Hazard Communication Information Sheet
reflecting the US OSHA Implementation of
the *Globally Harmonized System (GHS) of
Classification and Labelling of Chemicals*
Produced by the SCHC-OSHA Alliance
GHS/HazCom Information Sheet Workgroup

Acute Toxicity - Inhalation | July 2017

How does OSHA's Hazard Communication Standard (HCS) 2012 define Acute Toxicity by Inhalation?

Acute toxicity by inhalation refers to those adverse effects occurring following an inhalation exposure of gas, dust, mist or vapor for 4 hours. *Dust* is defined as solid particles of a substance or mixture suspended in a gas (usually air). *Mist* is defined as liquid droplets of a substance or mixture suspended in a gas (usually air). *Vapor* is defined as the gaseous form of a substance or mixture released from its liquid or solid state.

How is Acute Toxicity by Inhalation classified under HCS 2012?

Acute toxicity values are expressed as (approximate) LC_{50} (inhalation) values or as acute toxicity estimates (ATE). The ATE for the classification of a substance is derived using the LC_{50} where available, the appropriate conversion value from the table below that relates to the results of a range test, or the appropriate conversion value from the table below that relates to a classification category. Chemicals that are toxic by inhalation may be in the form of gases, vapors, or dust/mist.

Table 1: Acute toxicity hazard categories and acute toxicity estimate (ATE) values defining the respective categories

| Exposure route	Classification Category			Converted Acute Toxicity point estimate
Inhalation – Gases (ppmV)	0	< Category 1 ≤	100	10
	100	< Category 2 ≤	500	100
	500	< Category 3 ≤	2500	700
	2500	< Category 4 ≤	20000	4500
Inhalation – Vapors (mg/l)	0	< Category 1 ≤	0.5	0.05
	0.5	< Category 2 ≤	2.0	0.5
	2.0	< Category 3 ≤	10.0	3
	10.0	< Category 4 ≤	20.0	11
Inhalation – Dust/mist (mg/l)	0	< Category 1 ≤	0.05	0.005
	0.05	< Category 2 ≤	0.5	0.05
	0.5	< Category 3 ≤	1.0	0.5
	1.0	< Category 4 ≤	5.0	1.5

Additional classification considerations

Inhalation cut-off values in the table are based on 4 hour testing exposures. Conversion of existing inhalation toxicity data which has been generated according to 1 hour exposure is achieved by dividing by a factor of 2 for gases and vapors and 4 for dusts and mists. For some substances the test atmosphere will be a vapor which consists of a combination of liquid and gaseous phases. For other substances the test atmosphere may consist of a vapor which is nearly all the gaseous phase. In these latter cases, classification is based on ppmV as follows: Category 1 (100 ppmV), Category 2 (500 ppmV), Category 3 (2500 ppmV), and Category 4 (20000 ppmV). The preferred test species for evaluation of acute toxicity by the inhalation route is the rat. Test data already generated for the classification of chemicals under existing systems should be accepted when reclassifying these chemicals under the harmonized system. When experimental data for acute toxicity are available in several animal species, scientific judgment should be used in selecting the most appropriate LC_{50} value from among scientifically validated tests.

Classification criteria for mixtures

Appendix A (section A.1.3) to the OSHA HCS provides the following:
The approach to classification of mixtures for acute toxicity is tiered, and is dependent upon the amount of information available for the mixture itself and for its ingredients. The following flow chart indicates the process that must be followed:

Figure 1: Tiered approach to classification of mixtures for acute toxicity

Test data on the mixture as a whole
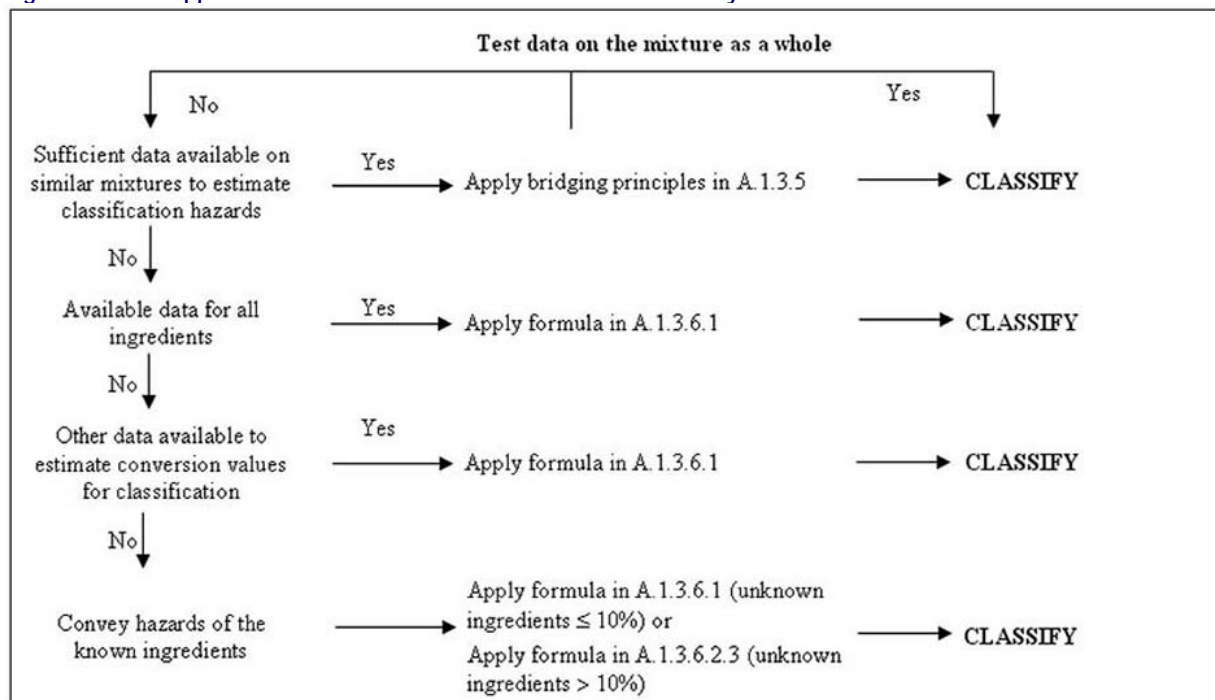
A.1.3.2 **Classification of mixtures** for acute toxicity may be carried out for each route of exposure, but is only required for one route of exposure as long as this route is followed (estimated or tested) for all ingredients and there is no relevant evidence to suggest acute toxicity by multiple routes. When there is relevant evidence of acute toxicity by multiple routes of exposure, classification is to be conducted for all appropriate routes of exposure. All available information shall be considered. The pictogram and signal word used shall reflect the most severe hazard category; and all relevant hazard statements shall be used.

A.1.3.3 **For purposes of classifying the hazards of mixtures in the tiered approach:** (a) The "relevant ingredients" of a mixture are those which are present in concentrations ≥ 1% (weight/weight for solids, liquids, dusts, mists and vapors and volume/volume for gases). If there is reason to suspect that an ingredient present at a concentration < 1% will affect classification of the mixture for acute toxicity, that ingredient shall also be considered relevant. Consideration of ingredients present at a concentration < 1% is particularly important when classifying untested mixtures which contain ingredients that are classified in Category 1 and Category 2; (b) Where a classified mixture is used as an ingredient of another mixture, the actual or derived acute toxicity estimate (ATE) for that mixture is used when calculating the classification of the new mixture using the formulas in A.1.3.6.1 and A.1.3.6.2; (c) If the converted acute toxicity point estimates for all ingredients of a mixture are within the same category, then the mixture should be classified in that category. (d) When only range data (or acute toxicity hazard category information) are available for ingredients in a mixture, they may be converted to point estimates in accordance with Table 1 when calculating the classification of the new mixture using the formulas in A.1.3.6.1 and A.1.3.6.2 of 29 CFR 1910.1200.

A.1.3.4 **Classification of mixtures where acute toxicity test data are available for the complete mixture**
Where the mixture itself has been tested to determine its acute toxicity, it is classified according to the same criteria as those used for substances, presented in Table 1. If test data for the mixture are not available, the procedures presented below must be followed.

A.1.3.5 **Classification of mixtures where acute toxicity test data are not available for the complete mixture: bridging principles**
Where the mixture itself has not been tested to determine its acute toxicity, but there are sufficient data on both the individual ingredients and similar tested mixtures to adequately characterize the hazards of the mixture, these data will be used in accordance with the following bridging principles: Dilution, Batching, Concentration of mixtures, Interpolation within one toxicity category, Substantially similar mixtures, and Aerosols.

A.1.3.6 **Classification of mixtures based on ingredients of the mixture (additivity formula)**
A.1.3.6.1 Data available for all ingredients
The acute toxicity estimate (ATE) of ingredients is considered as follows: (a) Include ingredients with a known acute toxicity, which fall into any of the acute toxicity categories, or have an oral or dermal LD_{50} greater than 2000 but less than or equal to 5000 mg/kg body

weight (or the equivalent dose for inhalation); (b) Ignore ingredients that are presumed not acutely toxic (e.g., water, sugar); (c) Ignore ingredients if the data available are from a limit dose test (at the upper threshold for Category 4 for the appropriate route of exposure as provided in the flow chart above) and do not show acute toxicity.

Ingredients that fall within the scope of this paragraph are considered to be ingredients with a known acute toxicity estimate (ATE). The ATE of the mixture is determined by calculation from the ATE values for all relevant ingredients according to the following formula below for oral, dermal or inhalation toxicity:

$$\frac{100}{ATE_{mix}} = \sum_n \frac{C_i}{ATE_i}$$

where:
C_i = concentration of ingredient i
n ingredients and i is running from 1 to n
ATE_i = acute toxicity estimate of ingredient i

A.1.3.6.2 Data are not available for one or more ingredients of the mixture
Where an ATE is not available for an individual ingredient of the mixture, but available information provides a derived conversion value, the formula in A.1.3.6.1 of 29 CFR 1910.1200 may be applied. This information may include evaluation of: (a) Extrapolation between oral, dermal and inhalation acute toxicity estimates. Such an evaluation requires appropriate pharmacodynamic and pharmacokinetic data; (b) Evidence from human exposure that indicates toxic effects but does not provide lethal dose data; (c) Evidence from any other toxicity tests/assays available on the substance that indicates toxic acute effects but does not necessarily provide lethal dose data; or (d) Data from closely analogous substances using structure/activity relationships.

This approach requires substantial supplemental technical information, and a highly trained and experienced expert, to reliably estimate acute toxicity. In the event that an ingredient with unknown acute toxicity is used in a mixture at a concentration ≥ 1%, and the mixture has not been classified based on testing of the mixture as a whole, the mixture cannot be attributed a definitive acute toxicity estimate. In this situation the mixture is classified based on the known ingredients only. (Note: A statement that x percent of the mixture consists of ingredient(s) of unknown toxicity is required on the label and safety data sheet in such cases). If the total concentration of the relevant ingredient(s) with unknown acute toxicity is ≤ 10% then the formula presented in A.1.3.6.1 of 29 CFR 1910.1200 must be used. If the total concentration of the relevant ingredient(s) with unknown acute toxicity is > 10%, the formula presented in A.1.3.6.1 of 29 CFR 1910.1200 is corrected to adjust for the percentage of the unknown ingredient(s) as follows:

$$\frac{100 - \left(\sum C_{unknown} \ if \ > 10\% \right)}{ATE_{mix}} = \sum_n \frac{C_i}{ATE_i}$$

Table 2: Acute toxicity by Inhalation Label Elements

Hazard Category	Signal Word and Hazard Statement	Pictogram
Category 1	Danger Fatal if inhaled	 Skull and Crossbones
Category 2	Danger Fatal if inhaled	 Skull and Crossbones
Category 3	Danger Toxic if inhaled	 Skull and Crossbones
Category 4	Warning Harmful if inhaled	 Exclamation Mark

To learn more…

- **OSHA: Hazard Communication:.** https://www.osha.gov/dsg/hazcom/index.html
  HCS 2012.

- SCHC site: http://www.schc.org/osha-alliance

Under the Occupational Safety and Health Act, employers are responsible for providing a safe and healthy workplace and workers have rights. OSHA can help answer questions or concerns from employers and workers. OSHA's On-site Consultation Program offers free and confidential advice to small and medium-sized businesses, with priority given to high-hazard worksites. For more information, contact your regional or area OSHA office, call 1-800-321-OSHA (6742), or visit www.osha.gov.