

# Acrolein

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## Hazard Summary

Acrolein is primarily used as an intermediate in the synthesis of acrylic acid and as a biocide. It may be formed from the breakdown of certain pollutants in outdoor air or from the burning of organic matter including tobacco, or fuels such as gasoline or oil. It is toxic to humans following inhalation, oral or dermal exposures. Acute (short-term) inhalation exposure may result in upper respiratory tract irritation and congestion. No information is available on its reproductive, developmental, or carcinogenic effects in humans, and the existing animal cancer data are considered inadequate to make a determination that acrolein is carcinogenic to humans.

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Please Note: The main sources of information for this fact sheet are EPA's Integrated Risk Information System (IRIS) (2), which contains information on the chronic toxicity of inhaled acrolein and the [RfC](#), and the Agency for Toxic Substances and Disease Registry's (ATSDR's) Toxicological Profile for Acrolein (1) which is the source of information on the acute toxicity and the [MRL](#).

## Uses

- The largest use for acrolein is as an intermediate in the synthesis of acrylic acid and as a biocide. (1)

## Sources and Potential Exposure

- Acrolein may be formed from the breakdown of certain pollutants found in outdoor air, from the burning of organic matter including tobacco, or from the burning of fuels such as gasoline or oil. (1)
- Airborne exposure to acrolein may occur by breathing contaminated air, by smoking tobacco or by being in the proximity of someone who is smoking, by being near vehicle exhaust, or by being near oil- or coal-fired power plants. (1)
- Occupational exposure to acrolein could occur in industries that use acrolein to make other chemicals. (1)
- Average concentrations of acrolein measured in the ambient air in the U.S. ranged from non-detect to 2.05 micrograms per cubic meter in 2006–2009. The range of concentrations for individual 24-hour measurements may be appreciably higher. (6)
- Small amounts of acrolein may be found in some foods, such as fried foods, cooking oils, and roasted coffee. (1)
- Acrolein has not been detected in drinking water, and is not commonly found in surface water. (1)

## Assessing Personal Exposure

- There are currently no simple tests available to determine personal exposure to acrolein. Acrolein or breakdown products of acrolein may be measured in blood or urine. (1)

## Health Hazard Information

### Acute Effects:

- Volunteers acutely exposed to increasing levels of acrolein for 10 to 60 minutes reported very slight eye irritation and "annoyance"/discomfort at 0.09 parts per million ([ppm], 0.2 milligrams per cubic meter), and nose/throat irritation and a decrease in respiratory rate at approximately 0.3 ppm (0.7 milligrams per cubic

meter).(1)

- The Agency for Toxic Substances and Disease Registry (ATSDR) has established an acute minimal reference level (MRL) of 0.003 ppm (0.007 milligrams per cubic meter) based on respiratory effects in humans. The ATSDR acute MRL is a daily human exposure concentration at or below which adverse health effects are not likely to occur given continuous (all day, every day) exposures of 1–14 days. MRLs are used by ATSDR health assessors and others as screening levels to identify and prioritize contaminants and potential health effects for further attention. MRLs are not intended to define clean up or action levels for ATSDR or other Agencies. (1)

#### Chronic Effects (Noncancer):

- The major effects from chronic (long-term) inhalation exposure to acrolein in humans and animals consist of general respiratory congestion and eye, nose, and throat irritation. (1,5)
- Acrolein is a strong dermal irritant with the eye being the most sensitive target for exposure. (1)
- Animal studies have reported that the respiratory system is the major target organ for acrolein toxicity. (1,2,5)
- The Reference Concentration (RfC) for acrolein is 0.00002 milligrams per cubic meter ( $\text{mg}/\text{m}^3$ ) based on squamous metaplasia and neutrophilic infiltration of nasal epithelium in rats. The RfC is an estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure to the human population (including sensitive subgroups) that is likely to be without appreciable risk of deleterious noncancer effects during a lifetime. It is not a direct estimator of risk but rather a reference point to gauge the potential effects. At exposures increasingly greater than the RfC, the potential for adverse health effects increases. Lifetime exposure above the RfC does not imply that an adverse health effect would necessarily occur. (2)
- The Reference Dose (RfD) for acrolein is 0.0005 mg/kg-day based on decreased survival following oral exposures in an animal study. The RfD is defined similarly to the RfC except that the exposure is oral rather than by inhalation. (2)

#### Reproductive/Developmental Effects:

- No information is available on the reproductive effects of acrolein in humans. (1)
- In available reproductive animal studies, rats exposed to 0.55 to 4 ppm (1.3 – 9.2 milligrams per cubic meter) of acrolein by inhalation, showed no effects on the number of pregnancies, the number and weights of the fetuses, or the overall reproductive fitness of the animals. (1)
- No studies were located regarding developmental effects in humans or animals after inhalation exposure to acrolein. (1)

#### Cancer Risk:

- The potential carcinogenicity of acrolein cannot be determined because existing data are inadequate for an assessment of human carcinogenic potential for either the oral or inhalation routes of exposure. (2)

## Physical Properties

- Acrolein is a clear or yellow liquid with a burned, sweet, pungent odor that most people may begin to smell at air concentrations around 0.25 ppm (0.6 milligrams per cubic meter).(1)
- The chemical formula for acrolein is  $\text{C}_3\text{H}_4\text{O}$  and the molecular weight is 56.06 g/mol. (1)
- The vapor pressure for acrolein is 274 mm Hg at 25 °C, and its log octanol/water partition coefficient ( $\log K_{ow}$ ) is -0.01. (1)

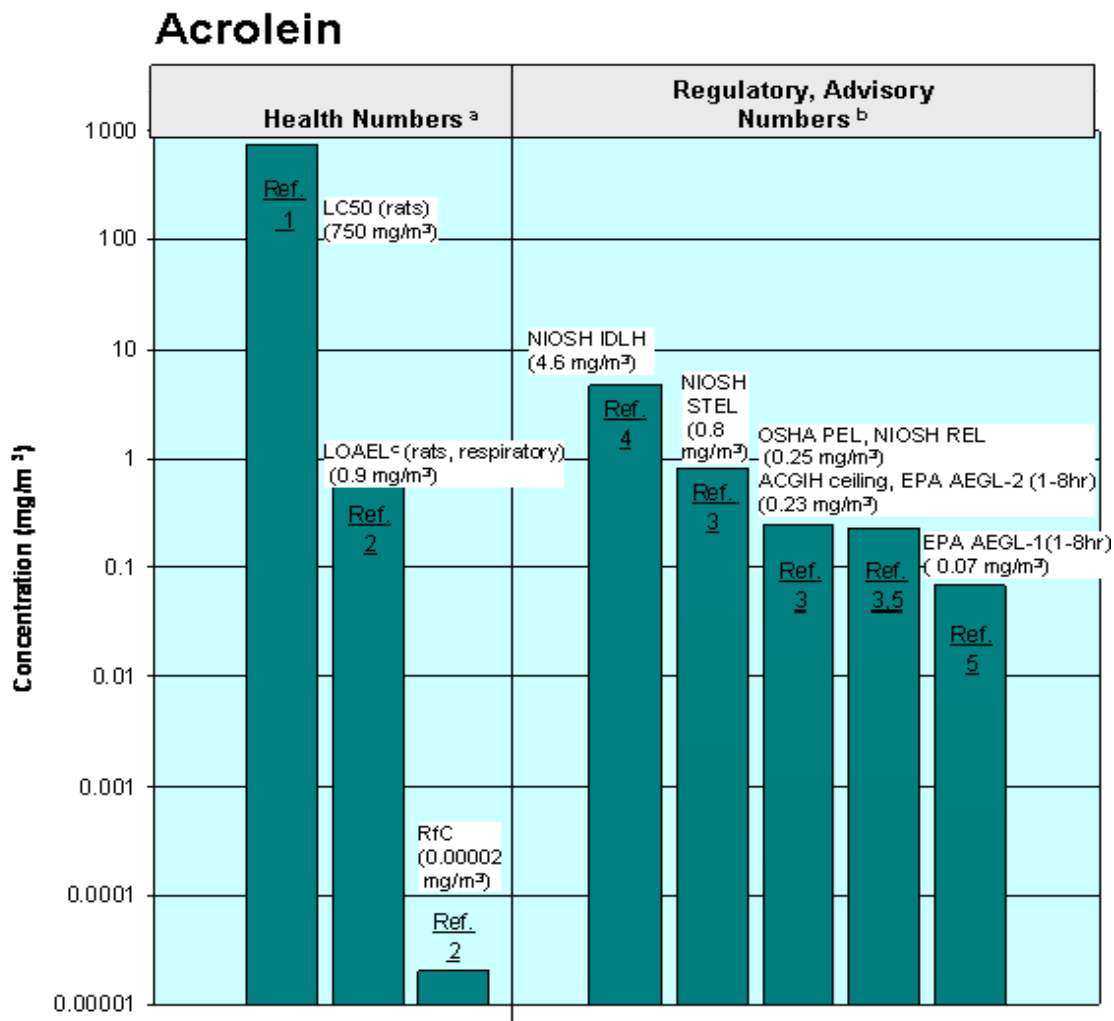
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#### Conversion Factors:

To convert concentrations in air (at 25°C) from ppm (parts per million) to  $\text{mg}/\text{m}^3$  (milligrams per cubic

meter):  $\text{mg}/\text{m}^3 = (\text{ppm}) \times (\text{molecular weight of the compound}) / (24.45)$ .  
 For acrolein:  $1 \text{ ppm} = 2.29 \text{ mg}/\text{m}^3$ .

## Health Data from Inhalation Exposure



<sup>a</sup> Health numbers are toxicological numbers from animal testing or risk assessment values developed by EPA and/or ATSDR.

<sup>b</sup> Regulatory numbers are values that have been incorporated in Government regulations, while advisory numbers are nonregulatory values provided by the Government or other groups as advice. OSHA numbers are regulatory, whereas NIOSH, ACGIH, and AIHA numbers are advisory.

<sup>c</sup> This LOAEL is from the critical study used as the basis for the RfC.

EPA AEGL--EPA's acute exposure guideline levels. AEGL-1 is the maximum airborne concentration above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic, non-sensory effects. AEGL-2 is the airborne concentration above which it is predicted that the general population, including susceptible individuals, could experience irreversible or serious, long-lasting adverse health effects or an impaired ability to escape exposure.

ACGIH ceiling--American Conference of Governmental and Industrial Hygienists' threshold limit value ceiling; the concentration of a substance that should not be exceeded during any part of the working exposure.

LC<sub>50</sub> (Lethal Concentration<sub>50</sub>)--A calculated concentration of a chemical in air to which exposure for a specific length of time is expected to cause death in 50% of a defined experimental animal population.

LOAEL--Lowest-observed-adverse-effect level.

RfC-- The RfC is an estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure to the human population (including sensitive subgroups) that is likely to be without appreciable risk of deleterious noncancer effects during a lifetime.

NIOSH IDLH--National Institute of Occupational Safety and Health's immediately dangerous to life or health limit; NIOSH recommended exposure limit to ensure that a worker can escape from an exposure condition that is likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from the environment.

NIOSH REL--NIOSH's recommended exposure limit; NIOSH recommended exposure limit for an 8- or 10-h time-weighted average exposure and/or ceiling.

NIOSH STEL--NIOSH's short term exposure limit; NIOSH recommended exposure limit for a 15-minute period.

OSHA PEL--Occupational Safety and Health Administration's permissible exposure limit expressed as a time-weighted average; the concentration of a substance to which most workers can be exposed without adverse effect averaged over a normal 8-h workday or a 40-h workweek.

This factsheet was updated in September 2009 with newer health and regulatory values.

Summary created in April 1992, updated in September 2009.

#### References

1. Agency for Toxic Substances and Disease Registry (ATSDR). *Toxicological Profile for Acrolein*. Public Health Service, U.S. Department of Health and Human Services, Atlanta, GA. 2007.
2. U.S. Environmental Protection Agency. *Integrated Risk Information System (IRIS) on Acrolein*. National Center for Environmental Assessment, Office of Research and Development, Washington, D.C. 2003.
3. American Conference of Governmental Industrial Hygienists (ACGIH). *Guide to Occupational Exposure Values*. Cincinnati, OH. 2009.
4. National Institute for Occupational Safety and Health (NIOSH). *Pocket Guide to Chemical Hazards*. U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention. Cincinnati, OH. 2005.
5. National Advisory Committee for Acute Exposure Guideline Levels for Hazardous Substances (NAC/AEG> Committee). 2006. *Acrolein. Interim Acute Exposure Guideline Levels*. For NAS/COT Subcommittee for AEGLs.
6. U.S. Environmental Protection Agency. Air Quality System (AQS) at <https://www.epa.gov/aqs/>.