

## Ask Dr. ALOHA: Choosing Toxic Levels of Concern

Levels of Concern (LOCs), like wind speed or puddle area, are required input for an ALOHA scenario. ALOHA provides you with default LOCs, which will be the best option for many of your releases. However, there are times when you should use other LOCs. Like other values you enter into ALOHA, you should make sure that the LOC values are appropriate for your scenario.

### What is a toxic Level of Concern?

A toxic LOC is a threshold concentration of an airborne pollutant, usually the concentration above which a hazard may exist. You may choose up to three LOCs in ALOHA. For each LOC you choose, ALOHA estimates a threat zone where the ground-level pollutant concentration is predicted to exceed that LOC at some time after a release begins. These zones are displayed on a single threat zone plot, as shown in Figure 1 below. If the LOC you've chosen is a concentration above which a hazard is thought to exist, then the threat zone represents the predicted area where people might be exposed to that hazard.

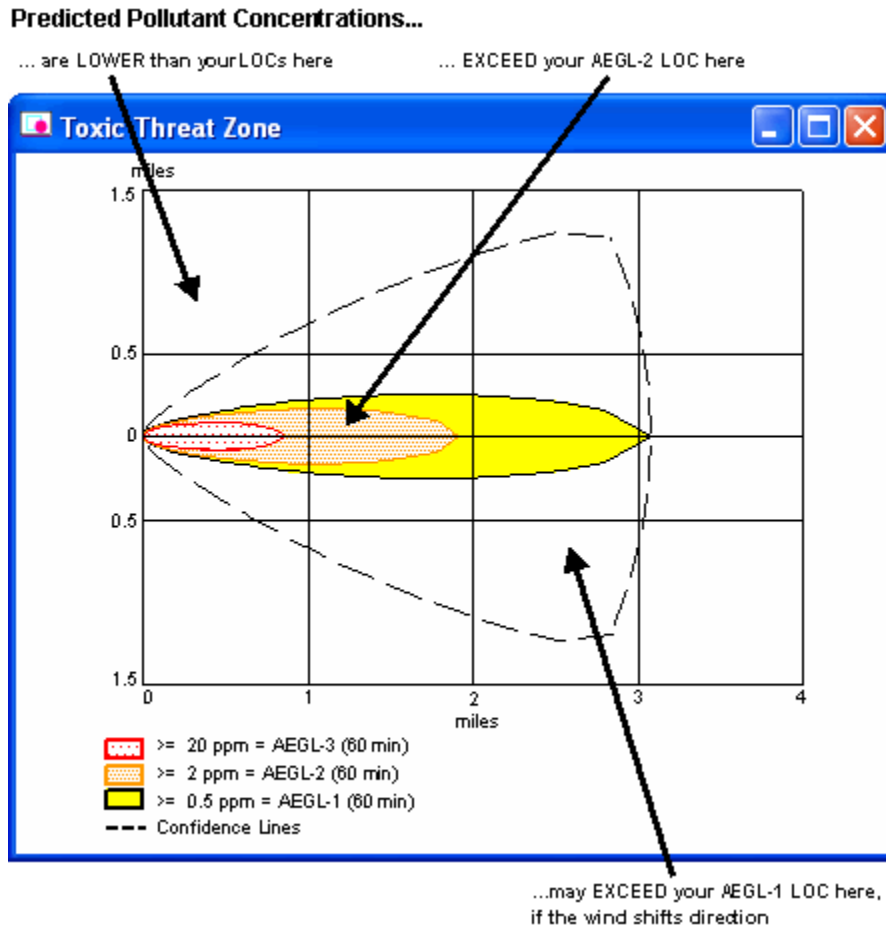


Figure 1. An ALOHA toxic threat zone plot, showing where pollutant concentration estimates are higher or lower than the chosen Levels of Concern (LOCs). The red threat zone is the most hazardous.

The most commonly-used LOCs for air modeling are **public exposure guidelines** such as:

- **AEGLs** (Acute Exposure Guideline Levels)
- **ERPGs** (Emergency Response Planning Guidelines)
- **TEELs** (Temporary Emergency Exposure Limits)

Each of these exposure guidelines has three tiers of exposure values (e.g., AEGL-1, AEGL-2, and AEGL-3) for each covered chemical. There are some key differences between the exposure guidelines; however, at a very general level, the tiers are similar: the first tier (e.g., ERPG-1) is a mild effects threshold, the second tier is an escape impairment threshold, and the third tier is a life-threatening effects threshold.

Public exposure guidelines like these are intended to predict how members of the general public would be affected if exposed to a particular hazardous chemical. Generally, public guidelines are used for tasks like air modeling and other kinds of consequence analysis, when the goal is to assess the severity of a hazard to the general public. ALOHA includes these public exposure guidelines for applicable chemicals, so that you can use them as LOCs.

Using public exposure guidelines as LOCs in ALOHA is ideal for emergency response or planning situations, because these guidelines are specifically designed to predict how the general public would be affected by an accidental release of a particular hazardous chemical. In fact, the developers of the Emergency Response Guidebook (the "ERG") used the ERPG-2 whenever possible to prepare recommended isolation and evacuation distances for the chemicals included in the guidebook.

Today, AEGLs are considered the best public exposure guidelines to date, because they undergo a rigorous review process, have multiple exposure durations, and are designed as guidelines for nearly all members of the general public—including sensitive individuals. As part of the review process, interim AEGL values are established and then evaluated thoroughly (sometimes over several years) before the final AEGL values are approved. (ALOHA only includes the final AEGLs with a 60-minute exposure duration.)

However, because the AEGL development process is so exhaustive, relatively few final AEGLs have been defined. When AEGLs are not available for a chemical, you may want to use ERPGs or TEELs, which are available for more chemicals. ERPGs are based on experimental data, but unlike AEGLs they are only available for a 1-hour exposure duration and they are not designed as guidelines for sensitive individuals. TEELs are temporary limits designed to be used as exposure limits for chemicals for which AEGLs or ERPGs have not yet been defined.

Most common chemicals will be defined under one or more of these public exposure guidelines; however, you may occasionally be faced with a chemical for which no public guideline exists. No clear rules describe what you should do if you're in this situation, and your goal is to assess the hazard to the general public posed by a release of that chemical.

One option is to use a **workplace exposure limit**, if no other potential LOC is available or if you don't have time to search for a more appropriate LOC. These are usually defined for healthy adult workers, and typically incorporate safety factors to ensure that workers won't be overexposed to hazardous chemicals in the workplace. Generally, employers are responsible for ensuring that these limits are not exceeded in the workplace.

However, if you're considering this option, be aware that:

- These limits were designed to protect workers, not for use in assessing hazard to people exposed during an accidental release.
- Because age, health, and exertion influence how susceptible people will be to a pollutant, it's possible that some workplace limits may underestimate risk to the sensitive portions of the general population (such as members who are old, young, or sick).

Common workplace exposure limits include:

- **IDLHs** (Immediately Dangerous to Life and Health limits)
- **TLVs** (Threshold Limit Values)
- RELs (Recommended Exposure Limits)
- PELs (Permissible Exposure Limits)

For defined chemicals, ALOHA includes IDLH as an LOC option. (The IDLH values are used primarily for making decisions regarding respirator use.) However, unlike the three-tiered public exposure guidelines, only a single IDLH value is defined for applicable chemicals.

### How do I choose toxic Levels of Concern in ALOHA?

Once you choose a chemical, ALOHA will display the chemical's LOCs in the Text Summary window with other chemical data information, as shown in Figure 2. Although a chemical may be defined under the AEGL, ERPG, and TEEL hazard classification systems, ALOHA only displays the public exposure guideline it uses as the default: AEGLs are used preferentially, followed by ERPGs, and then TEELs.

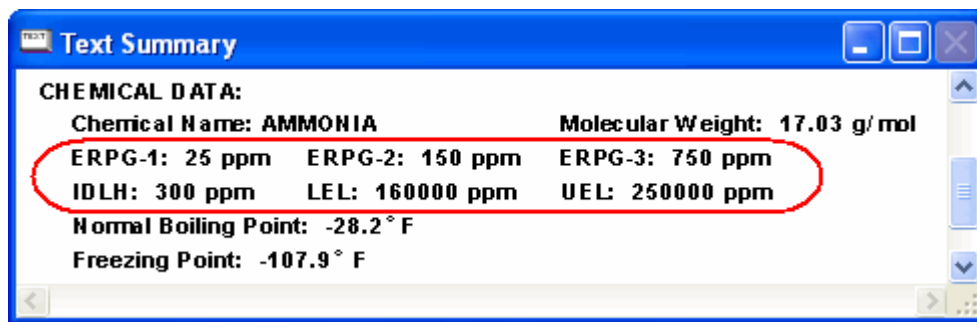


Figure 2. ALOHA's Text Summary window, showing the Levels of Concern (LOCs) for ammonia.

**Note:** In the Text Summary window, you also may see other LOC values such as IDLH, LEL (Lower Explosive Limit), and UEL (Upper Explosive Limit). If the chemical is flammable, ALOHA can use the explosive limits (also called the flammability limits) to estimate the flammable area of the vapor cloud.

When you are using ALOHA to model a toxic chemical release, you will choose your LOCs on the Toxic Level of Concern dialog box (Figure 3). To make things easier for you, ALOHA automatically provides default LOCs. For toxic LOCs, ALOHA uses final 60-minute AEGLs preferentially. However, if those are unavailable for the chosen chemical, ALOHA will default in turn to ERPGs, TEELs, and then IDLH.

Most users will use ALOHA's default LOCs; however, ALOHA also provides some additional LOC options. For each LOC, you can choose a different LOC from the pulldown list of available LOCs (such as AEGLs, ERPGs, TEELs, and IDLH) or you can choose User Specified from the list and enter your own LOC value. (Note: TEELs are interim values that are superseded by ERPGs and AEGLs when those become available. Therefore, TEELs are not included in the pulldown list when the other values are available.)

**Toxic Level of Concern**

Select Toxic Level of Concern:

**Red Threat Zone**  
LOC: ERPG-3: 750 ppm

**Orange Threat Zone**  
LOC: ERPG-2: 150 ppm

**Yellow Threat Zone**  
LOC: User specified 30

ppm  
 milligrams/cubic meter  
 milligrams/liter  
 grams/cubic meter

Show confidence lines:  
 only for longest threat zone  
 for each threat zone

OK Cancel Help

Figure 3. Choose your toxic Levels of Concern (LOCs) for ammonia from the pulldown list of common exposure values or specify your own. Here, the interim 60-minute AEGL value is being entered by hand for the LOC-1 level because ALOHA only includes AEGL values in the pulldown list when they have been finalized.

Setting a user-specified LOC, as in Figure 3, is temporary. However, you can permanently add your own default toxic LOCs for any chemical in ALOHA's chemical library, as shown in Figure 4. To do this:

1. Open ALOHA's chemical list dialog box and select the chemical name.
2. Click Modify.
3. Select Default LOC-1 (Yellow), and then type in your new value and choose units for it.
4. Repeat step 3 for LOC-2 and LOC-3, and then click OK.
5. Click Select on the chemical list dialog box, and click OK on the warning that appears.

**Input Available Information**

Chemical Name: AMMONIA

Molecular Weight: DIPPR

AEGL-1  
 AEGL-2  
 AEGL-3  
 Boiling Point (normal)  
 Critical Pressure  
 Critical Temperature  
**Default LOC-1 [Yellow]**  
 Default LOC-2 [Orange]  
 Default LOC-3 [Red]  
 Density (gas)  
 ERPG-1

Default LOC-1 Value: 30

ppm

Next Field OK Cancel Help

Figure 4. Adding a new default toxic Level of Concern (LOC) for ammonia to ALOHA's chemical library. This value, 30 parts per million, is the interim 60-minute AEGL-1 value for ammonia. ALOHA's standard values only include final AEGL values.

Once you have added your own LOCs for a particular chemical, ALOHA will use those values rather than its standard defaults as the LOCs for that chemical. Your new default LOCs will be displayed in the Text Summary window above the standard LOCs.

### When should I use other Levels of Concern?

Although ALOHA makes it easy for you by providing default LOCs and common alternates, there may be times when another LOC is more appropriate for your purpose. As you chose LOCs for use in ALOHA, ask yourself whether it makes sense in the context of your work. To predict the area of a hazard or other effect, you must first decide what the hazard or effect is, and then make sure that the LOC reflects it. For example,

- If you want to identify locations where people may be especially concerned if an accidental release occurs, you may wish to choose a detection limit such as the odor threshold. (Learn more by reading the Ask Dr. ALOHA article on [odor thresholds](#).)
- If you're preparing consequence analyses to meet provisions of the Risk Management Planning Rule, be sure to use as your LOCs the toxic endpoints listed in the rule for the chemicals you're working with.
- If your release has a short duration and ALOHA's concentration graphs show that the predicted exposure durations are short at all points in the threat zone, you may want to use the 10-minute or 30-minute AEGL values instead of the 60-minute AEGLs included in ALOHA.

## What about exposure durations?

The duration of exposure to a pollutant, as well as the pollutant's concentration, affects how it may harm people. For that reason, toxic hazard exposure guidelines usually have specific exposure (or contact) durations assigned to them. The guidelines indicate that the harm is expected to be caused when the concentration limit is exceeded for the exposure duration or longer. For example, the exposure duration associated with ERPGs is 1 hour. The AEGLs are developed for five exposure durations (10 minutes, 30 minutes, 60 minutes, 4 hours, and 8 hours); however, only the 60-minute AEGLs are included in ALOHA.

If you are using ALOHA to model an accidental chemical release, you should choose LOCs that have exposure durations appropriate for emergency response use. After this type of release, people downwind may be exposed to high concentrations of the chemical, but typically for only a brief period. An LOC with an exposure duration much greater than an hour is probably not appropriate for use in ALOHA, because ALOHA only models the release for one hour from your start time.

You can learn more about exposure durations associated with exposure limits by reading the Ask Dr. ALOHA article on [working with the concentration graph](#).

## In Summary

For ALOHA's results to be useful to you, you must use accurate values for model inputs such as wind speed or tank size. You also must choose LOCs that are appropriate for the scenario you're modeling. As much as possible, your LOCs should:

- Represent the hazard or effect that you're concerned about.
- Be intended for the population that you're concerned about.
- Have an exposure duration appropriate for your scenario.

## For More Information

- AEGLs: <http://response.restoration.noaa.gov/aegls>
- ALOHA: <http://response.restoration.noaa.gov/aloha>
- ALOHA Tools: <http://response.restoration.noaa.gov/alohatools>
- Ask Dr. ALOHA Articles: <http://www.response.restoration.noaa.gov/ADA/overview>
- Ask Dr. ALOHA - Working with the Concentration Graph: <http://www.response.restoration.noaa.gov/ADA/concentrationgraph>
- Ask Dr. ALOHA - Working with Toxic and Odor Thresholds: <http://www.response.restoration.noaa.gov/ADA/toxicodorthresholds>
- ERPGs: <http://response.restoration.noaa.gov/erpgs>
- IDLHs: <http://response.restoration.noaa.gov/idlhs>
- Public Exposure Guidelines: <http://response.restoration.noaa.gov/pubexpguides>
- Toxic Levels of Concern: <http://response.restoration.noaa.gov/toxiclocs>
- TEELs: <http://response.restoration.noaa.gov/teels>
- TLVs: <http://response.restoration.noaa.gov/tlvs>
- Workplace Exposure Limits: <http://response.restoration.noaa.gov/workexplimits>