

and ambient and GM WPF by respirator brand, and particle size distribution by job category. The authors stated that “* * * half-facepiece respirators (maximum use concentration 10 times the PEL) were a suitable selection for the tasks included in this study.”

Study 9. In January 1993, W.R. Meyers and Z. Zhuang reported on the third part of their investigation, in which they determined protection against exposure to particulate titanium (Ti), chromium (Cr), strontium (Sr) and total ambient mass (TAM) for 22 workers who spray painted aircraft on day, evening, and night shifts (Ex. 1–64–52). The three brands of half-mask elastomeric respirators studied were the: American Optical 5-Star, MSA Comfo II, and Scott Model 65. All respirators were equipped with combination high-efficiency filter/organic vapor cartridges.

Twelve participants each wore two brands of respirator with a WPF determined for each brand worn; nine participants wore one brand of respirator and had one WPF determined; and one employee had one WPF determined for one respirator brand and two WPFs determined for another brand. The participants were quantitatively fit tested and a fit factor of 100 or more constituted a pass. The overall study and sampling protocol was discussed by the authors in the foundry portion of the studies, summarized in Study 7 above (Ex. 1–64–51). While not specifically discussed, it is assumed that the same sampling parameters were in place during this particular study as in the foundry study, unless the authors stated otherwise. These assumptions include: composition of the sampling trains was unchanged; individual WPFs were based on monitoring times of one to four hours; elastomeric facepieces were cleaned and inspected at the end of each shift but were not the inside was not wiped during the shift, unless such wiping was the employer's standard practice before the study; filters and disposable respirators were changed at the end of each shift unless the employer's policy dictated more frequent changing; and the mouth of the in-mask probe was plugged whenever the respirator was not being worn. In addition, it is assumed that the participants were clean-shaven, normally used respirators, were trained in the proper donning and adjustment of the respirators, were instructed not to remove or lift the respirator from their face in the work area, and were observed by the researchers throughout the sampling period.

The inside-the-facepiece sampling train was a closed-face 25 mm cassette containing a 0.5 micron pore size

polyethylene filter and polypropylene backup pad. A reducing ring under the filter restricted airflow to an 18 mm circle in the center of the filter to aid in sample analysis. A heating bonnet was slid over the outside of the cassette to minimize condensation of moisture from exhaled breath. This cassette was attached directly to a flared mouth probe, inserted into the respirator opposite the mouth. Sampled air was then drawn through a moisture trap using a personal sampling pump operating at approximately 2 Lpm. The outside-the-facepiece sampling train was a closed-face 25 mm cassette containing a 0.5 micron pore size polyethylene filter and polypropylene backup pad. A reducing ring under the filter restricted airflow to an 18 mm circle in the center of the filter. The cassette was not connected to a flared mouth probe. This sampling train was attached in the lapel area, and samples were collected at a flow rate of 1 Lpm. (**Note:** Unlike the foundry portion of the study, outside samples were collected as total mass rather than respirable mass samples.) Sampling pump flows were calibrated before and after each sampling period and pumps were monitored at approximately 15–20 minute intervals. Respirators were donned and doffed, and sampling trains were started and stopped, in a clean area. New cassettes were used for each sampling period. Working (*i.e.*, field) blanks and manufacturer's (media) blanks were used to determine possible contamination of filters due to handling or manufacturing. The investigators did not wash the interior of the sampling cassettes to determine retention of particles on the cassette wall, since a simple alcohol wash would not have removed dried paint spray. Ambient particle size distributions were not characterized.

Analysis of all filters was by proton induced X-ray emission analysis (PIXEA). The average field blank mass loading was used as a correction factor for estimating background contamination. The authors did not mention adjusting inside-the-facepiece measured values for particle retention in the respiratory tract. A total of 36 individual pairs of inside-the-facepiece and outside-the-facepiece concentrations of each analyte (total airborne mass, titanium, chromium, strontium) were provided by shift and date, painting location on the plane (*i.e.*, top, side, or underside of the aircraft), employee, brand of respirator, and paint type (*i.e.*, top coat, primer). A total of 36 WPFs were reported by shift, task location on the plane, employee, and

respirator brand; of the original 38 data sets, two sets were eliminated as outliers. For primer spraying, the reported WPFs were based on Cr data, while WPFs for spraying topcoat were based on Ti data. WPFs were not calculated for total airborne mass. The authors also provided data and discussion on a number of sampling analyses, including GM concentration of analyte (TAM, Ti, Cr) for both in-mask and ambient measurements by task location on the plane; GM WPF as a function of painting location on plane and paint type, and respirator brand; and GM WPF by respirator brand. The fifth percentile estimates for all WPF data were reported to be much greater than 10. The authors concluded that these half-facepiece elastomeric respirators, when properly worn and used in conjunction with existing controls provided effective worker protection.

Study 13. G. Wallis, R. Menke, and C. Chelton reported in 1993 on a WPF study in which they evaluated exposure to manganese dioxide dust for an unknown number of participants in several alkaline battery manufacturing plants (number of plants not provided) (Ex. 1–64–70). All participants wore the disposable 3M 8710 dust/mist respirator and performed their normal work activities. The participants were not trained by the investigators, but had been previously trained and routinely used respirators. It was not stated whether the participants had ever been fit tested for the 3M 8710 respirators. Prior to sampling, the participants washed their faces and were taken to a clean area, where the study was explained. The participants were observed throughout the sampling period.

The inside-the-facepiece sampling train was a closed-face 37 mm cassette containing a 0.8 micron pore size mixed cellulose ester filter. The cassette was connected to a tapered Liu probe (made of nylon) which was inserted into the respirator midway between the nose and mouth. The outside-the-facepiece sampling train was a closed-face 37 mm cassette containing a 0.8 micron pore size mixed cellulose ester filter. The outside sampling cassette was attached to the employee's lapel. No mention is made of connection of the outside cassette to a tapered Liu probe. Inside- and outside-the-facepiece samples were collected at an airflow rate of 1.5 Lpm for 30 to 40 minutes. The authors chose a short sampling interval to prevent resistance across the inside-the-facepiece sampling filter due to a buildup of moisture from exhaled breath. Sampling pump flows were