

## **A state of the science review of the potential health hazards associated with asbestos in shielded metal arc welding rods in the United States.**

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Due to its unique chemical properties, chrysotile asbestos was historically incorporated into a wide variety of products, including the outer covering, or “flux” of certain classifications of general arc mild steel welding electrodes. The purpose of this analysis is to review the historical engineering, toxicology, regulatory, and epidemiology information relevant to asbestos in mild steel welding rods in order to assess whether mild steel welders are at increased risk of developing asbestos-related diseases as a result of welding rod use. We divided our analysis into four distinct time periods, based on what we perceived to be seminal events in welding technology or in the evolution of knowledge regarding asbestos and asbestos-related diseases. These time periods are as follows: late 1800s to 1929, 1930–1955, 1956–1970, and 1971–2006. We found that studies that attempted to measure airborne asbestos directly in welding rod fumes found no measurable fibers; this is likely due to the fact that the fibers degrade at high temperatures present in the welding arc. In addition, “worst-case” use simulation studies, specifically intended to generate airborne flux particles, reported that airborne asbestos concentrations were either undetectable or very low. The airborne concentrations generated were always below the current OSHA permissible exposure limit (0.1 f/cc TWA), and the lifetime doses associated with “worst-case” use were found to be far below the plausible thresholds for mesothelioma and lung cancer. The epidemiology of mild steel welders is difficult to interpret due to confounding exposures such as (1) possible exposure to nickel and hexavalent chromium in stainless steel welding fumes (lung cancer), (2) smoking (lung cancer), and (3) bystander exposure to amphibole asbestos (lung cancer and mesothelioma). None of the published welder studies controlled for all three factors, yet when any single source of bias was controlled for, the majority of the studies reported no significant risk in either asbestos-related disease. Furthermore, none of the investigators in any of the welder studies suggested that asbestos in welding rods might be a risk factor for lung cancer or mesothelioma, and there is not a single case report in the medical literature that attempts to link welding rod use to an asbestos-related disease. We conclude that the weight of evidence indicates that welders were not historically at risk of developing asbestos-related diseases as a result of welding rod use.

Keywords: asbestos; welding; chrysotile; state-of-the-art