Effectiveness in Disease and Injury Prevention

Control of Excessive Lead Exposure in Radiator Repair Workers

In 1988, 83 automotive repair workers with blood lead levels (BLLs) >25 μg/dL were reported to state health departments in the seven states* that collaborated with CDC's National Institute for Occupational Safety and Health (NIOSH) in maintaining registries of elevated BLLs in adults. In 18 (22%) of these 83 persons, BLLs were >50 μg/dL[†]. Among automotive repair workers for whom a job category was specified, radiator repair work was the principal source of lead exposure. The major sources of exposure for radiator repair workers are lead fumes generated during soldering and lead dust produced during radiator cleaning (*2*). This report summarizes current BLL surveillance data for radiator repair workers and describes three control technologies that are effective in reducing lead exposures in radiator repair shops.

Airborne lead levels as high as 500 μg/m^3 (10 times greater than the Occupational Safety and Health Administration [OSHA] permissible exposure limit [PEL] of 50 μg/m^3) have been reported in small radiator repair shops (*3*). Engineering controls in such facilities typically consist of wall- or roof-mounted propeller fans, which provide general area ventilation, or electrostatic precipitators suspended from the ceiling, which remove airborne particulates (*2*). However, neither method reduces worker lead exposures to levels below the OSHA PEL. In 1989, to meet the need for effective engineering controls in radiator repair shops, NIOSH researchers studied three exhaust-ventilation control systems for radiator shops. Each of the three local control systems effectively reduced radiator repair workers' lead exposures to levels substantially below the OSHA PEL. The performance of each control system was documented by collecting personal breathing-zone samples for lead and by measuring local exhaust-ventilation system airflow capacities.

Ventilated Enclosure

An enclosure resembling a laboratory hood surrounds the workstation (*4*). The enclosure's walls are curtains of silicone-coated fibrous glass cloth, which have a temperature rating of 1000 F (538 C), cannot be set on fire by a mechanic's torches, and will not corrode. The curtains are suspended from the building's ceiling and extend to the top outer edges of a water bath (used to leak-test radiators). The ceiling forms the top of the enclosure; the back wall of the building, which has a propeller exhaust fan, forms the rear wall. A 3-foot by 3-foot opening in the front of the enclosure permits the mechanic access to repair the radiator, which remains within the enclosure. The fan exhausts air at a rate of 2000 cubic feet per minute (cfm), producing an air flow of 200 feet per minute (fpm) through the enclosure opening.

The approximate cost of the enclosure was $1000 (1990 dollars), which included structural materials, installation, and a wall-mounted axial fan with motor. During the study of this system, lead exposures for the radiator repair worker using the ventilated enclosure averaged 9.9 μg/m^3. Comparison personal breathing-zone sam-

*California, Colorado, Maryland, New Jersey, New York, Texas, and Wisconsin.

†Under the Occupational Safety and Health Administration lead standard, BLLs exceeding an average of 50 μg/dL on three separate occasions in a 6-month period require medical removal of the employee from the workplace (*1*).

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ples obtained from a radiator repair mechanic in the same shop who worked at an identical workstation without ventilation control averaged 453 μg/m³.

Movable Exhaust Hood

A canopy-shaped exhaust hood with a 24-inch by 36-inch opening is connected to an 8-inch diameter flexible duct that permits the hood to be moved directly to the work that generates lead fume. The face velocity at the hood opening is approximately 100 fpm. The cost of the hood and duct work for each workstation was $1000 (1990 dollars). Lead exposures for the busiest mechanic averaged 12 μg/m³. In comparison, personal sampling data collected at this shop by the Virginia Occupational Safety and Health Department before the exhaust hood installation found time-weighted average lead exposures for workers at levels as high as 193 μg/m³ (R.D. Mitchell, Virginia Occupational Safety and Health Department, personal communication, December 20, 1988).

Ventilated Booth

A shop owner, using design information provided by NIOSH, relocated the shop's two existing radiator repair benches against an outside wall and enclosed them in a booth. Cement-block walls form the sides, a welding curtain encloses the top of the booth, and a strip of plastic across the bottom 3 feet of the front of the booth creates a front opening 11.5 feet wide by 4 feet high. An axial, belt-driven fan (exhaust capacity 14,000 cfm) was installed in the outside wall at the rear of the booth, which produced a 250 fpm face velocity airflow through the front opening. The cost of the control system, including materials and labor, for two workstations was approximately $2200 (1990 dollars); this included a set of high-intensity lights costing $250. The average lead exposure for radiator repair workers using this system was 9 μg/m³, a reduction of 91% compared with an average lead exposure of 98 μg/m³ (range: 30–220 μg/m³) measured during a NIOSH health hazard evaluation conducted before installation of the control (*5*).

Reported by: A Miller, MD, Occupational Health and Safety Center, Univ of Illinois at Chicago. Div of Physical Sciences and Engineering, Div of Surveillance, Hazard Evaluations, and Field Studies, National Institute for Occupational Safety and Health, CDC.

Editorial Note: The manifestations of symptomatic lead poisoning (convulsions, coma, neuropathy, nephropathy, anemia, and abdominal colic) generally occur at BLLs >80 μg/dL. Adverse health effects at lower BLLs include inhibition of heme production, peripheral neuropathy, male and female reproductive dysfunction, and hypertension (*6*). In occupational settings, absorption of lead results primarily from exposure to lead dust and fumes. Data from the National Occupational Exposure Survey, conducted during 1981–1983, indicated that approximately 827,000 U.S. workers have potential work-related exposure to lead (excluding those with exposure to lead in gasoline) (*7*). Workplace exposure also has been described as a vector for childhood and community lead exposure through contamination of work clothing (*8*).

Current estimates indicate that approximately 435,000 workers are employed in the automotive repair industry (*9*); an estimated 40,000 are involved specifically in radiator repair work, with an average of four workers in each shop (W.H. Juchno, National Automotive Radiator Service Association, personal communication, March 15, 1990). Studies in a variety of settings indicate that lead exposure is substantial in these workers. For example, in Finland, the mean BLL in 56 radiator repair workers was 38 μg/dL, which represented the sixth highest value among 30 occupational categories (*10*). NIOSH health hazard evaluations conducted from 1979

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through 1990 at radiator repair shops in California, Colorado, and Georgia found that, among 46 radiator repair workers, 68% had lead exposures exceeding the OSHA PEL, 83% had BLLs ≥30 µg/dL, and 26% had BLLS ≥50 µg/dL. Finally, among 56 radiator repair mechanics in the Boston area, 80% had BLLs >30 µg/dL, and 16% had BLLs >50 µg/dL (*2*).

By applying representative BLL findings from these studies to the estimated 40,000 U.S. radiator workers, BLLs in approximately 32,000 (80%) workers exceed 30 µg/dL, BLLs in 16,000 (40%) exceed 40 µg/dL, and BLLs in 8400 (21%) exceed 50 µg/dL. Based on this approach, the 83 cases of elevated BLLs reported to the seven state health departments in 1988 represent a substantial underestimation of the prevalence of this condition.

In general, environmental monitoring and medical surveillance for lead exposure in radiator repair workers is inadequate. For example, in California in 1986, only 1.4% of these workers were employed in positions where environmental monitoring was ever done; only 7.9% of the surveyed radiator repair shops performed any routine biologic monitoring (*11*). Inadequate medical surveillance of these workers can result in substantial underestimation of the number of workers at risk for lead toxicity and further underscores the need for both improved monitoring and effective engineering controls to protect the health of these workers. The three economic and effective ventilation control systems described in this report have potential for widespread application in relatively small radiator shops that lack resources for purchase of elaborate ventilation systems.[§]

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[§]To obtain the latest reports on engineering controls for radiator repair shops, contact John W. Sheehy, NIOSH, CDC, Mailstop R-5, 4676 Columbia Parkway, Cincinnati, OH 45226; telephone (513) 841-4221.

CENTERS FOR DISEASE CONTROL

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Epidemiologic Notes and Reports

Transmission of Multidrug-Resistant Tuberculosis from an HIV-Positive Client in a Residential Substance-Abuse Treatment Facility — Michigan

In November 1989, a man with a history of intravenous (IV)-drug use first presented to the tuberculosis (TB) clinic of the Muskegon County (Michigan) Health Department (MCHD). The patient indicated that he had been treated for pulmonary TB in another city, and he produced for clinic staff his labeled medications, which included isoniazid (INH), rifampin (RIF), and ethambutol (EMB). The patient also stated that he was an IV-drug user (IVDU) and previously had tested positive for human immunodeficiency virus (HIV) infection. Sputum specimens for acid-fast bacilli (AFB) were obtained, and the patient was maintained on his anti-TB medications. His HIV-antibody status was confirmed.

The patient was living in a residential substance-abuse treatment facility in Michigan after moving from a large northeastern city. This treatment facility recruits persons from the northeast who have a history of IV-drug use and offers them a prescribed rehabilitation program of 1 year's duration; however, the facility's attrition rate is high, and no health screening program is in place at the facility.

One week after the initial visit, one of the sputum specimens was reported smear-positive for AFB. A follow-up chest radiograph of the patient revealed a pulmonary infiltrate with a cavitary lesion. Three weeks later, culture of the sputum specimen yielded *Mycobacterium tuberculosis* resistant to INH, RIF, and EMB. Subsequently, the patient's prior medical records arrived at the TB clinic, confirming his HIV status and his treatment for TB since March 1988; these records also indicated that *M. tuberculosis* isolated from his sputum previously had been resistant to INH. Because the patient could not be properly isolated in the residential facility, he was transferred to a hospital.

Because of concerns regarding the potential for TB transmission in the residential facility, the MCHD conducted a TB contact investigation in the facility. Its rehabilitation program involves close interaction among clients and staff. Clients are housed in a two-story building that contains several large, crowded dormitories for sleeping. Ventilation is provided by opening windows and doors, rather than through a central system, and heat is provided by steam radiators.