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### Keywords

Allergic contact dermatitis · Erythema · Irritant reactions · Skin cancer · UV radiation

## 1 Core Messages

- Welding is a technique used for joining metal parts usually through the application of heat.
- Since classical antiquity, smiths have used forge welding, and this technique is known from the earliest uses of iron.
- Nowadays, there are several types of welding techniques, but only a few of them are currently in use to a greater extent. In metal

welding, heat could be generated by gas or electricity. Heating is done to a suitable temperature, and welding could be done with or without the application of pressure and with or without filler material.

- In gas welding, heat is supplied mostly by burning acetylene in oxygen. Gas welding is nowadays mostly used for small repairs and by, for example, artists.
- In resistance welding, the required heat for joining is generated by the interface by the electrical resistance of the joint. Spot, seam, and projection welding are resistance welding, and they are used in car industries and when making household appliances.
- Arc welding is a group of welding processes which produces coalescence of metals by heating them with an arc, with or without application of pressure or filler material. Shielded metal arc welding is the most used welding process today. In gas-shielded arc welding, the arc is shielded from the air mostly by an inert gas such as helium or argon. Tungsten could be used as the electrode, and it is used when welding with, for example, stainless steel.

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- Welding fluxes are used to prevent, dissolve, or facilitate removal of oxides and other undesirable surface substances. Welding rod is a form of filler metal used, which does not conduct the electrical current. Welding alloys may be aluminum powder with iron oxide, nickel, manganese, or steel.

Welding generates ultraviolet (UV) radiation mainly within the UVC region as well as infrared radiation (Okuno 1987). Welders are usually well protected against UV radiation and heat, but unintentional exposure often occurs. The most frequent skin disorder when welding is localized cutaneous erythema and small scars (Emmett and Horstman 1976) (Emmett et al. 1981). Usually, such an erythema does not cause any problems and the cause is obvious to the welder. Spot welding without proper protection may result in severe facial photodermatitis (Shehade et al. 1987). Polymorphous light eruption (PMLE) in welders has also been described (Majoie et al. 2010).

A white textile hood that was used as a protective equipment was reported to reflect UV radiation and cause erythema, and in this case the cause of the erythema at first was a mystery (Bruze et al. 1994). UVC-induced exacerbation of atopic dermatitis in a welder has been described (Elsner and Hassam 1996). In welders, chronic discoid lupus erythematosus is a possible occupational disease (Wozniak 1971), and in “dermatitis electrogenica chronica,” the histology resembles lupus erythematosus (Von Balbanow et al. 1967). A connection between scleroderma and welding has been discussed (Fessel 1977). Keratoconjunctivitis and cataracts from exposure to ultraviolet radiation are well known among welders (Emmett et al. 1981; Zamanian et al. 2015).

There may also be an increased risk of non-melanoma skin cancer (NMSC) in welders (Currie and Monk 2000; Dixon 2007). Welding has also been reported to be a risk factor for uveal melanoma (Nayman et al. 2017).

Burns among welders are most frequently caused by flying sparks leaving pea- to bean-sized scars (Eun et al. 1984).

A variety of toxic fumes including ozone, nitrogen dioxide, and carbon monoxide are generated by welding. Also, the coated rods or fluxes used in welding can release, for example, fluorides, manganese oxides, zinc oxides, lead oxides, and cadmium oxides (Bringham and Landringan 1985). Fumes from welding of chromium steel alloys may contain chromium oxide and may cause allergic contact dermatitis (Fregert and Övrum 1963; Shelley 1964; Zugerman 1982). Allergic contact dermatitis from copper, on the hands, has been reported in a welder holding the welding mouthpiece consisting of brass and a copper-covered welding wire in the hand (Förström et al. 1977).

Occupational siderosis, tattooing with iron particles, was observed in employees working with spot welding in an automobile factory (Jirasek 1979).

Occupational asthma due to stainless steel welding has also been reported (Keskinen et al. 1980).

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#### *Irritants*

Abrasives

Fluxes

Heat

Metal particles

Ultraviolet radiation

#### *Standard allergens*

Potassium dichromate, 0.5% pet

Cobalt chloride, 0.5% pet

Nickel sulfate, 5% pet

#### *Additional allergens*

Copper sulfate, 2% pet

Aluminum chloride hexahydrate, 10% pet (Bruze et al. 2008)

Protective equipment

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