

A claim would meet the presumption for solvent-related hearing loss if there is

(1) A diagnosis of sensorineural hearing loss

AND

(2) Significant solvent exposure defined as:

Work for at least 7 cumulative years in any of the job titles on list in current presumption, or in any construction or maintenance job.

OR

Reported exposure to styrene toluene, xylene, ethylbenzene TCE, carbon disulfide on OHQ, or evidence for exposure organic solvents in the SEM, for at least 7 years cumulative

OR

Reported exposures to solvent mixtures on OHQ, or evidence for sustained exposure to those solvent mixtures in the SEM, for at least 7 years cumulative

OR

Exposure for 7 years cumulative established through work history and DDWLP

Additionally, claims examiners should not routinely deny claims for solvent induced hearing loss if the worker has had fewer than 7 years of exposure, does not have a DDWL for task, or is not in a labor category on list. Claims that do not meet the requirements set forth here but do have reported exposure to organic solvents for at least 5 years cumulative should be sent for IH and/or CMC review.

Solvents and hearing loss: rationale for presumption

There is sufficient animal data, primarily from studies in rats, to conclude that several specific organic solvents cause hearing loss. Because of their metabolism, rats are considered comparatively good animal models for the investigation of the ototoxic properties of aromatic solvents in humans. Epidemiologic studies in humans exposed both to combined solvents as the individual solvents identified as ototoxic in rat studies; these confirmed the results of animal experiments, and found effects on hearing from combined solvents as well. The research supporting these statements is well summarized in a document produced collaboratively in 2010 by NIOSH and the Nordic Expert Group, which is a collaboration among the Institutes of Environmental and Occupational Health in Norway, Finland, Denmark, Iceland and Sweden (nordicexpertgroup.org).

In 2009, the European Agency for Safety and Health at Work produced a report looking specifically at the effects of combined exposures to noise and ototoxic substances, including interaction between organic solvents and noise, on hearing. This working group concluded that "Good evidence" (at least in animal studies) has been accumulated on the adverse effects on hearing of the following solvents: toluene, ethylbenzene, n-propyl-benzene, styrene and methyl styrenes, trichloroethylene, p-xylene, n-hexane, and carbon disulfide. In human studies health effects have found from solvent mixtures containing methyl-ethyl ketone and methyl-isobutyl-ketone as well. The EU Agency report also concluded that due to limitations in the

human studies, there are no clear data on dose-response relationships nor clear effects on auditory thresholds in humans.

Experiments with rats have shown that combined exposure to noise and solvents such as toluene, styrene, benzene, and trichloroethylene induced synergistic adverse effects on hearing. Even given the limitations the review found in the human epidemiologic studies, the report concluded "Overall, in combined exposure to noise and organic solvents, interactive effects may be observed depending on the parameters of noise (intensity, impulsiveness) and the solvent exposure concentrations. In case of concomitant exposures, solvents can exacerbate noise-induced impairments even though the noise intensity is below the permissible limit value." Although exposure to noise is not assessed by EEOICPA (noise is not a hazard covered by the statute), a significant proportion of the workers who qualify under this presumption will have had substantial noise exposure (see Dement reference below.)

These two reviews summarize many years of research, and allow us to conclude that hearing loss in humans can be attributed to a range of organic solvents. We can also conclude that it is likely that there is a synergistic effect between noise exposure at work and exposure to these solvents.

Animal experiments are generally done with one chemical at a time while human exposure is often to a mix of chemicals. Toluene, xylene, MEK, and MIBK are often present when a worker is exposed to a mixture of organic solvents. Therefore, it is reasonable to base a presumption on combined exposure to organic solvents rather than requiring evidence of exposure to one of the specific solvents studied in animal experiments.

As noted above there is limited information on which to base an assessment of toxic dose in humans. At least one study of human exposures to toluene showed hearing loss at levels of 50 ppm for 7 years, with one other study showing effects after 5 years of exposure. For styrene one study showed health effects with a mean exposure at 14 ppm over working lifetime. Since many of the studies looked at populations with long-term exposure solvents these numbers should not be considered a threshold below which there is no harm from solvents.

Based on the limited human data a presumption that requires at least 7 years of cumulative exposure to organic solvents is reasonable. Since health effects have been reported at levels well below the current OSHA PEL of 200 ppm, exposures occurring now could be still injurious if continued over many years.

References:

Campo-P; Morata-TC; Hong-O. Chemical exposure and hearing loss. *Dis Mon* 2013 Apr; 59(4):119-138 <http://dx.doi.org/10.1016/j.disamonth.2013.01.003>

Dement J, Ringen K, Welch L, Bingham E, Quinn P. Surveillance of hearing loss among older construction and trade workers at Department of Energy nuclear sites. *Am J Ind Med.* 2005 Nov;48(5):348-58.

EU-OSHA – European Agency for Safety and Health at Work 2009. Combined exposure to Noise and Ototoxic Substances. Authors: Pierre Campo, Katy Maguin, Stefan Gabriel, Angela Möller, Eberhard Nies, María Dolores Solé Gómez, Esko Toppila

<https://osha.europa.eu/en/.../combined-exposure-to-noise-and-ototoxic-substances>

Nordic Expert Group, 2010. Authors Johnson, Ann-Christin

Morata, Thais C. Occupational exposure to chemicals and hearing impairment

<http://hdl.handle.net/2077/23240>