cartridge(s) providing protection against chlorine. ▶ A chemical cartridge respirator with a full facepiece and cartridge(s) providing protection against chlorine. ▶ Air-purifying, full facepiece respirator (gas mask) with chin-style, front- or back-mounted chlorine vapor canister. ▶ Supplied-air respirator with a full facepiece. ▶ Self-contained breathing apparatus with a full facepiece.	50
Up to 10 ppm	▶ Supplied-air respirator operated in a continuous-flow mode.	25
Up to 5 ppm	▶ A chemical cartridge/canister with chlorine cartridges. ▶ Supplied-air respirator with chlorine cartridges.	10

Spills and Emergencies:

- ✓ Evacuate endangered area. If there is a fire/explosion threat, consider an evacuation in all directions within ½ mile.
- ✓ Do not touch or walk through spilled material. Restrict persons not wearing appropriate PPE from the areas of spills or leaks until the affected area is safe to reoccupy.
- ✓ Remove all ignition sources.
- ✓ Effectively ventilate the area of the spill or leak. Chlorine is heavier than air. Keep out of low lying areas or confined spaces.
- ✓ Stop the leak.

Emergency First Aid Measures:

Eye Contact

1. Immediately flush eyes with large amounts of water. Continue for at least 20 minutes.
2. Seek medical attention immediately.

Skin Contact

1. Quickly remove and isolate contaminated clothing.
2. Immediately wash skin with large amounts of water for at least 20 minutes, followed by washing with soap and water.
3. Seek medical attention immediately.

Respiratory

1. Remove the victim from the site of the release to fresh air.
2. Begin rescue breathing if breathing has stopped, and CPR if heart activity has stopped.
3. Do not use mouth-to-mouth method if victim ingested or inhaled chlorine; induce artificial respiration with a pocket mask equipped with a one-way valve.
4. Transfer the victim promptly to a medical facility. Observation after high exposure is recommended for up to three days, as fluid in the lungs (pulmonary edema) may be delayed.

Fire Extinguishing and Explosion Hazard:

- ✓ All extinguishing agents allowed. Chlorine is not combustible, but enhances combustion of other substances.
- ✓ Contain the fire and let burn.
- ✓ Do NOT use dry chemical, Carbon Dioxide, or Halon®. Chlorine may react violently with air, moist air, and/or water.
- ✓ Containers may explode when heated. Ruptured containers may rocket.
- ✓ Cool containers that are exposed to flames by spraying with water, however, NO direct contact with water.
- ✓ Fight the fire from a maximum distance or use unmanned hose holders or monitor nozzles. Isolate the area for ½ mile in all directions.

TxHSEES Facts

The Texas Department of State Health Services (TDSHS) has participated in this surveillance system since 1993. HSEES collects and analyzes information about releases of hazardous substances (excluding petroleum) that need to be cleaned up or neutralized as

well as threatened releases that result in a public health action such as an evacuation. The goal of HSEES is to reduce the morbidity (injury) and mortality (death) that result from hazardous substance events. Due to the large number of spills and air releases in Texas, TxHSEES requires that the spill or release must be greater than one gallon or 10 pounds, unless the CERCLA reportable quantity is one pound.

HSEES categorizes chemicals into 16 substance categories. The substance category, Chlorine, accounted for 1% of all events and included Sodium Hypochlorite, Chlorine, and closely-related substances that readily produce Chlorine. Chlorine was involved in 242 actual or threatened events where only one chemical was released: 224 fixed-facility events and 18 transportation events (Table 1). A total of 152 people were injured during 30 events involving chlorine releases (Table 1).

Table 1. Summary of chlorine events reported to TxHSEES

	Fixed Facility		Transportation		Total
	No.	%	No.	%	
Events	224	(93%)	18	(7%)	242
Evacuations	34	(94%)	2	(96%)	36
Shelter-in-place	2	(67%)	1	(33%)	3
People receiving emergency decontaminations	19	(100%)	0	(0%)	17
Events with victims	27	(90%)	3	(10%)	30
Victims	149	(98%)	3	(2%)	152

More than 2294 people were evacuated in 36 chlorine events. The number of people evacuated ranged from 1 to 600, with a median number of 25 people evacuated. The total number of people evacuated was unknown in four events. The length of evacuation ranged from 1 to 8 hours, with a median number of 2 hours. In one event, the length of evacuation was unknown.

The industries most frequently associated with chlorine releases were chemical manufacturing (94, 39%) and public utilities (51, 21%) (Table 2). Twelve percent of all chlorine release events injured people. Forty people (26% of the total number of victims) injured were in the transportation industry.

Table 2. Frequency of events, events with victims, and victims by selected industries

Industry Category	Events No. (%)	Events with victims No. (%)	Victims No. (%)
Chemical Mfg.	94 (39%)	6 (20%)	26 (17%)
Utilities	51 (21%)	10 (33%)	30 (20%)
Transportation	21 (9%)	4 (13%)	40 (26%)
Wholesale	17 (7%)	3 (10%)	36 (24%)
Paper Mfg.	10 (4%)	1 (3%)	5 (3%)
Petroleum Refining	10 (4%)	0 (0%)	0 (0%)
Recreation	7 (3%)	2 (7%)	11 (7%)
All other	28 (12%)	3 (10%)	3 (2%)
Unknown	4 (2%)	1 (3%)	1 (1%)
Total*	242 (101%)	30 (99%)	152 (100%)

* Percentages may not add to 100% due to rounding.

Utilities and wholesale businesses both had the largest number of evacuations (7 each, 19% of all evacuations), followed by chemical manufacturing (6, 17% of all evacuations). Nineteen people received emergency decontamination in 6 events.

The majority of injured persons were employees (95, 63%) and their most frequent injuries were respiratory irritation, eye irritation, and gastrointestinal problems. For the 51 victims who were members of the general public, respiratory irritation and eye irritation were most frequently reported. The 6 injured responders reported respiratory irritation. Most people were treated on the scene or at a hospital and released.

Case Study

Highlights: 32 victims

A train hit a stationary train parked near a rural town when the train conductor failed to stop. Multiple cars derailed; some caught fire; and one damaged tank car released 90,000 pounds of chlorine.

Three people died: the train conductor from trauma and two women, who lived within ¼ mile of the collision, from chlorine gas inhalation. Twenty-nine members of

the general public reported respiratory, eye, and skin irritation, dizziness, headache, and shortness of breath.

One area downwind of the release was initially ordered to shelter-in-place, but later, this same area was evacuated. The evacuation was not feasible initially because there was heavy rain followed by some flooding. Fifteen people, plus an unknown number who self-evacuated, were evacuated for 13 days.

A county-wide meeting was held to discuss errors in the emergency management phase of this event. Flooding and resulting bridge damage made it difficult to transport people out of the area. Rural roads were difficult to navigate. Radio and television announcements were not utilized; these types of announcements could have helped direct people to hospitals and given important guidance about what to do during the event. Persons sought treatment throughout the county, instead of going to those facilities designated in the general response plan. Shelter-in-place information could have been followed more effectively if it had been communicated in both English and Spanish.

For more information about TxHSEES, call 512-458-7220.

This fact sheet does not replace the material safety data sheet (MSDS) required for a hazardous chemical under the Occupational Health and Safety Act of 1970 (29 U.S.C. 651 ET SEQ.) and regulations promulgated under this Act.

Information for this fact sheet was obtained from the TxHSEES program, the Environmental Protection Agency (EPA); the Agency for Toxic Substances and Disease Registry (ATSDR) TOXFAQS; the Handbook of Toxic and Hazardous Chemicals and Carcinogens, Third Edition; ACGIH, Threshold Limit Values and Biological Exposure Indices, 2004; Federal OSHA Regulations: 29 CFR 1910.1000, 29 CFR 1910.111; National Institute of Occupational Safety and Health, NIOSH Pocket Guide to Chemical Hazards, 2003; NIOSH International Chemical Safety Cards; Department of Transportation Gydebook (<http://hazmat.dot.gov/gydebook>); Department of Transportation hazmat.dot.gov/erg2000/g124.pdf); and National Library of Medicine's TOXNET Hazardous Substances Databank (toxnet.nlm.nih.gov).

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