



Service Life Characteristics of Air-Purifying Respirator Cartridges When Exposed to Glutaraldehyde Vapor

Worker exposure to glutaraldehyde should be maintained below the permissible exposure limit at all times (see 253-01442 The Importance of Adequate Ventilation with Glutaraldehyde). The use of respirators in conjunction with routine use of glutaraldehyde, however, is not generally necessary. If it is suspected that personnel are being overexposed to glutaraldehyde vapor, workplace vapor monitoring should be conducted (see 253-01438 An Evaluation of Four Personal Monitoring Methods for Glutaraldehyde in Ambient Air), and, if necessary, appropriate environmental controls should be employed. These controls include:

- Work practices that minimize exposures
- Enclosure or confinement of the operation
- Increased general ventilation
- Local exhaust ventilation

A respirator, however, may be necessary prior to implementation of environmental controls or in the event of a spill that could potentially result in overexposure to glutaraldehyde vapor. Personnel cleaning up a large spill should be trained and equipped with a certified air-purifying respirator containing an organic vapor cartridge, as well as splashproof monogoggles, gloves, and clothing impervious to glutaraldehyde (see 253-01443 Spills, Deactivation, and Disposal of Glutaraldehyde).

The canisters and cartridges used for atmosphere-supplying or air-purifying respirators must be changed before the end of their service life. Dow recommends that a change schedule for canisters and cartridges be implemented. If no end-of-service-life indicator (ESLI) is available, the schedule should be based on information or data that will ensure the canisters and cartridges are changed before the end of their service life.^{1,2}

Testing of half mask organic vapor respiratory cartridges under normal work conditions and exposure to 2.5 ppmv glutaraldehyde vapor indicate that all cartridges tested were resistant to breakthrough. Estimation of service life by service-life calculators suggests that under extreme conditions cartridges would be resistant to glutaraldehyde vapor breakthrough for several days.

Cartridge Testing

Estimation of Service Life Based on Laboratory Experimentation

Pairs of NIOSH-approved half mask organic vapor respiratory cartridges (North Safety N7500-1, MSA 451315, Scott 642 OV, and 3M 6001) were tested at 2.5 ppmv glutaraldehyde.³ This concentration of glutaraldehyde is 50 times higher than the ACGIH TLV of 0.05 ppmv, ceiling. The results of the respirator cartridge tests are summarized in Table 1.

Table 1 • Respirator cartridge life as determined by exposure of cartridge to glutaraldehyde vapor

Cartridge	Average GA Concentration (ppmv)	Flow Rate (L/min)	Temperature (°C)	Relative Humidity (%)	Time to 0.01 ppm Breakthrough (hrs)
North	2.5	30	25	50	>10
				80	>10
MSA	2.5	30	25	50	>10
				80	>10
Scott	2.5	30	25	50	>10
				80	>10
3M	2.5	30	25	50	>10
				80	>10

Estimation of Service Life Based on Cartridge Service Life Calculators

MSA and 3M have developed cartridge service life calculator software, which is available on their respective websites, and can be used to estimate the service life of cartridges in the presence of glutaraldehyde vapor⁴ (Table 2). OSHA has also developed a mathematical model (“Advisor Genius”) to predict the service life of an organic vapor respirator cartridge when used as protection against single contaminants.⁵

Table 2 • Respirator cartridge life data as determined by service life calculator software

Cartridge	Average GA Concentration (ppmv)	Flow Rate (L/min)	Temperature (°C)	Relative Humidity (%)	Time to 0.025 ppm Breakthrough (hrs)
MSA	2.5	30	25	80	497
		60			235
		85			158
3M	2.5	30	30	80	999
		60			976
		85			708

Recommendations

- Any of the four vapor cartridges tested (North Safety N7500-1, MSA 451315, Scott 642 OV, and 3M 6001) should be adequate for use in the presence of glutaraldehyde vapor. Environmental and user factors, however, must be considered, and a conservative approach should be used when evaluating service-life testing data. A safety factor should be applied to any estimate to account for uncertainty.
- Under normal conditions (25°C and 50% humidity), cartridges should be resistant to breakthrough of glutaraldehyde vapor for several days, even at glutaraldehyde vapor concentrations of 2.5 ppmv.

- Cartridge use should be logged after each exposure to vapor in order to assess the viability of a used cartridge.
- Cartridges subjected to extreme work conditions (high vapor concentration, humidity or temperature, or strenuous work rate) have a significantly shorter service life. Cartridges subjected to extreme conditions should be monitored carefully and frequently.
- Service-life predictions for cartridges subjected to multiple contaminants should be derived from the least well-adsorbed compound.
- The cartridge manufacturer should be consulted for specific instructions, information, and recommendations regarding the use of its cartridges with any chemical, including glutaraldehyde.

Notes

1. The OSHA respiratory protection standard **29 CFR 1910.134**, provides in part (paragraph (d)(3) (iii)) "For protection against gases and vapors, the employer shall provide:
 - (A) An atmosphere-supplying respirator, or
 - (B) An air-purifying respirator, provided that:
 - (1) The respirator is equipped with an end-of-service-life indicator (ESLI) certified by NIOSH for the contaminant; or
 - (2) If there is no ESLI appropriate for conditions in the employer's workplace, the employer implements a change schedule for canisters and cartridges that is based on objective information or data that will ensure that canisters and cartridges are changed before the end of their service life. The employer shall describe in the respirator program the information and data relied upon and the basis for the canister and cartridge change schedule and the basis for reliance on the data."

OSHA recognizes that much of this information is lacking for industrial chemicals. The respiratory protection standard requires that a respirator cartridge change-out schedule be developed from objective information or data, which will ensure that respirator cartridges are changed before the end of their service life.
2. American National Standard Institute (ANSI) Standard for Respiratory Protection, ANSI Z88.2-1992.
3. Respirator cartridge tests conducted by the Miller-Nelson research facility, 8 Harris Court, Suite C-6, Monterey, California, 93940-5713.
4. Internet addresses for MSA and 3M are, respectively, <http://www.msanet.com/safetyproducts/cartlife/msa.html> and <http://www.3m.com/market/safety/ohes2>.
5. "Advisor Genius" available at the Internet address: http://www.osha-slc.gov/SLTC/respiratory_advisor/advisor_genius_wood/advisor_genius.html.

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