

# Metal Fume Fever

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Metal fume fever is an occupational hazard in metal-working industries.

**M**etal fume fever (MFF) is a benign, self-limited syndrome resulting from deposition of fine metal particulates in the alveoli. First reported more than 150 years ago in connection with brass foundry work, MFF is primarily associated with the inhalation of zinc oxide fumes produced when zinc-coated (galvanized) steel or zinc-containing alloys (brass) are heated to high temperatures. MFF has also been called copper fever, brazier's disease, welder's ague, foundry fever, brass chills, and spelter shakes.

MFF is an occupational hazard for those employed in a wide range of metal-working occupations, although welders are most commonly affected. An estimated one in five welders has experienced MFF by age 30, primarily due to working with galvanized steel (Keyes, 2004). Cutting, metallizing, melting, forging, casting, soldering, and brazing are associated with metal fume exposure and MFF from exposure to zinc oxide fumes. Working in closed spaces with poor ventilation, speed of metal cutting and arc (welding) time, and increasing thickness of metal in cutting operations all increase workers' exposure to metal fumes.

Zinc oxide dust is considered relatively benign, whereas zinc oxide fume is considered more hazardous. This is due, in part, to the size difference between the dust and the tiny (most < 1  $\mu\text{m}$ ) particles produced during welding. Fumes are produced when metal evaporates due to high heat and then condenses into small particles in the ambient air. It is unknown whether fresh formation of zinc oxide is important in causing MFF. Concern exists that zinc oxide nanoparticles being cur-

rently produced may, if inhaled, cause MFF.

Due to overlapping presenting symptoms, MFF can be mistaken for atypical or community-acquired pneumonia, influenza, and acute malarial illness. No specific laboratory or physical findings establish the diagnosis. Timely and accurate diagnosis is dependent on a thorough occupational history.

MFF is almost indistinguishable from other inhalation fevers, with the exception of the metallic taste some affected individuals may complain of and the history of welding with zinc or galvanized materials. Cadmium inhalation (sometimes incorrectly referred to as cadmium fume fever) can also be accompanied by fever; however, unlike MFF, lung injury does not resolve spontaneously and is progressive and often fatal. Cadmium inhalation should be considered when the history reveals welding or flame cutting of cadmium-containing alloys or brazing of tungsten carbide tool tips with cadmium silver alloy (Blanc, 2007).

A prodrome often precedes the onset of constitutional symptoms in MFF. Workers may notice a sweet or metallic taste in their mouth, thirst, or dry throat. MFF typically presents with fever and myalgia and may be accompanied by headache and nausea. Symptoms typically occur 4 to 12 hours after exposure to metal fumes. Body temperature may reach 40°C and may be followed by profuse diaphoresis and rigorous shakes. Workers may complain of chest tightness and nonproductive cough, with mild to moderate dyspnea. Physical examination may reveal pleural friction rub, rales, and wheezing. Tachycardia, bradycardia, and a macular rash are rare. Symptoms generally last only 1 to 3 hours. Severe cases of MFF generally resolve within 24 to 48 hours.

Transient leukocytosis, which may reach 15,000 to 20,000 cells/mm<sup>3</sup>, may occur with MFF. Erythrocyte sedimentation rate may be elevated. Arterial blood

gas analysis shows hypoxemia. Elevated urinary or serum zinc levels may be present; however, absence of the latter does not rule out the diagnosis of MFF.

In some individuals with respiratory symptoms, radiographic changes consistent with pneumonitis, abnormalities of diffusion, and obstructive and restrictive defects have also been reported. However, chest x-ray and pulmonary function testing usually yield normal results (Schwartz, 2005).

Clinical management primarily involves exposure termination, administration of oxygen by mask, antipyretic therapy, fluids, rest, and supportive care. In more severe cases, aggressive management may be required to treat bronchospasm and wheezing. Depending on severity, monitoring is generally recommended for 24 hours following the acute episode.

No chronic sequelae result from repeated exposures. Tachyphylaxis has been observed in some metal workers who are repeatedly exposed to zinc oxide fumes. However, these workers may rapidly lose tolerance. Workers may experience more pronounced MFF after a brief period of nonexposure (e.g., a weekend off) and subsequent re-exposure. This phenomenon is termed Monday morning fever.

MFF can be prevented with training, safe work practices, specially designed engineering controls (e.g., built-in fume extractors on welding machines or tables with built-in local exhaust ventilation), and personal protective equipment (e.g., air-purifying respirators built into welding helmets).

## REFERENCES

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