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Welding Safety

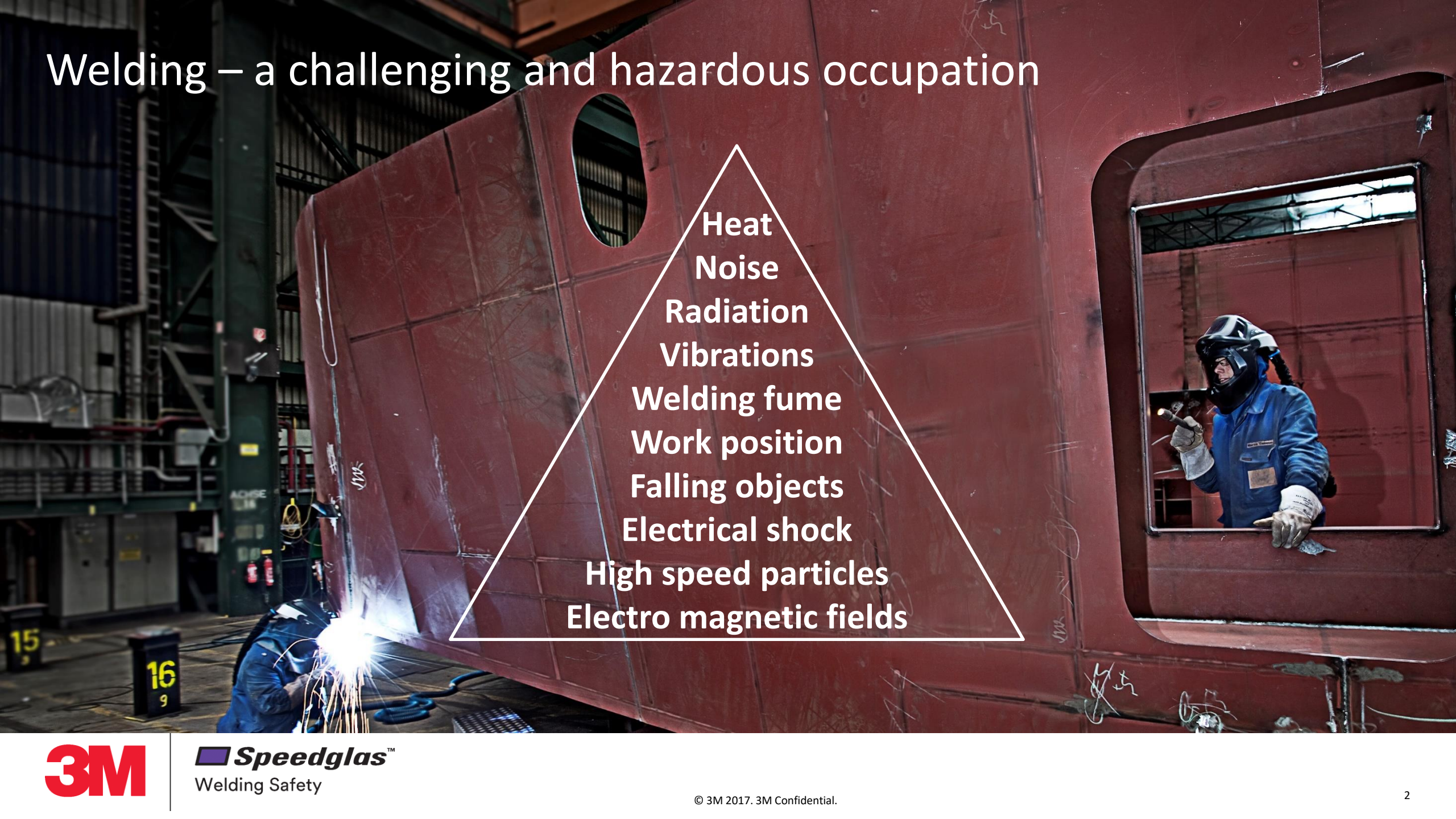
One of the most Dangerous jobs in the world?

Carina Haglund

3M Science. Applied to Life.™



Welding – a challenging and hazardous occupation



Heat
Noise
Radiation
Vibrations
Welding fume
Work position
Falling objects
Electrical shock
High speed particles
Electro magnetic fields



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Eye hazards in welding applications

Radiation

- Ultraviolet
- Bright visible light
- Infrared

Mechanical hazards

- Molten metal
- Chipping slag
- High speed particles



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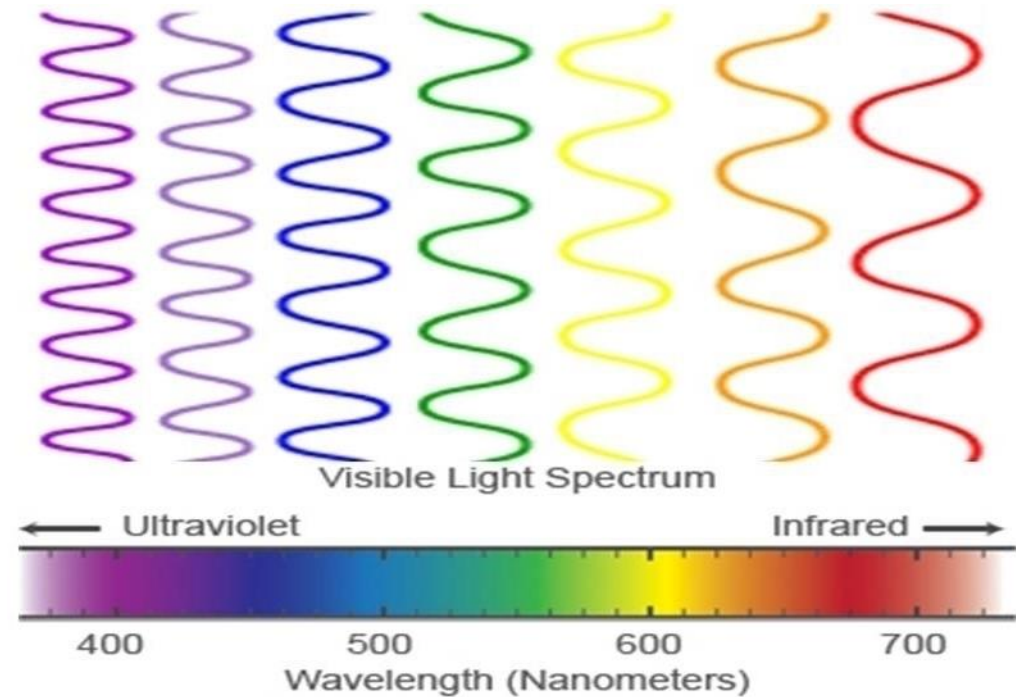
Light Spectrum

- Light is measured in Wavelengths
- Our interest is wavelengths UV to IR

Ultraviolet less than 380 nm

Visible 380 nm to 780 nm

Infrared higher than 780 nm



Eyes

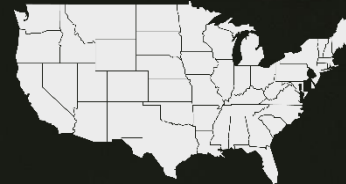
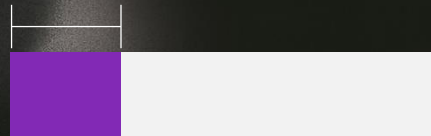
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There are no second chances
when it comes to your eyes

FACTS:

1/4

of all welding
injuries is of the eye



Costs associated with
workplace eye injuries:

\$300M/yr



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Symptoms when overexposed to radiation

Ultraviolet

Short term

- Itchy eyes
- Tearing eyes
- Arc eye, feels like sand in the eyes

Long term

- Cataract
- Malignant melanoma

Visible

Short term

- Spot blindness
- Blood shot
- Heacache

Long term

- Macula degeneration
- Retinal injuries

Infrared

Short term

- Dry eyes
- Tearing eyes
- Itchy eyes
- Headache

Long term

- Cataract



Where and when?

Ultraviolet

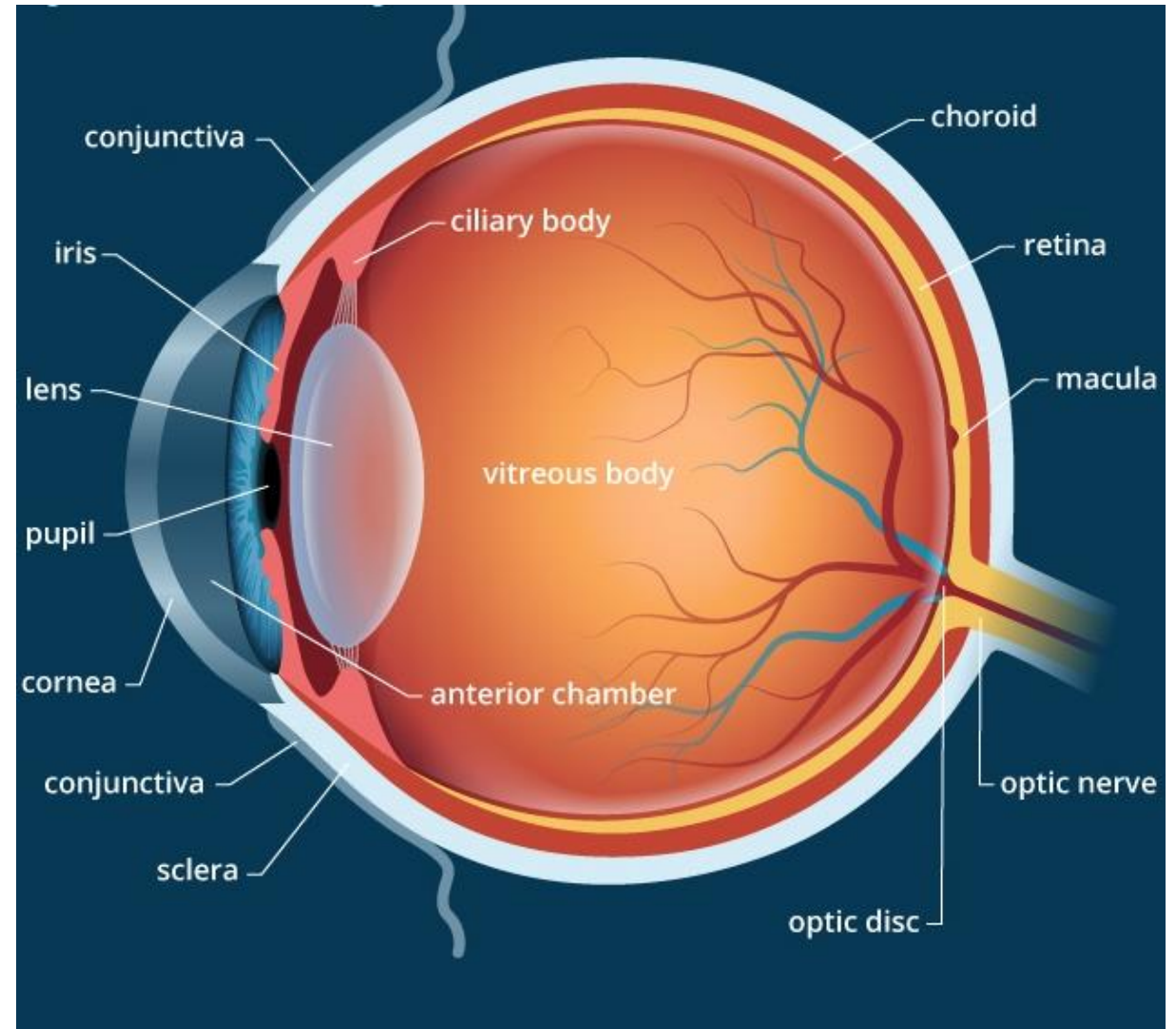
Happens very quickly – in milliseconds
Damage is immediate and accumulative
Usually to Cornea but on long term also to lens

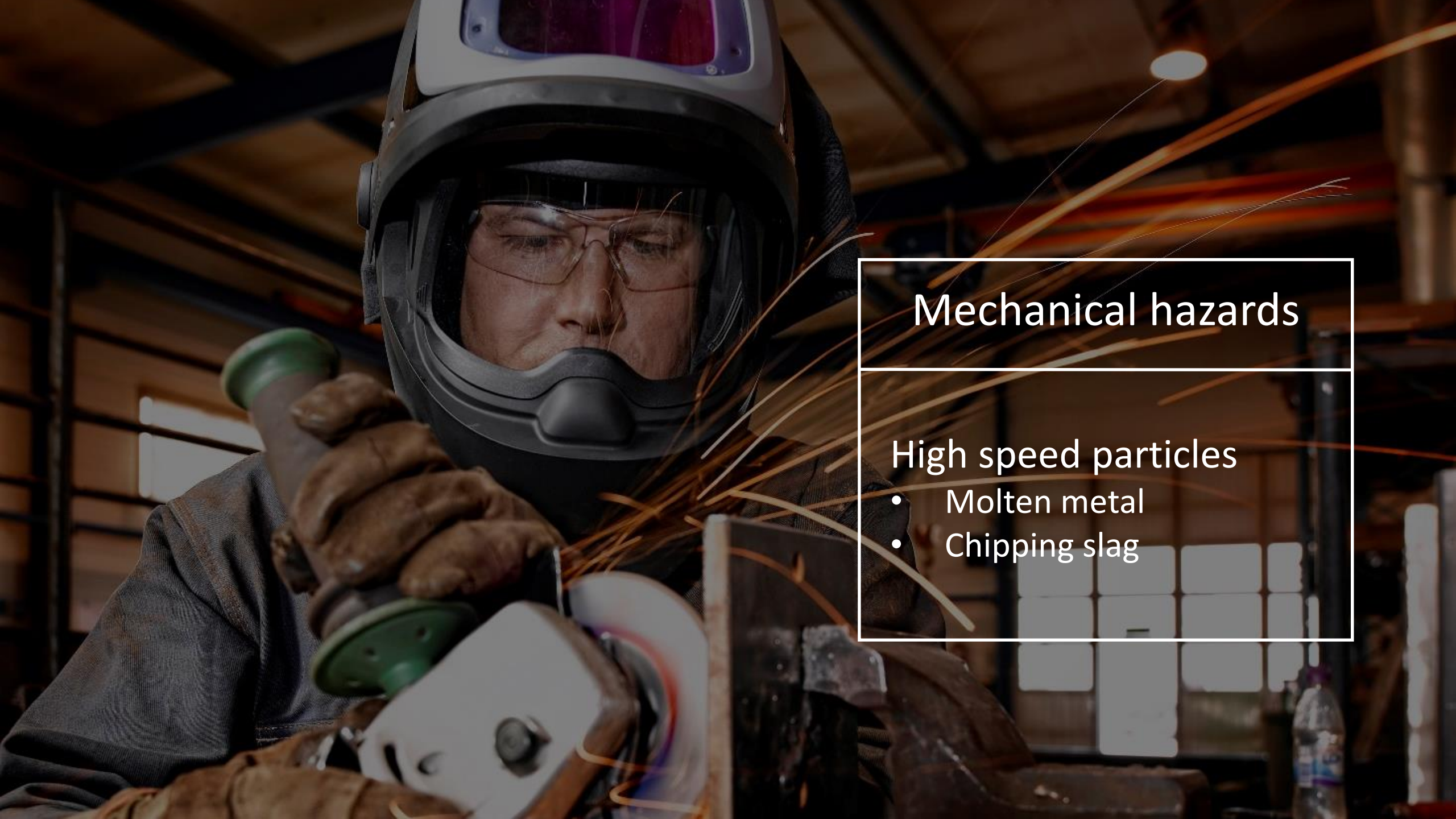
Visible

Takes time to happen – Seconds to hours
Damage can be immediate and accumulative
Usually to Macular and Retina (always permanent)

Infrared

Takes long time to happen – usually years
Damage is accumulative
Usually to the lens





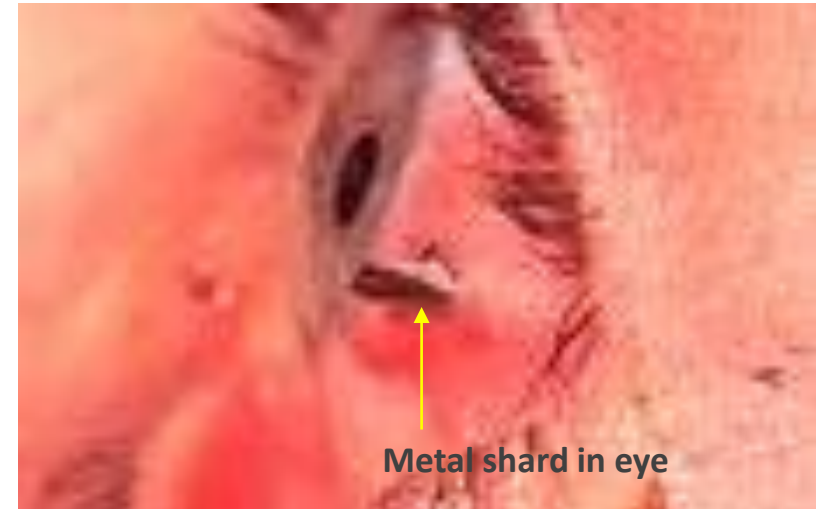
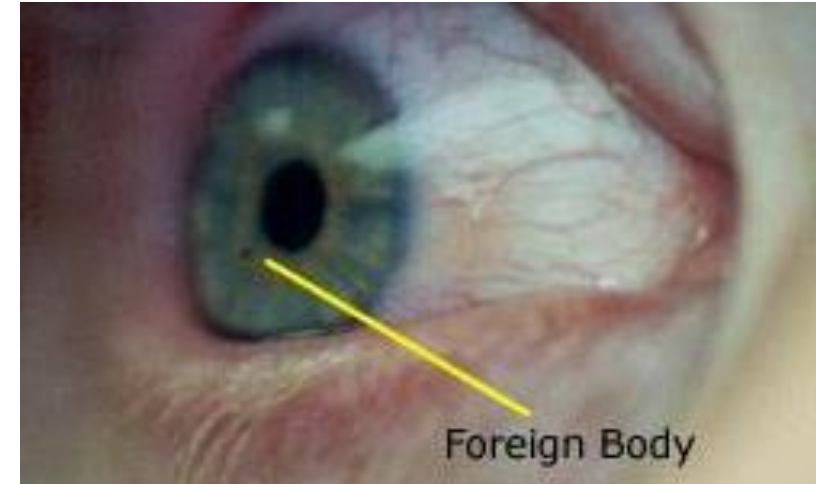
Mechanical hazards

High speed particles

- Molten metal
- Chipping slag

Mechanical hazards are typically accidental

- Traumatic incidents
- Often very painful
- Require immediate medical-eye specialist attention
- Can be cause for lost work time
- Impact productivity



Right classification for your application

Classification of mechanical strength	
Class S	Increased robustness (drop ball test 5,1 m/s)
Class F	Resistance to high speed particles at low energy impact (45 m/s.)
Class B	Resistance to high speed particles at medium energy impact (120 m/s.)
Class T	High speed particle was conducted at extremes of temperature (-5° and +55°C)

Note: Products classified in class B are not made to give total protection under all possible circumstances, e.g. when using grinding wheels /grinding machines.



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Respiratory



Do you know what
you are breathing?



2017 welding fumes became classified
carcinogenic
by WHO's cancer institute IARC



NEW


FACTS:

Inadequate respiratory
protection is the 4th most
frequently cited workplace
violation.¹⁾

40–50 welders

in UK are hospitalised every
year with pneumonia caused
by welding fume. Two of these
welders die every year.²⁾

1) Top 10 Most Frequently Cited Standards, OSHA, U.S. Department of Labor, for 2015.
2) Source: Health and Safety Executive. (www.hse.gov.uk/welding/illness.htm)



All welding
fumes contains
particles
and/or gases



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Welding fume

PARTICLES

Aluminium
Beryllium
Lead
Ferrous oxide
Cadmium
Copper
Chromium
Silicon dioxide
Manganese
Magnesium
Nickel
Vanadium oxide
Zinc
Zinc chloride
Zinc oxide

GASES

Argon
Fluoride
Phosphine
Phosgene
Helium
Hydrogen chloride
Hydrogen fluoride
Hydrogen sulphide
Carbon dioxide
Carbon monoxide
Nitrogen dioxide
Nitrogen oxide
Ozone
Sulphur dioxide



SYMPTOMS

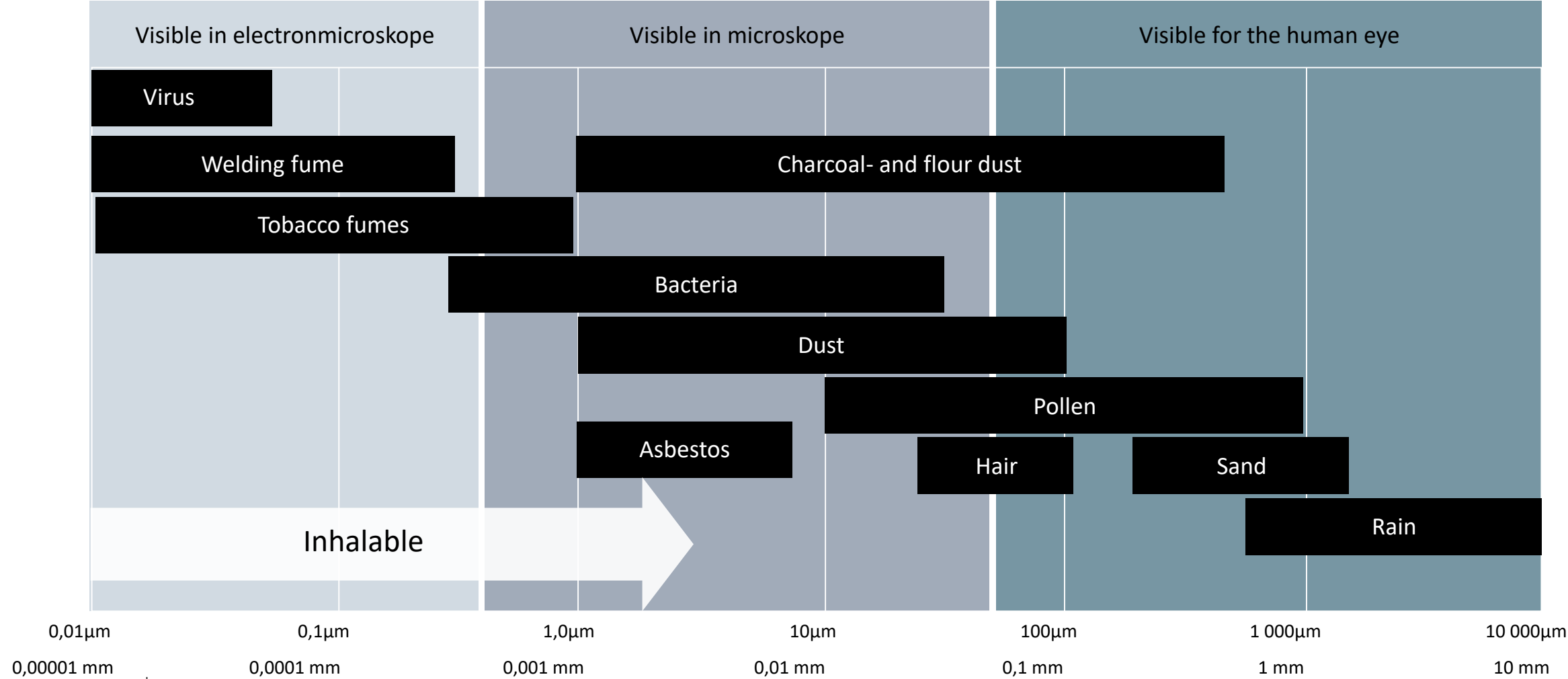
Immediate symptoms from exposure to welding fumes:

- Eye irritation
- Skin irritation
- Nausea
- Headache
- Dizziness
- Metal fume fever

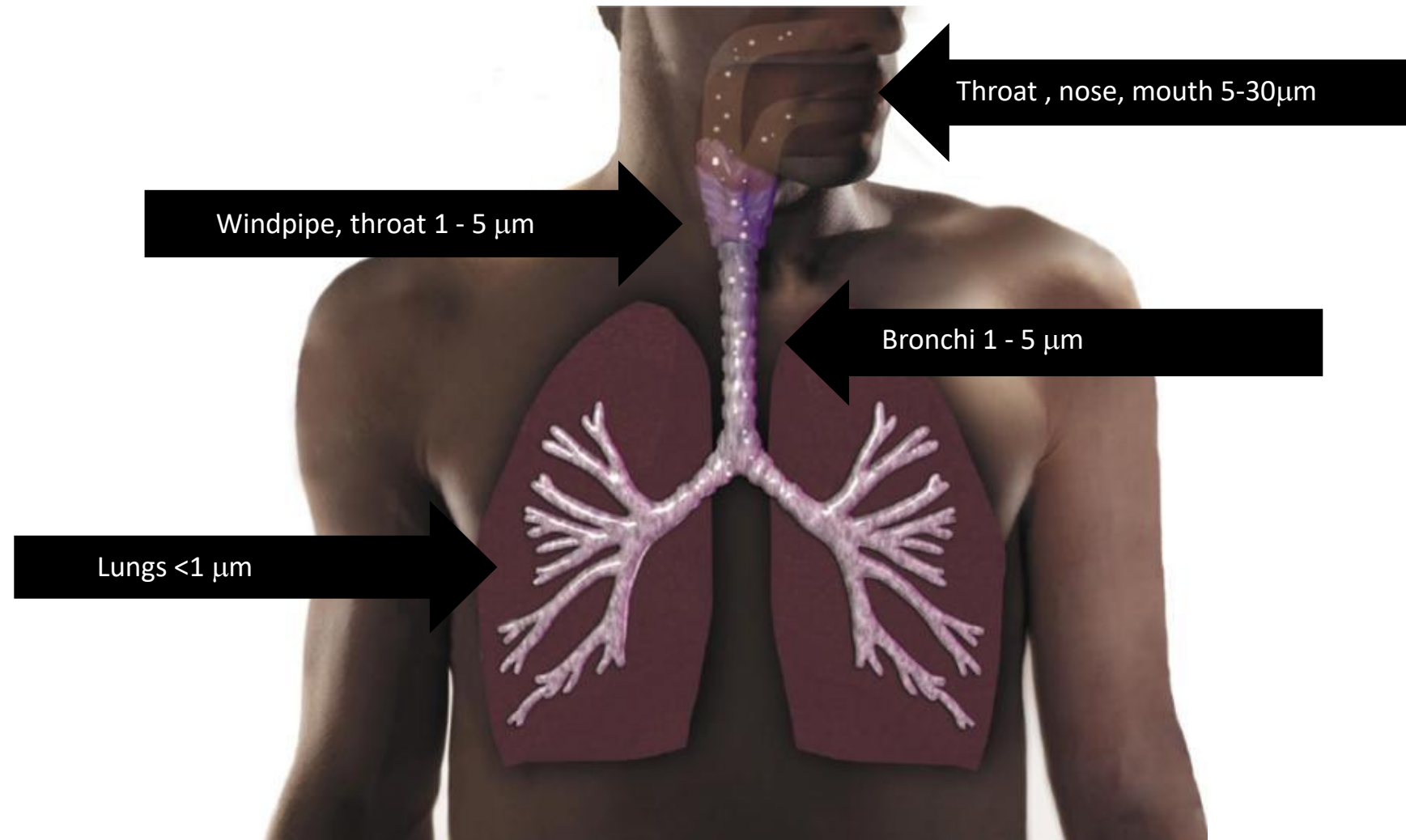
Chronic injuries on:

- Respiratory organ
- Lungs
- Central nervous system

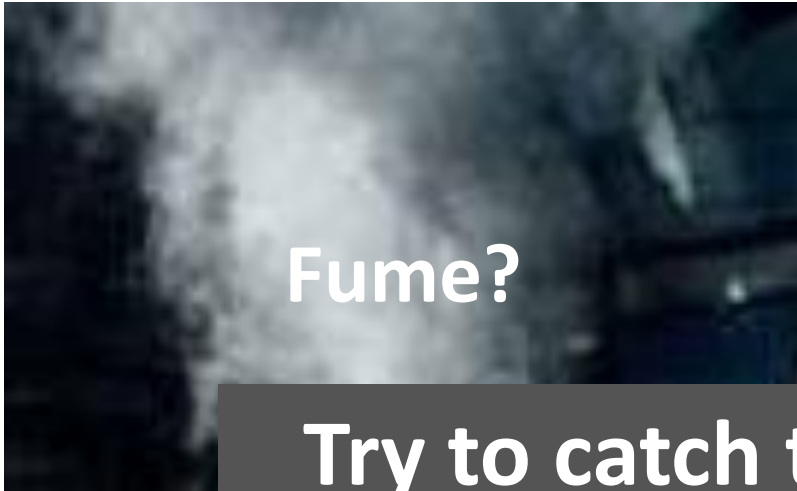
Example of particles in different sizes



The body's ability to cleanse the inhaled air



Quiz



Question:

If we drop a particle that is $0,5\text{ }\mu\text{m}$ from 1,5 m height. How long will it take for it to reach the floor?

Try to catch the fumes before it is spread in the workshop!



Answer:

Approximately two days

100% usage?

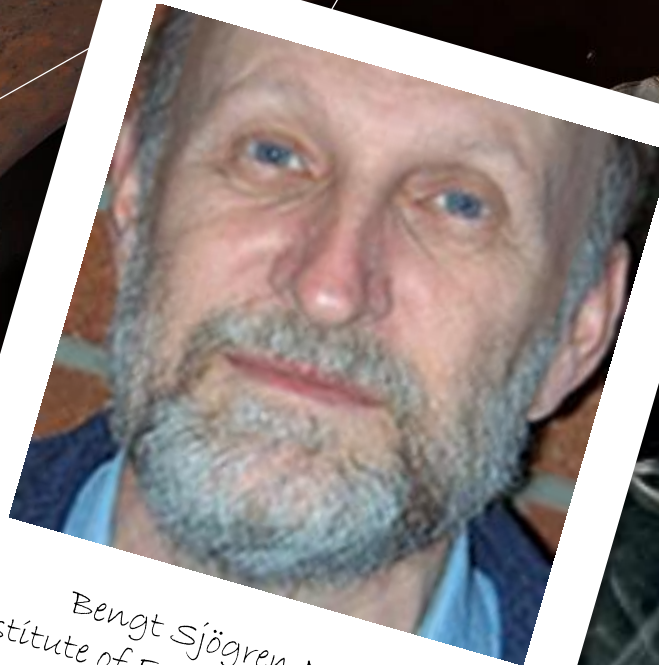


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Health effects from gases and particles in welding fume



Bengt Sjögren MD PhD
Institute of Environmental medicine

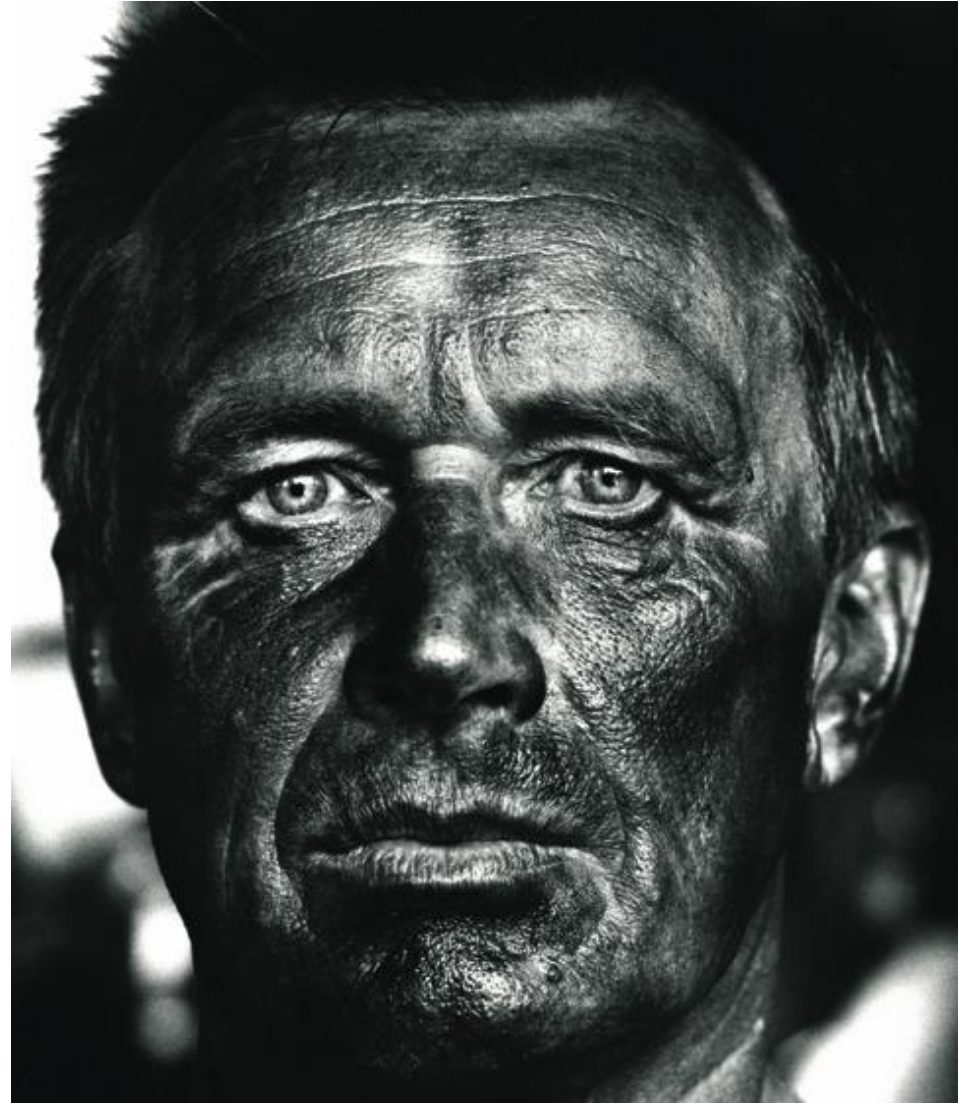


The aim of this review is to describe effects and diseases associated with inhalation of welding-generated gases and particles.

Health effects from welding

Eyes & upper respiratory airways

- Irritated eyes more common among welders
- Irritation in nose, including cold and nasal congestion is more common amongst welders.



Source "Arbetsmiljöverket, ISSN 1650-3171, Report 2013: "Health related issues of gases and particles from Welding" by Bengt Sjögren, MD, PhD, Specialist in Occupational Medicine and Chairman of a Subcommittee regarding Health and Safety within the Swedish Welding Commission.



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Health effects from welding

Suffocation

- Argon as shield gas in confined space
- Gas welding in confined space with acetylene- and oxygen: Carbon monoxide
- District heating pipes
- If use carbon dioxide as protective gas when MAG welding can transform into carbon monoxide in high temperature.

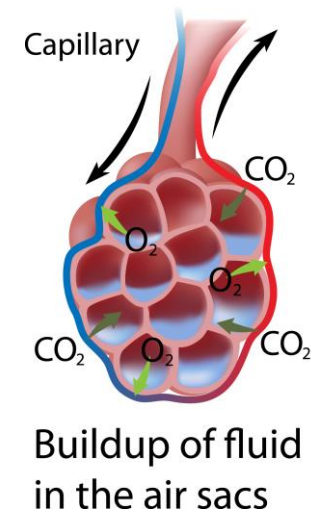
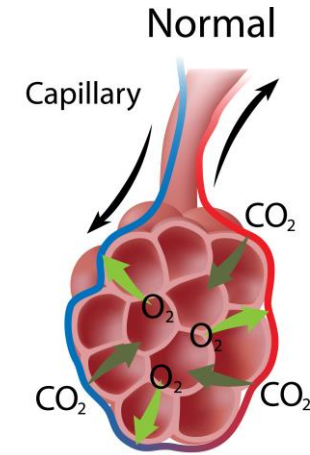


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Health effects from welding

Pulmonary Edema

- Can be caused by Nitrogen Dioxide – ex from the nitrogen and oxygen in surrounding air when gas welding.
- Symptoms may come after several hours



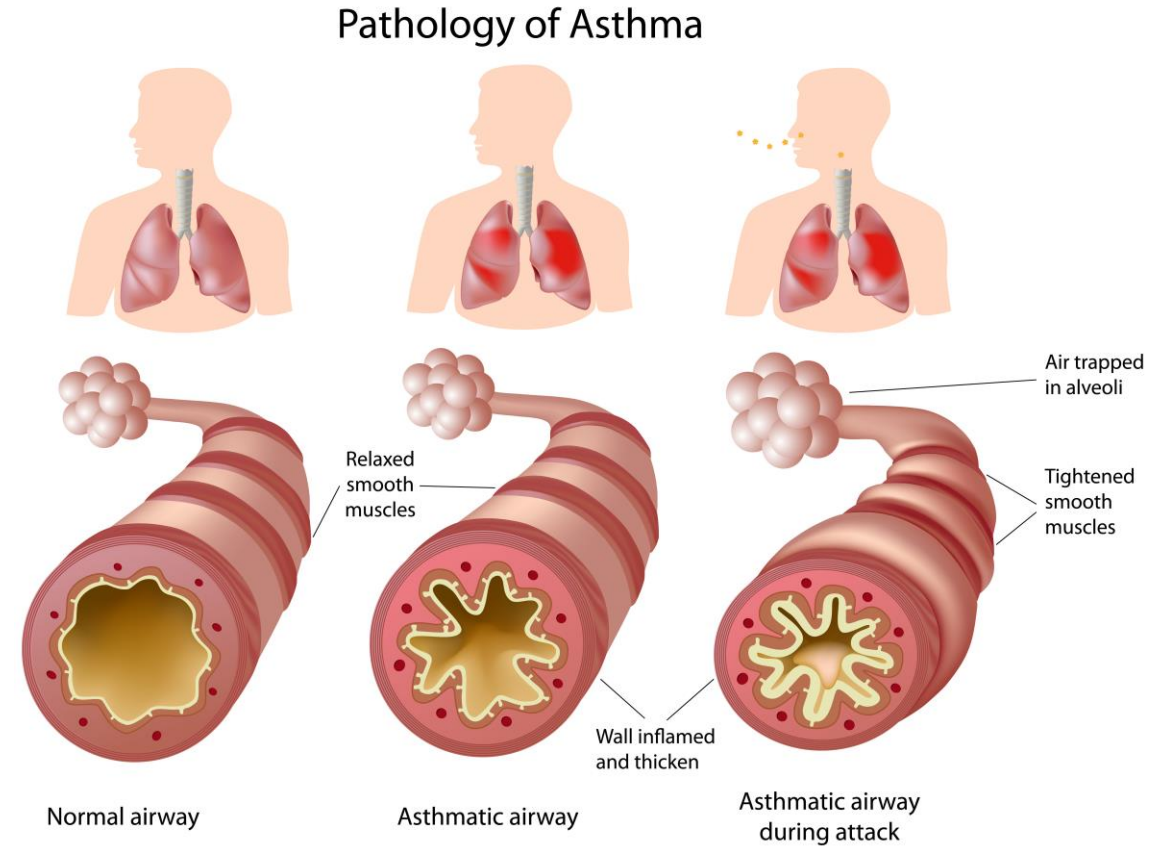
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Health effects from welding

Asthma (variation of airway obstruction)

Can be caused by a number of different substances

- Example: From hexavalent chromium when welding with coated electrodes in stainless steel.
- ... or exposure to ozone when welding in aluminum
- ... or exposure to diisocyanates when welding in Polyurethane surface coated material



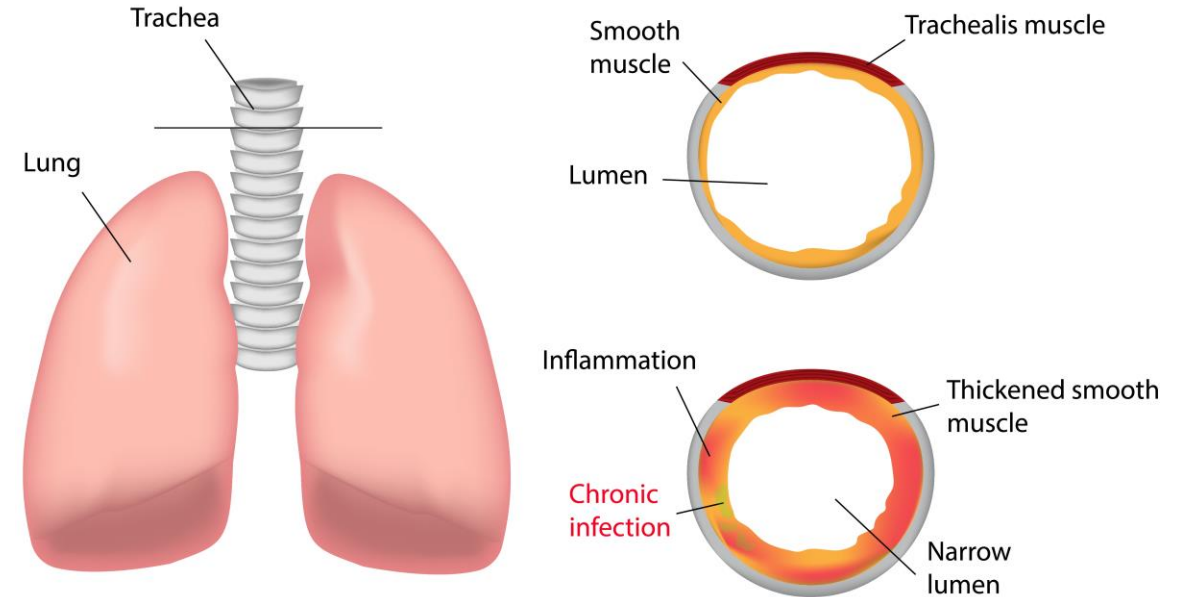
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Health effects from welding

Chronic bronchitis

Study of 16 000 welders in the Nordics welding minimum 25% during the day:

- Number of welders that had chronic bronchitis was doubled compared to non welders.
- The same risk as for chronic bronchitis caused by smoking.
- Highest risk when welding galvanized steel.



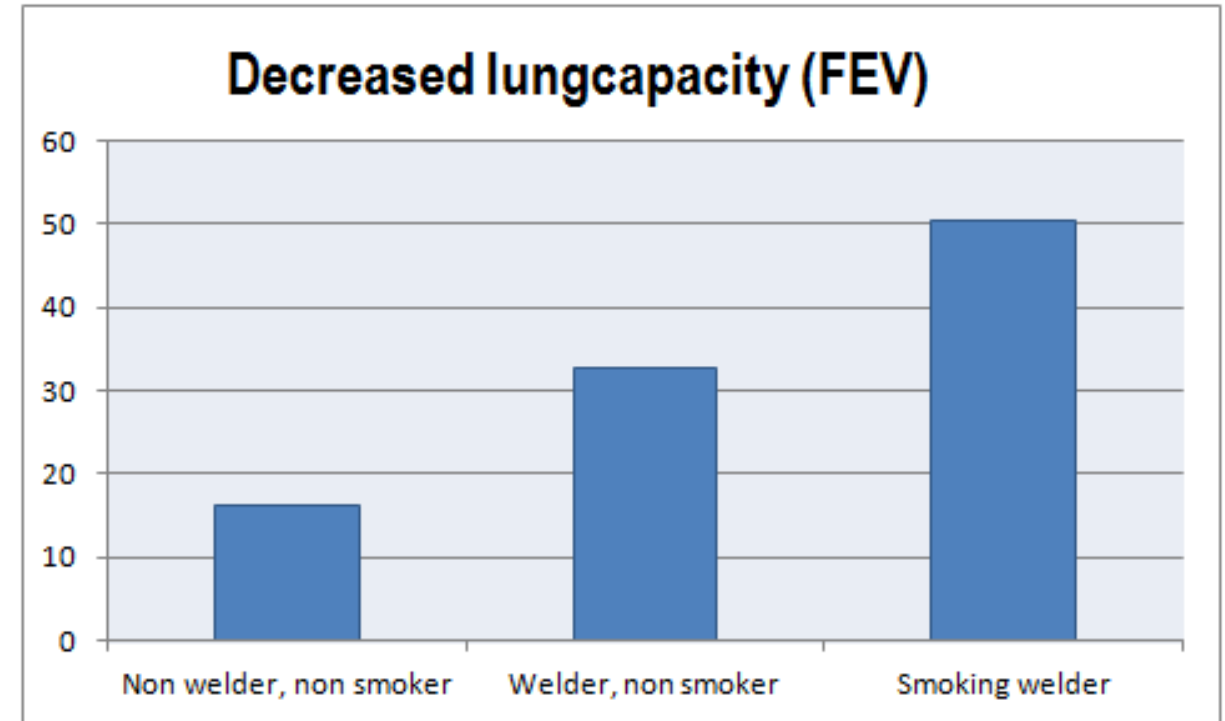
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Health effects from welding

COPD (Chronic obstructive pulmonary disease)

600 shipyard workers were followed during 7 years:

- Non smoking non welder – lung function (FEV_1) decreased 16,2 ml/year
- Non smoking welders – lung function (FEV_1) decreased 32,6 ml/year
- Smoking welders – lung function (FEV_1) decreased 50,3 ml/year



FEV_1 = Forced expiratory volume; volume of one maximum expiration during the first second

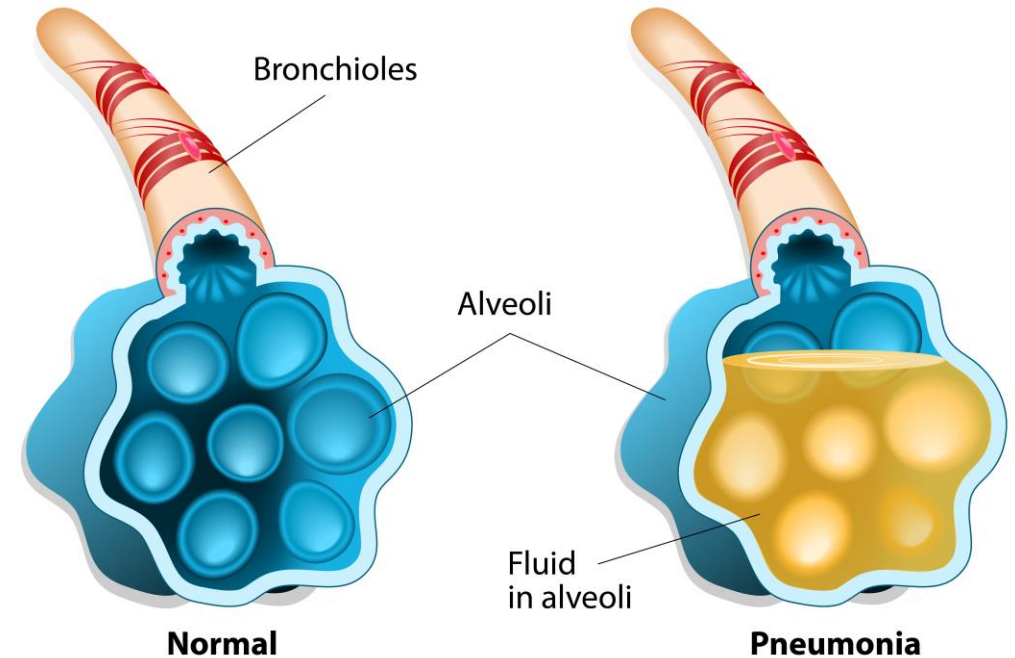
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Health effects from welding

Pneumonia

- High level of welding fumes – toxic inflammation in the lungs
- Higher level of deaths in pneumonia for welders compared to non welders.



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Health effects from welding

Metal fume fever

- A third of the welders have experienced it.
- Zink and copper are the metals that usually causes the fever
- The illness starts normally four hours after exposure
- Symptoms like fever chills, muscle and head ache, nausea, joint pains, shortness of breath etc.
- More common on Mondays.



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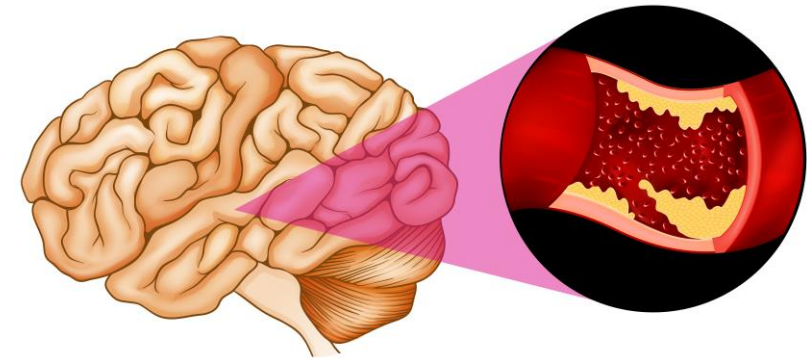
Health effects from welding

Heart attack

- Significant increase of acute myocardial infarction (heart attack) among welders compared to non welders.

Stroke

- Higher risk for thrombosis in the brain for welders



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Health effects from welding

Nerve system

- High concentration of aluminum particles – higher risk of effects on dexterity, concentration, reaction time and memory.
- Welders exposed to manganese – accumulated in a certain part in the brain that can result in symptoms like fatigue, depression, headache and effects on dexterity.



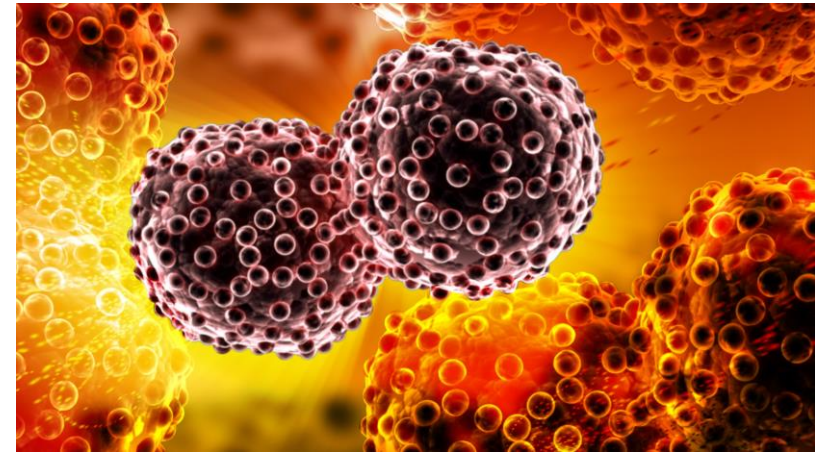
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Health effects from welding

Cancer

- 20-30% higher risk for lung cancer
- Welding in stainless steel, nickel oxide and hexavalent chromium - can cause lung cancer and nose cancer
- Welding in asbestos environment (older ships: engine rooms, boilers, pipes)



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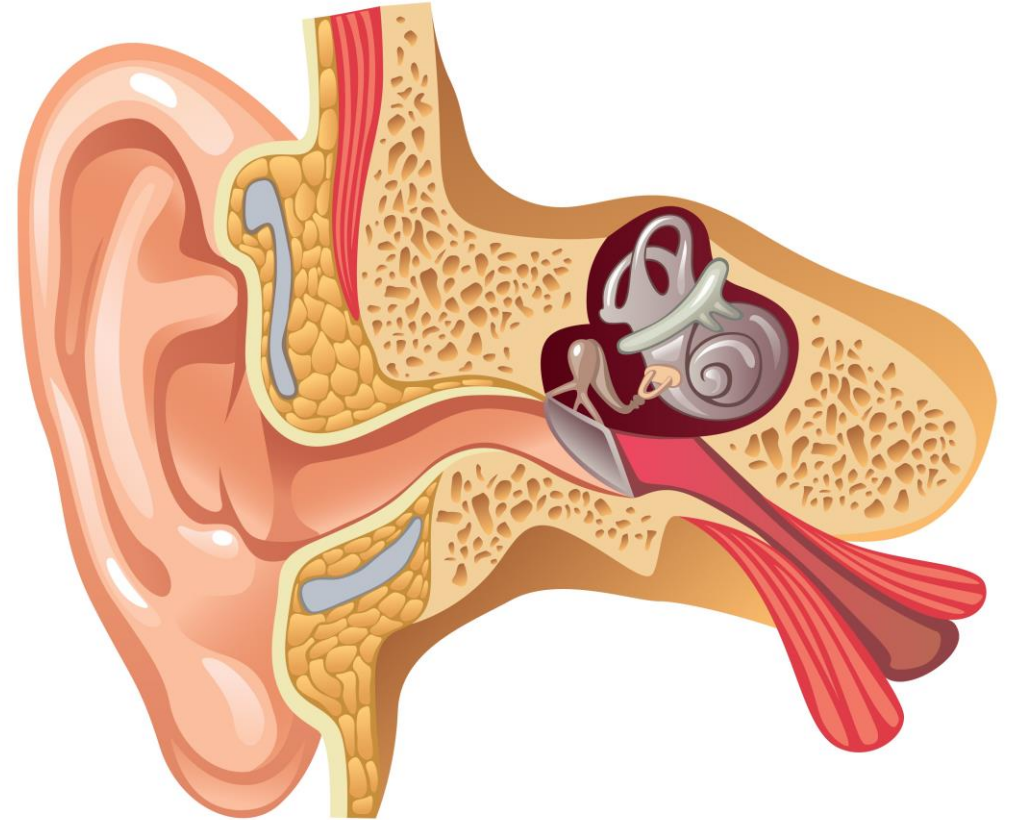


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Health effects from welding

Ear damage

- Welding sparks into the ear can hurt eardrum and labyrinth – severe pain and dizziness
- Hearing damage, tinnitus, infection, paralysis of face nerve.
- Easy to avoid by using ear protection.



Source "Arbetsmiljöverket, ISSN 1650-3171, Report 2013: "Health related issues of gases and particles from Welding regarding Health and Safety within the Swedish Welding Commission.

Health effects from welding

Reproduction

- The heat from the welding operation toward the testicles impairs the mobility and quality of the sperms
- Mothers exposed to welding/metal fumes – 61,8% girls
- Mothers not exposed to welding/metal fumes – 49,5% girls
- Higher risk for preterm delivery
- Lower weight on babies
- Women married to stainless steel welders – higher risk for miscarriage



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What type of respiratory protection is needed?

PROTECTS THE WELDER

PROTECTS EVERYONE NEAR THE WORKSTATION

PROTECTS EVERYONE IN THE WORKSHOP



For the best protection and comfort, we recommend a powered respirator or, depending on the situation, a supplied air system.



On-gun and local extractors remove much, but not all, of the welding fumes right at the source, thereby reducing their spread to other areas.



Well-designed general ventilation will remove welding fumes that were not immediately captured at the workstation and exchange them with fresh air.



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Thank you