Chapter 6

Troubleshooting

Often, when you encounter difficulties while running ALOHA, it will alert you of the problem and suggest a solution. At other times, you may encounter a problem and not know how to solve it. Below are some of these cases. For more ALOHA information, check the ALOHA Page at http://response.restoration.noaa.gov/cameo/aloha.html.

In the Text Summary, I see tank volume estimated to be "5.2e8 gallons." How many gallons is that?

ALOHA displays its results in **exponential notation** whenever numbers are too large to display in decimal notation. Exponential notation is a way of displaying a number as a digital number multiplied by a power of 10. In the number 5e3, for example, 5 is the digital number and 3 is the power to which 10 is taken. Interpret 5e3 as "5 times the quantity 10 taken to the power of 3," which equals 5,000 in decimal notation. Likewise, interpret 5e-3 as "5 times the quantity 10 taken to the power of -3," which equals 0.005 in decimal notation. Interpret 5.2e8 as "5.2 times 10 taken to the power of 8," or 520,000,000.

ALOHA gave me an outdoor concentration estimate that's greater than 1 million parts per million—how can that be?

You have asked for a concentration estimate for a point very close to the source. ALOHA "knows" that concentrations of a pollutant are extremely high right at the point of release, and drop off as you move downwind. It uses equations to approximate what happens in reality. Modelers call ALOHA a "far-field" model because these equations much more accurately predict events at distances of more than a few yards from the source than very near the source. According to these equations, in fact, concentration is infinite at the point of release.

I want to modify a chemical, but I can't change some properties—they appear grey.

These properties are estimated by ALOHA from other information in its chemical library. To use different property values, add a new chemical (use a name such as "CHLORINE-2"), then enter new property values.

I am trying to model the release of gas from a gas pipeline, but ALOHA says the pipe is too short. It tells me that the length must be at least 200 times the diameter of the pipe. What should I do?

If the pipe is too short relative to its diameter, and its diameter is greater than about 8 inches (20 centimeters), use the Tank option instead, selecting the configuration of a horizontal tank. If the pipe is less than 1 meter long and connected to a tank, you also can use the Tank option (in this case, select **Short pipe/valve** as the type of leak). Either of these methods should produce a conservative estimate of downwind dispersion.

I am using a SAM with ALOHA. I have set the SAM options using the Atmospheric menu, but the Source menu is not available—I can't set my source.

Either the SAM has not yet been collecting data for 5 minutes, or ALOHA has not received valid data. Before ALOHA can estimate atmospheric stability, it must have received data from the SAM for at least 5 minutes. Check the Text Summary window for a message alerting you that either the SAM has not been transmitting for 5 minutes, or the transmitted data are not valid.

ALOHA tells me that the input value I just entered is not within allowable limits.

ALOHA will accept a numeric input value (that is, a value such as puddle area or tank hole diameter that you enter as a number) only if it is within a specified range. These restrictions help to prevent you from inadvertently entering an unrealistic input value. If you enter a value outside of the allowable range, ALOHA will warn you and tell you what the limits are. You must modify your value before ALOHA will continue. Check the table in this chapter to see the allowable ranges for ALOHA inputs. Check ALOHA's online help topics for more information about ALOHA inputs.

When I changed some atmospheric conditions, ALOHA told me that it is unable to verify the consistency between my new atmospheric data and the source data. Then I had to reset the source.

ALOHA's Puddle, Tank, and Pipe source strength calculations are affected by atmospheric conditions. ALOHA recomputes source strength whenever possible after you have modifed atmospheric information. In some cases, however, it cannot, so it asks you to reenter information about the source. For example, by increasing air temperature, you may cause a tank to be filled to more than 100 percent of capacity, or a puddle's temperature to increase above its boiling point. In such cases, you must enter new source information to resolve the problem.

I set up a release scenario in ALOHA, then started MARPLOT, clicked on a location on my map, and chose Set Source Point from the ALOHA menu (in MARPLOT's Sharing menu). But I don't see a footprint on my map. What's wrong?

Before ALOHA can place a footprint on your MARPLOT map, a footprint plot needs to be displayed in ALOHA. To solve your problem, in ALOHA, choose Footprint from the Display menu, then return to MARPLOT. You should now see the footprint on your map.

My computer crashed while I had an ALOHA footprint plotted on a map in MARPLOT (Windows or Macintosh). Now whenever I reopen the map, I see the old footprint on the map, and I can't delete it; MARPLOT tells me that the ALOHA layer is locked.

To delete a footprint remaining on a map after a crash, delete the entire ALOHA layer (open the map again in MARPLOT, choose **Layer List** from MARPLOT's **List** menu, click on the lock icon for the ALOHA layer to unlock the layer, then click **Delete** while the ALOHA layer is highlighted in the layer list). A new ALOHA layer will be added next time you plot a footprint on the map.

I'm running MARPLOT with ALOHA (in Windows or on a Macintosh) while I respond to a spill. I'm also using a SAM station to collect weather data. I've had a footprint displayed in MARPLOT for the last half hour. I know the wind has shifted direction but the footprint hasn't changed at all. What's wrong?

Whenever you bring MARPLOT forward (so that its windows are in front of ALOHA's windows), you'll halt data transmission from the SAM to ALOHA. Bring ALOHA forward to update the weather data and footprint.

I thought I knew what an ALOHA footprint looks like. But on my current footprint plot, I see a big, shaded circle around my source point. What is it?

There are two possible explanations, depending on your scenario. If your source is a puddle of spilled liquid, and if it's large in diameter relative to the size of the footprint, you may be seeing it on the footprint plot. You may also have a heavy gas footprint. If a heavy gas is escaping into the atmosphere at a fast enough rate, it will form a large "blanket" of gas over the source point before it moves downwind. If the blanket is big enough, ALOHA will show it on your footprint plot.

We have two computers in our office that sometimes give different answers for the same ALOHA scenario.

Individual computers can come up with different answers when they make the same calculations. In particular, different computers can round off numbers differently as they make their calculations. This can have a visible effect on ALOHA's source and dispersion estimates.

Allowable Input

Input Value...	Must be... ...greater than (or equal to)	...less than (or equal to)
Time & Location		
Air exchange rate	0.01 per hour	60 per hour
Elevation	-1286 ft (-392 m)	28,000 ft (8,535 m)
Latitude	0°	90°
Longitude	0°	180°
Month	1	12
Day	1	31
Hour	0	23
Minute	0	59
Meteorological		
Air temperature	-100°F (-73°C)	150°F (65°C)
Cloud cover	0 tenths	10 tenths
Ground roughness	0.0004 in (0.001 cm)	78 in (200 cm)
Inversion height	10 ft	

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Glossary

ALOHA Areal Locations of Hazardous Atmospheres. The air dispersion model described in this manual (ALOHA is a trademark of the U.S. Government).

AEGLs Acute Exposure Guideline Levels (AEGLs) are under development by the National Research Council's Committee on Toxicology. The committee developed detailed guidelines for developing uniform, meaningful emergency response standards for the general public. The criteria in the guidelines take into account sensitive individuals and are meant to protect nearly all people. The committee has begun putting the guidelines into practice in developing AEGLs for specific chemicals. As of mid-2001, defined AEGL values for four chemicals have been released; proposed AEGL values for more chemicals are under review. The committee's objective is to define AEGLs for the 300+ extremely hazardous substances listed in Title III of the Superfund Amendment and Reauthorization Act (the US EPA offers an online list of these substances).

Aerosol Fine liquid droplets (or solid particles) suspended in a gas.

Air dispersion model A computer model such as ALOHA that predicts the movement and dispersion of a gas in the atmosphere.

Air exchange rate The number of times that the outdoor air replaces the volume of air in a building per unit time. Usually expressed as number of air changes per hour.

AlohaSpy A companion application to ALOHA. Use AlohaSpy to view or print archived Spy files. AlohaSpy is no longer in available for Aloha version 5.3 and greater.

Ambient Saturation concentration

The maximum concentration of vapor that could be attained in the air in a closed space above a liquid at ambient temperature and pressure. If a spilled liquid has a high ambient saturation concentration, it has a strong ability to displace air, and the concentration of vapor in the air above it will be high. If it has a low ambient saturation concentration, the vapor concentration will be low. This property changes with temperature: a liquid at a higher temperature will have a higher ambient saturation concentration. A chemical that is a gas at ambient temperature and pressure has an ambient saturation concentration of 100% (1,000,000 ppm).

Anhydrous

Without water. A chemical shipped or stored without water, rather than in solution, is in anhydrous form (anhydrous ammonia is a common example).

Atmospheric stability

A measure of the tendency of air to move upward or downward within the atmosphere, generating turbulence. Meteorologists have defined six “atmospheric stability classes,” from A to F, each representing a different degree of turbulence in the atmosphere. A represents the most unstable conditions (air has a strong tendency to move up or down, and the atmosphere is more turbulent) and F represents the most stable conditions (air has little tendency to be displaced up or down, and the atmosphere is less turbulent).

Average

(Mean) The sum of n values divided by n. For example, the mean of 2, 2, 4, and 6 is $(2 + 2 + 4 + 6) \div 4$, which equals 3.5.

Boiling point The maximum temperature at which a substance's liquid phase can exist in equilibrium with its vapor phase. Above the boiling point a liquid vaporizes completely. (The boiling point is also the temperature at which the vapor pressure of a liquid equals the atmospheric pressure). The boiling point depends on a chemical's composition and on the pressure. As pressure increases, a substance's boiling point also increases. The "normal" boiling point is the temperature at which a liquid under 1 atmosphere of pressure boils.

ChemLib ALOHA's library of chemical information. ChemLib contains values for physical properties and toxic thresholds for about 1,000 chemicals.

CityLib ALOHA's location library. It contains elevations, latitudes and longitudes, and other information about many U.S. cities, and a few non-U.S. locations. You can add or delete cities from CityLib.

Cloud cover The fraction of the sky that is obscured by clouds. ALOHA uses a scale in which cloud cover is measured in tenths (for example, when half the sky is covered by clouds, the cloud cover is 5 tenths).

Concentration The amount of a chemical present in a given weight or volume of air. In ALOHA, concentration of a gas in air is expressed in units such as parts per million (by volume) or milligrams per cubic meter.

Conservative An estimate that is more likely to result in footprint and downwind concentration estimates that are too large rather than too small. Selecting conservative choices for weather conditions (low wind speed and a stable atmosphere), source strength (larger puddle area or higher release rate), or LOC (a low LOC concentration) results in a longer footprint.

Continuous source A source that releases gas into the atmosphere at a constant or near-constant rate for an extended period of time.

Crosswind Perpendicular to the wind.

Cryogenic Relating to processing or storing substances at very low temperatures. For purposes of ALOHA, the use and storage of gases liquefied by refrigeration.

DEGADIS DEnse GAs DISpersion model (Havens and Spicer 1990). ALOHA uses a simplified version of this complex computer model, developed by researchers at the University of Arkansas, to predict the dispersion of a heavy gas.

Dialog box A window that ALOHA presents to you, in which you enter information or choose options.

DIPPR data Values for physical properties compiled by the Department of Chemical Engineering of Brigham Young University for the Design Institute for Physical Property Data (DIPPR) of the American Institute of Chemical Engineers. These values are included in ALOHA's chemical library, ChemLib, for more than half of the chemicals in the library.

Daylight savings time At most U.S. locations, daylight savings time is put into effect each spring when local standard time is advanced by 1 hour (the time is moved back 1 hour in the fall to become standard time again). When you select a U.S. location, ALOHA automatically switches between standard to daylight savings time for you when necessary, depending on the date that you enter. You must manually make this switch for locations outside the U.S.

Density The ratio of the mass (weight) of a substance to the volume it occupies. For example, if 1 cubic foot of a substance weighs 10 pounds, its density is 10 pounds per cubic foot.

Direct Source Choose this source option when you know, or can estimate, either the amount of pollutant gas entering the atmosphere or its rate of entry.

Dispersion For ALOHA's purposes, the process by which a cloud of pollutant gas spreads out into the atmosphere, mixing with the air and eventually becoming diluted to below hazardous levels.

Dose The concentration of pollutant to which people are exposed, taken to a power, multiplied by the period of time that it is present. Some researchers refer to this quantity as "toxic load."

Dusts Fine, solid particles at rest or suspended in a gas (usually air). These may have damaging effects on the environment, may be dangerous by inhalation or contact, and frequently constitute an explosion hazard when dispersed in air.

Eddies Parcels of air of various sizes that leave their normal position within an otherwise orderly, smooth flow. For example, air that encounters an obstacle must go over or around it. This change in the direction of air flow often causes "swirls" of air, or eddies, to tumble off the back of the obstacle. Impediments to airflow ranging from simple friction (grass) to larger obstacles (buildings) can cause eddies in a variety of sizes to form.

Entrainment The mixing of environmental air into a current of gas or air so that the environmental air becomes part of the current. For example, as air is mixed into a moving toxic cloud, the pure gas cloud becomes a gas/air mixture.

ERPGs

The Emergency Response Planning Guidelines (ERPGs) were developed by the ERPG committee of the American Industrial Hygiene Association. The ERPGs were developed as planning guidelines, to anticipate human adverse health effects caused by exposure to toxic chemicals. The ERPGs are three-tiered guidelines with one common denominator: a 1-hour contact duration (Figure 1). Each guideline identifies the substance, its chemical and structural properties, animal toxicology data, human experience, existing exposure guidelines, the rationale behind the selected value, and a list of references.

Exponential notation

ALOHA displays its results in exponential notation whenever numbers are too large to display in decimal notation. Exponential notation is a way of displaying a number as a digital number multiplied by a power of 10. In the number 5e3, for example, 5 is the digital number and 3 is the power to which 10 is taken. Interpret 5e3 as "5 times the quantity 10 taken to the power of 3," which equals 5,000 in decimal notation.

Flash boil

The sudden vaporization of a liquid. This occurs most often when a chemical is a gas at standard temperature and pressure, but is stored as a liquid under pressure. If the storage container ruptures, the sudden reduction in pressure leaves the material in a superheated state (causes it to be in a liquid state above its boiling point), so that it will flash boil as it leaves the container.

Footprint

ALOHA's footprint represents an overhead view of the area where the ground-level pollutant concentration is predicted to exceed your Level of Concern at some time after a release begins.

Freezing point Also, **melting point**. The temperature at which the solid and liquid phases of a substance exist in equilibrium. The freezing point depends on the chemical composition and the applied pressure. The “normal” freezing point is defined at a pressure of 1 atmosphere. For example, the normal freezing point of water is 0°C (32°F).

Fumes Dense, smoke-like vapors given off by fuming materials such as very reactive liquids, gases, or molten metals (for example, concentrated hydrochloric acid or sulfur monochloride). Fuming corrosive materials produce dense, choking, smoke-like clouds on contact with the moisture in air. Some liquefied gases that react with water when they evaporate (such as anhydrous hydrogen fluoride and anhydrous hydrogen chloride) also produce fumes. Fumes from hot or molten metals may not have a dense, smoke-like appearance but are hazardous, usually by inhalation.

GMT Greenwich Mean Time or Coordinated Universal Time. The reference time along the prime meridian (0° longitude), which passes through Greenwich, England.

Gas(es) Evenly dispersed molecules of a material at a temperature above its boiling point. A gas, unlike solids and liquids, does not have an independent shape or volume (a gas expands to fill available space, and the volume taken up by a gas depends on the pressure exerted on it). Examples of gases include oxygen, air (a mixture of nitrogen, oxygen, and trace amounts of other gases), chlorine, and carbon dioxide.

Gaussian A Gaussian curve is a bell-shaped, or “normal,” probability curve (named after a famous mathematician). ALOHA uses a Gaussian distribution to describe the movement and spreading of a gas that is neutrally buoyant (about as dense as air).

Ground roughness The roughness of the ground (over which a pollutant cloud is moving). Degree of ground roughness depends on the size and number of roughness elements, which can range in size from blades of grass to buildings. Ground roughness generates air turbulence, which acts to mix air into the pollutant cloud and dilute the pollutant gas. When all else is equal, a footprint will be *smaller* when you choose a *larger* ground roughness value.

Ground temperature The temperature of the ground beneath an evaporating puddle. ALOHA uses your value for ground temperature to estimate the amount of heat that is transferred from the ground to an evaporating puddle.

Ground type The physical composition of the ground beneath a puddle. The ground type is especially important when a refrigerated liquid spills to form a boiling puddle. In such cases, often more of the heat required for puddle evaporation is supplied by the ground rather than the atmosphere.

Heavy gas A gas cloud that is denser than the air around it. There are several reasons why a gas forms a heavy gas cloud, or behaves like a heavy gas: 1) because its molecular weight is greater than that of air (about 29 kilograms/kilomole), 2) because it is stored cryogenically (refrigerated), or 3) because aerosols form in sufficient quantity during a release to cause the mixture to behave like a heavy gas.

IDLH Immediately Dangerous to Life or Health. A limit originally established for selecting respirators for use in workplaces by the National Institute for Occupational Safety and Health (NIOSH). A chemical's IDLH represents the maximum concentration in the air to which a healthy adult worker could be exposed without suffering permanent or escape-impairing health effects.

Infinite tank source A case in which a gas pipeline is connected to a reservoir that is so large that gas escapes from the broken end of the pipeline at a constant rate for an indefinite period of time.

Instantaneous source A very short-term release. ALOHA assumes that an instantaneous release lasts 1 minute.

Inversion An atmospheric condition in which an unstable layer of air near the ground lies beneath a very stable layer of air above. The height of the abrupt change of atmospheric stability is called the inversion height. An inversion can trap pollutant gases below the inversion height. This may cause ground-level concentrations of a pollutant to reach higher levels than would otherwise be expected.

Level of Concern (LOC) A threshold concentration of an airborne pollutant, usually the concentration above which a hazard may exist. ALOHA plots a "footprint," which represents the zone where the ground-level pollutant concentration may exceed your LOC at some time after a release begins.

Mass Mass is a physical property related to weight. Mass is a measure of the amount of a substance that occupies a given space. While the weight of a given amount of a substance is a measure of the force by which it is attracted by gravity (and is less on the moon than on the earth), the substance's mass is independent of gravity.

Maximum Average Sustained Release Rate

ALOHA computes release rate from a puddle, tank, or gas pipeline as a series of hundreds of brief timesteps. It then averages this series of many release rates into between one and five release rates that are each averaged over a time period of at least 1 minute. To save calculation time, ALOHA uses these averaged release rate(s) to make its footprint estimates. The Maximum Average Sustained Release Rate is the highest of these averaged release rates. It is represented by the tallest timestep on the Source Strength graph.

Mixing

The process by which air is mixed into a pollutant gas cloud. This includes both mechanical (induced by the wind passing over rough ground) and thermal (induced by surface heating) mixing.

Mole

Amount of a substance containing 6.02×10^{23} molecules. The molecular weight of a chemical is the mass of 1 mole of that chemical.

Molecular weight

The sum of the atomic weights of all the atoms in the molecule (the weight of one molecule of the chemical).

Neutrally buoyant gas

A gas that is about as dense as air, and neither positively nor negatively buoyant (neither rises nor sinks in air).

Open Country

An area of low ground roughness, such as a parking lot or open field.

Parts per billion (ppb)

Units of gas or vapor concentration in air: parts of gas per billion parts of air. ALOHA uses parts per million (ppm). (1 ppm = 1 ppb x 1,000)

Parts per million (ppm)

Units of gas or vapor concentration in air: parts of gas per million parts of air. In ALOHA, ppm is by volume, not by weight.

Partial Pressure

At equilibrium, molecules move from the liquid to the gas phase at the same rate as they return to the liquid from the gas phase. In liquids that are mixtures of chemicals, each component vaporizes at its own characteristic rate. The partial pressure of a chemical in a mixture is a measure of the concentration of that chemical's gas-phase molecules in the air directly in contact with the liquid. In most actual cases equilibrium is not reached so the partial pressure represents the limiting value for chemical concentration in the air.

Particulates

Solid particles so small that they can disperse in the air like gases (however, unlike gases, particulates eventually “rainout,” or fall to the ground). ALOHA does NOT model particulate dispersion.

Patchiness

Distribution of a pollutant gas as patches of high and low concentration. Especially near the source of a release, wind eddies push a pollutant cloud unpredictably about, causing gas concentrations at any moment to be high in one location and low in another. ALOHA does not account for patchiness near the point of a release.

Pipe

For purposes of ALOHA, a pipeline carrying pressurized gas. ALOHA does not model releases from liquid pipelines.

Plume

A cloud of pollutant gas dispersing from a *continuous* source. A typical plume is a long, cigar-shaped gas cloud.

Plume rise

The upward transport of a gas plume (such as smokestack gases, which rise because they have been heated). ALOHA does not account for plume rise.

Puff

A cloud of pollutant gas dispersing from an *instantaneous* source. A typical puff is a short, round gas cloud.

Relative humidity The ratio of the amount of water vapor that the air contains to the maximum amount of water vapor that it could hold at the ambient temperature and pressure. Relative humidity is expressed as a percentage. When relative humidity is 50%, the air contains one-half as much water vapor as it could potentially hold.

Release duration The period of time over which a release occurs. ALOHA limits release duration to 1 hour.

Roughness length Also, Z_0. A numerical measure of ground roughness.

Running average An average taken in consecutive, overlapping segments (e.g., the average of the first five values, then the average of the second through sixth values, then the average of the third through seventh values, etc.). See **Average**.

SAM Station for Atmospheric Measurements. A portable meteorological measurement station that can transmit weather data to ALOHA through a computer's serial port.

Save file A file containing information about a release scenario that you have entered into ALOHA. You can reopen and modify a save file in ALOHA. Choose **Save** from the **File** menu to create a save file.

Serial port A data interface on a computer through which peripheral devices, such as a SAM, scanner, printer, or digitizing tablet, can be connected. ALOHA can receive weather data from a SAM through a serial port.

Sigma theta The standard deviation of the wind direction. A SAM configured for use with ALOHA measures changes in wind direction, then transmits an estimate of sigma theta. ALOHA uses this value for sigma theta and the wind speed to estimate stability class.

Smoke A mixture of gases, suspended solid particles, and vapors resulting from combustion.

Solution A mixture of two or more compounds. Many common solutions are mixtures of soluble chemicals and water. Examples include alcohol in water and table salt in water.

Solution Strength Mixtures of chemicals in which the components are interspersed uniformly at the molecular level are called solutions. The strength of a solution in ALOHA is defined as the mass of the volatile hazardous component divided by the mass of the solution. For example, the strength of an oleum solution is defined as the mass of free sulfur trioxide divided by the combined mass of the free sulfur trioxide and sulfuric acid.

Solutions Mixtures of chemicals in which the components are interspersed uniformly at the molecular level are called solutions. ALOHA's database includes a short list of solutions, most of them are composed of anhydrous acid and water (eg., hydrogen fluoride and water). In all cases, only one component of the solution is both toxic and volatile enough to pose an air hazard.

Source The vessel or pool releasing a hazardous chemical into the atmosphere.

Source height The distance above the ground at which a chemical is being released.

Source strength The amount of a pollutant gas entering the atmosphere, or its rate of entry.

Stability class (see **Atmospheric stability**)

Stable

The atmosphere is stable when little air turbulence exists, so that there is little tendency for air to be mixed into a dispersing pollutant cloud.

Standard deviation

A measure of the degree to which individual values deviate from an average value. Computed as the square root of the sum of the squared deviations divided by the number of measurements.

STP

Standard Temperature and Pressure. Physical properties such as boiling point are often expressed at standard temperature, 0°C, and standard pressure, 1 atmosphere.

Street canyon

A street bordered along both sides by high-rise buildings that block air movement, so that the wind and any dispersing pollutant cloud are channeled down the street.

Sublimation

A frozen substance *sublimates* when it passes directly into the gas phase without first becoming liquid.

TEELs

Temporary Emergency Exposure Limits (TEELs) are temporary LOCs similar to ERPGs, and defined by the U.S. Department of Energy for use when ERPGs aren't available. Like ERPGs, they do not incorporate safety factors. Rather, they are designed to represent the predicted response of members of the general public to different concentrations of a chemical during an incident.

Terrain steering

The way in which land features such as hills and valleys modify the speed and direction of air flow.

TLV-TWA Threshold Limit Value-Time Weighted Average. The maximum airborne concentration of a given hazardous chemical to which nearly all workers can be exposed during normal 8-hour workdays and 40-hour workweeks for an indefinite number of weeks without adverse effects. Set by the American Conference of Governmental Industrial Hygienists (ACGIH).

Threat distance The downwind distance along the centerline of a chemical cloud, out to the level of concern that you set. ALOHA's footprint length, reported in the Text Summary window, is a threat distance.

Threat zone The area downwind of the source of an escaping pollutant, within which concentrations of pollutant may become high enough to threaten people. ALOHA's footprint is a diagram of a predicted threat zone.

Time-dependent dispersion A time-dependent value is something that changes over time. ALOHA's dispersion predictions account for release rates that change over time; in this sense, these predictions are time-dependent. However, ALOHA does NOT account for changing atmospheric conditions when predicting dispersion: in this sense, its predictions are not time-dependent.

Time-dependent source A release rate that changes over time. For example, release rate from a pressurized tank declines over time as tank pressure drops.

Two-phase flow Both the liquid and gas phases of a chemical sometimes can escape together from a ruptured pressurized tank as a "two-phase flow." Many substances that are gases under normal pressures and temperatures are stored under high enough pressures to liquefy them. When a tank rupture or broken valve causes a sudden pressure loss in a tank of liquefied gas, the liquid boils violently, the tank contents foam up, and the tank fills with a mixture of gas and fine liquid droplets (called aerosol). When such a two-phase mixture escapes from storage, the release rate can be significantly greater than that for a purely gaseous release.

Unstable The atmosphere is unstable when substantial air turbulence exists, so that there is a strong tendency for air to be mixed into a dispersing pollutant cloud.

Urban or Forest An area of relatively high ground roughness, such as residential areas or forests.

Vapor The gas produced by the evaporation of a liquid (or sublimation of a solid). For example, the gas produced when liquid water evaporates is water vapor.

Vapor pressure Vapor pressure is a property of a liquid. At equilibrium, molecules move from the liquid to the gas phase at the same rate as they return to the liquid from the gas phase. The vapor pressure is a measure of the concentration of gas-phase molecules in the air directly in contact with the liquid, at equilibrium. In most actual cases equilibrium is not reached so the vapor pressure represents the limiting value for chemical concentration in the air.

Volatility The tendency of a liquid (or solid) to form a vapor.

Wind direction The direction from which the wind is blowing.

Wind rose For ALOHA's purposes, a diagram displaying recent measurements of average wind speed and direction at a location.

Z_0 (see **Roughness length**)

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