

THE 2025 NATIONAL OCCUPATIONAL HEALTH AND SAFETY CONFERENCE



***IMPROVING HEALTH AND SAFETY IN
THE IRON AND STEEL SECTOR***



Disclaimer



- The views expressed herein represent the author's views and I declare NO Conflict of Interest
- All images are to portray messaging with the aim of highlighting workplace health risks



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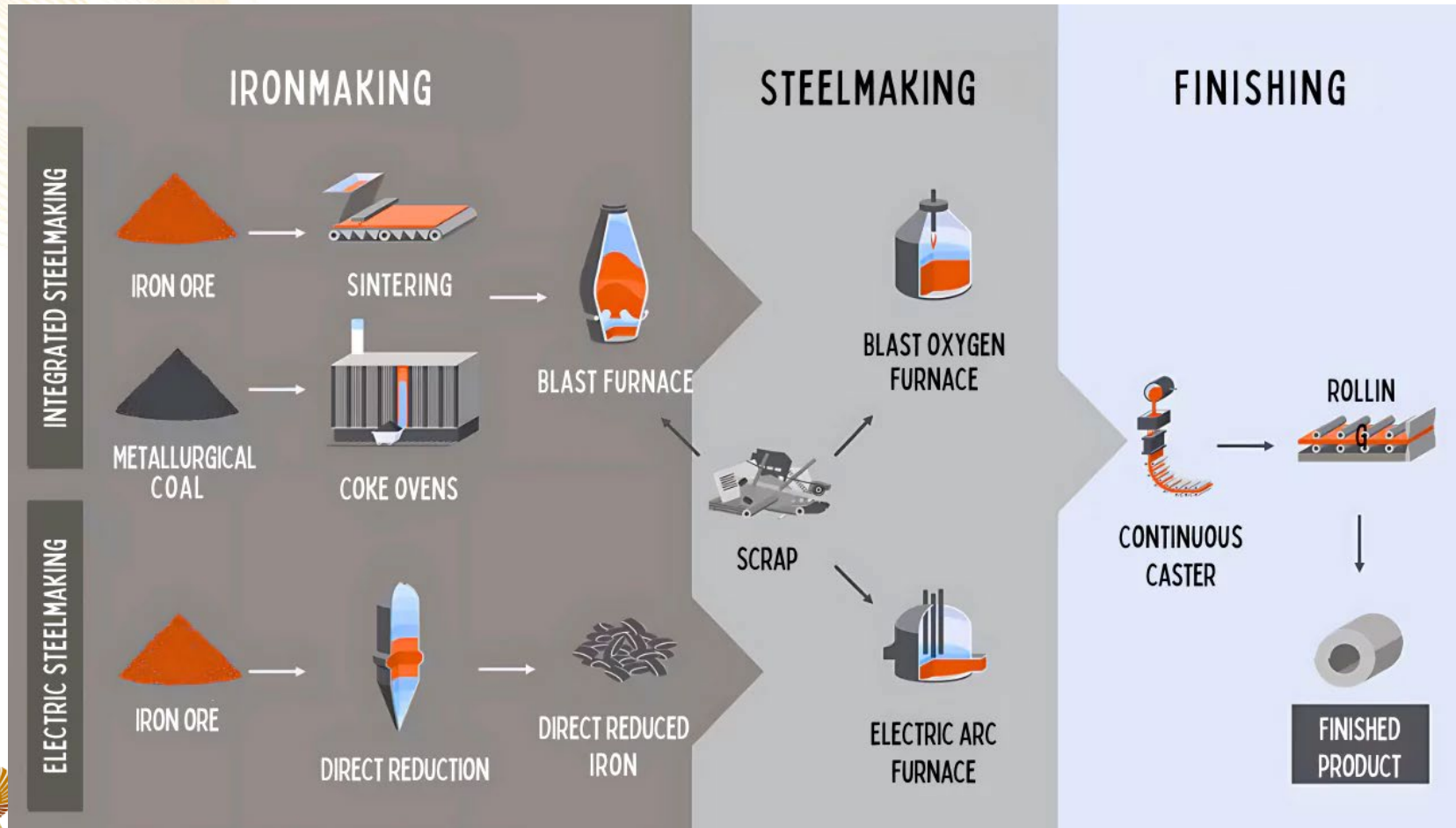
1. Process Review



Steel Production Process



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Steel Production Process



- Most steel in South Africa is produced via two basic routes: The Blast Furnace-Basic Oxygen Furnace (BF-BOF) route and the Electric Arc Furnace route (EAF)*
- Steel is a metal alloy made of iron and carbon
- The steel manufacturing process starts by making iron



* SA Iron & Steel Institute

Steel Production Process

- Blast Furnaces:
 - Relies on a chemical process called reduction
 - Iron oxide ore
 - Iron separated from oxygen using carbon
 - Coal used as main carbon bearing material
 - Liquid iron is about 1,500 degrees



Steel Production Process

- Electric Arc Furnaces:
 - Key component graphite electrodes
 - Heat necessary for melting the metal comes from an electric arc
 - Molten metal is about 1,800 degrees



2. Occupational Hygiene



Definition

The discipline of **anticipating, recognizing, evaluating** and **controlling** health hazards in the working environment with the objective of protecting worker health and well-being and safeguarding the community at large

“The goal is good control”



Definition

ANTICIPATION –identifying potential hazards in the workplace before they are introduced

RECOGNITION - identifying the potential hazard that a chemical, physical or biological agent - or an adverse ergonomic situation - poses to health



Definition

EVALUATION of the extent of exposure to the chemical hazards, physical or biological agents (or adverse ergonomic situation) in the workplace. This often involves measurement of the personal exposure of a worker to the hazard/agent in the workplace, particularly at the relevant interface between the environment and the body, e.g. breathing zone, hearing zone, and assessment of the data in terms of recommended occupational exposure limits (OELs), where such criteria exist.



Definition

CONTROL of the chemical, physical or biological agent - or adverse ergonomic situation, by procedural, engineering or other means where the evaluation indicates that this is necessary.



“The goal is good control”

Control Hierarchy



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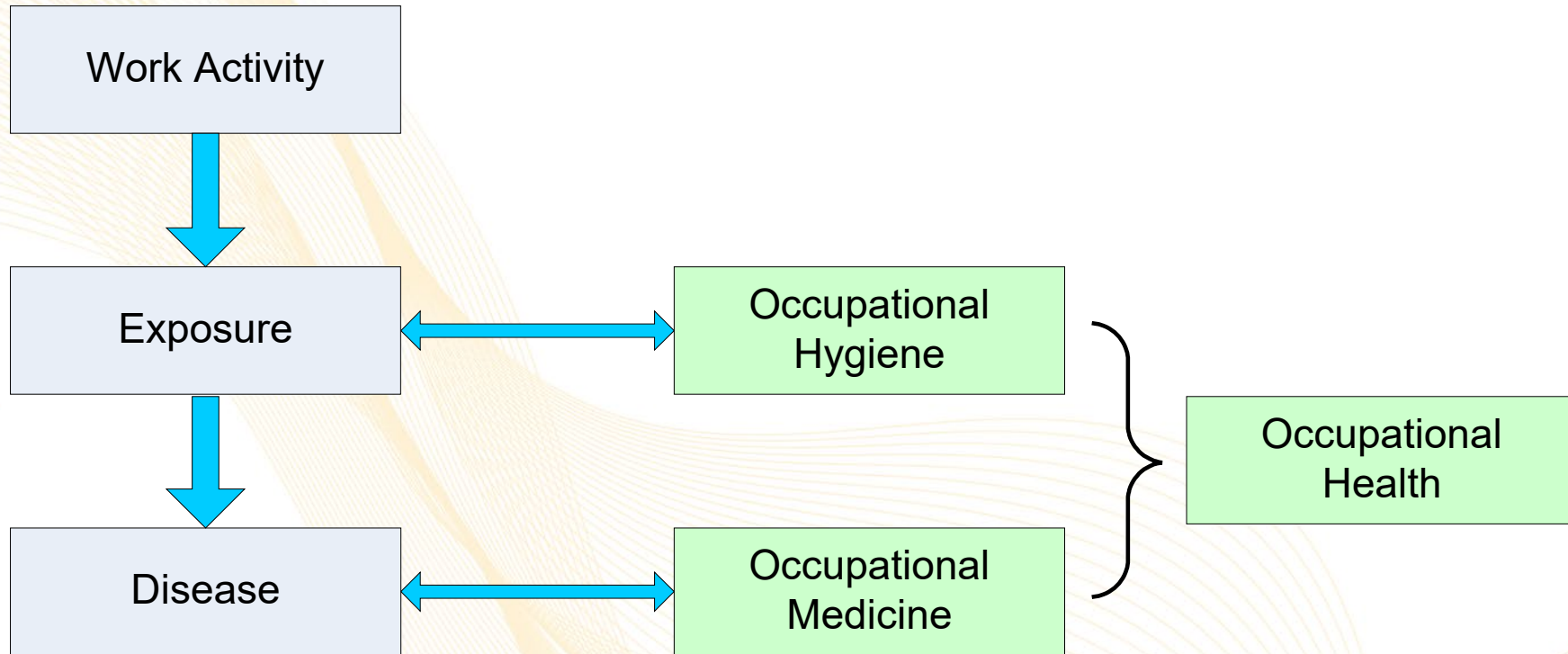
“The goal is good control”

Workplace Stressors

- Chemical: Hazardous Chemical Agents
- Biological: Hazardous Biological Agents
- Physical: Noise, Thermal, Radiation (Ionising and non-ionising), Human Vibration, Illumination
- Ergonomics
- Psychosocial



OH Organogram



Why Occupational Hygiene?*

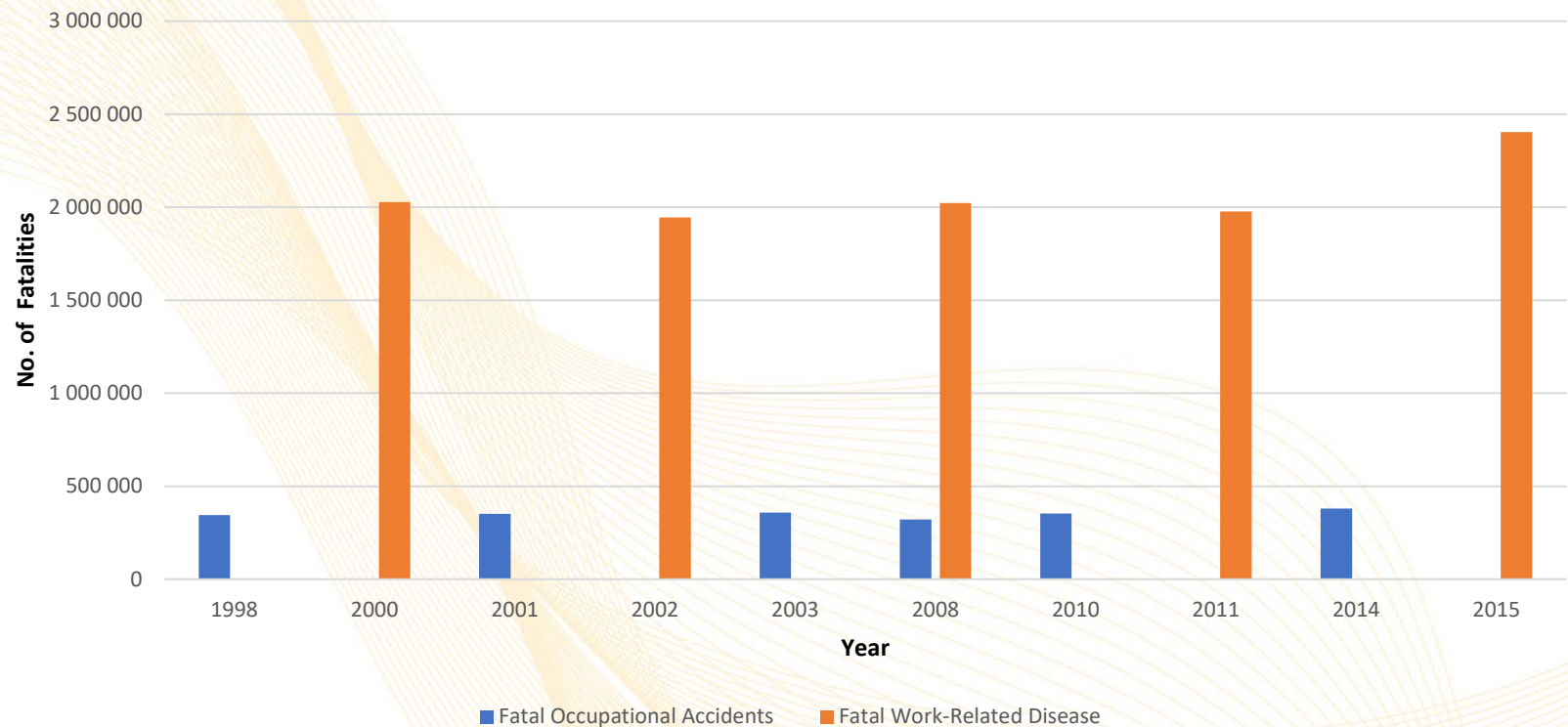


- 2,200,000 work-related deaths per year
- 450,000 deaths each year from exposure to airborne matter
- 152,000 deaths per year from carcinogens in the workplace
- 37% of Lower Back Pain is attributed to occupation
- Majority workplace disease related



Why Occupational Hygiene?

Global Trend of Occupational Accidents and Fatal Work-Related Diseases (1998-2015)



Workplace exposure to air pollution (particulate matter, gases and fumes) was responsible for 450,000 deaths

Why Occupational Hygiene?



Why Occupational Hygiene?



That means approximately **228 people have died** from work related injury or ill health since we started the session this morning



3. Health Risks



Hazardous Chemical Agents

Solid



Gas



Liquid



Hazardous Chemical Agents



Over 1,000 chemicals are used or encountered in steel making:

- Raw materials or as contaminants in scrap/fuels
- Additives in special processes – refractories
- Hydraulic fluids and solvents
- By-products such as tar, benzene and ammonia



Hazardous Chemical Agents

- Dusts, Mists, Fibres and Fumes
 - Steelworkers more susceptible to reversible narrowing of the airways (asthma)
 - Heavy metals
 - Early (subclinical) signs of disturbances of the same type as parkinsonism – steel making works study
- Silica
 - Furnace maintenance
 - Silicosis and lung cancer



Hazardous Chemical Agents

- Dusts, Mists, Fibres and Fumes
 - Oil mists generated in the cold rolling of steel
 - Irritation of skin, mucous membranes and upper respiratory tract, nausea, vomiting and headache
 - Lipoid pneumonia in rolling mill workers
 - Acid mists from pickling areas
 - Skin, eye and respiratory irritation
 - Nearly twofold increase in laryngeal cancer



Hazardous Chemical Agents



- Dusts, Mists, Fibres and Fumes
 - Asbestos historically used extensively for thermal and noise insulation
 - Encountered in maintenance and construction activities
 - Asbestosis, mesothelioma and other cancers
 - A cross-sectional study found pleural pathology in 20 out of 900 steelworkers



Hazardous Chemical Agents

- Gases and Vapours
 - Sulphur dioxide and nitrogen oxides have caused cases of chemical pneumonitis
 - CO/CO₂ released in dangerous concentrations: chemical and physical asphyxia
 - Benzene/toluene/xylene present in coke-oven gas
 - Respiratory and central nervous system symptoms
 - Bone marrow damage, aplastic anaemia and leukaemia



Hazardous Chemical Agents

- Gases and Vapours
 - Sulphur compounds from the use of high-sulphur fossil fuels and blast furnace slag
 - PAHs in steelworks, coke making is the major source
 - Irritation of the skin and mucous membranes, dizziness, headache and nausea
 - Carcinogen (confirmed)
 - Coke-oven workers have a lung cancer mortality rate twice that of the general population
 - Respiratory cancer risk for coke oven workers ranged as high as **4.45 times that for non-oven workers**



Physical Agents

- Vibration
 - WBV and HAV exposures
 - Motion sickness, blurring and loss of visual acuity
 - Carpal tunnel syndrome
 - Degenerative joint changes
 - Reynaud's phenomenon in the finger tips ("white finger disease")
 - Chippers and grinders twice as likely to develop Dupuytren's contracture



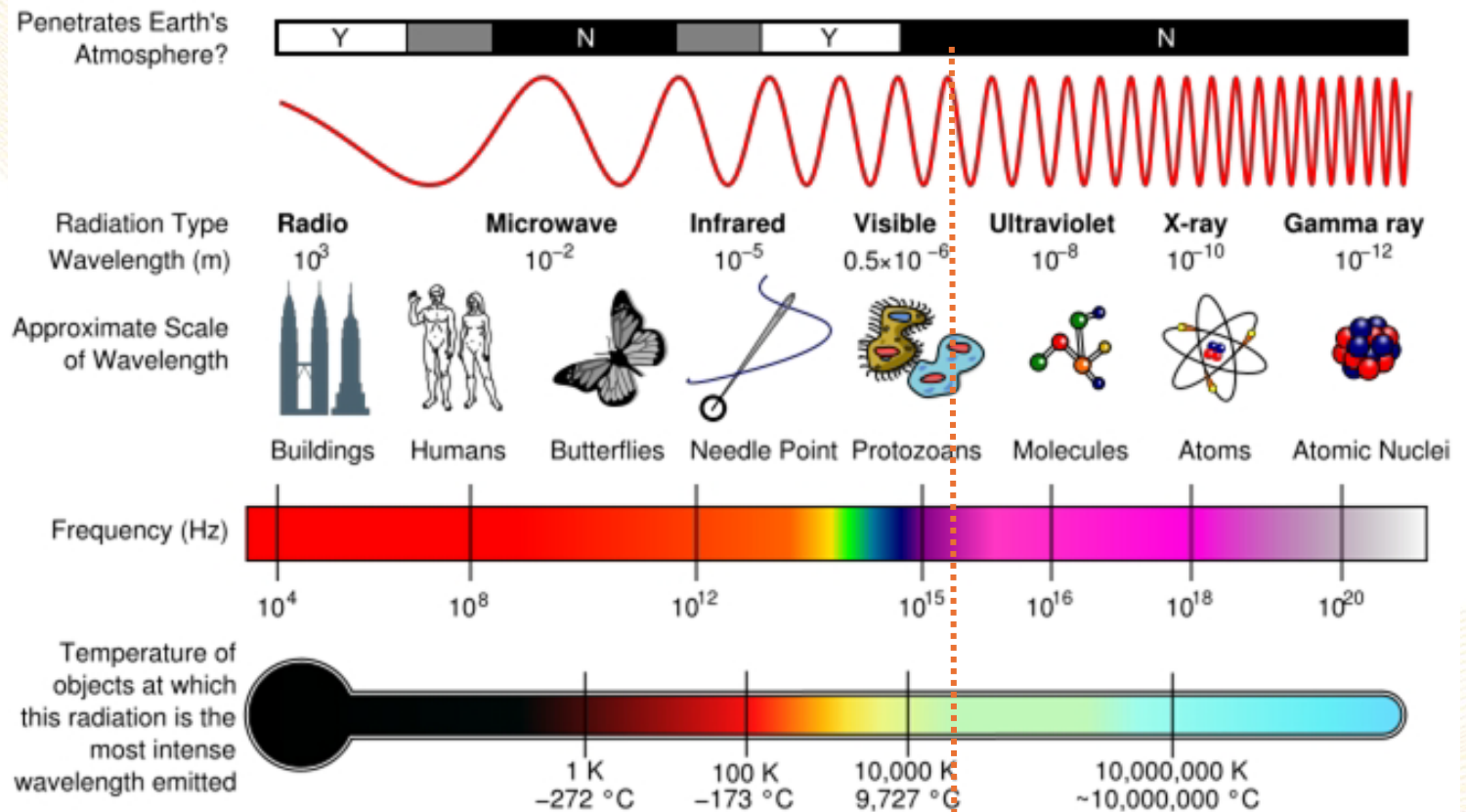
Physical Agents



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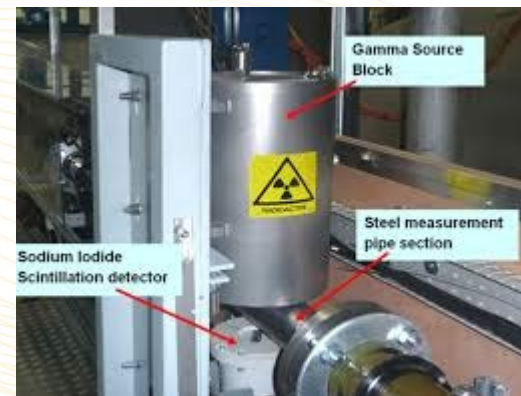
Non - Ionizing

Ionizing



Physical Agents

- Ionising Radiation
 - Sealed sources
 - Densitometers
 - Contaminated scrap
 - X rays
 - Carcinogen
(confirmed)



Physical Agents

- Non-Ionising radiation
 - Lasers: have a wide range of applications in steel making and may cause retinal damage
 - Infrared radiation
 - UV
 - Health effects include cataracts, keratitis, and chronic dry eye problems
- Static and low frequency EMF
 - The effects of Non-ionizing EMF on people depend on frequency and intensity



Physical Agents

- Static and Low Frequency (LF) fields stimulate sensory organs, nerves or muscles (known as “sensory effects”)

Neurobehavior

- Stimulation of nerve and muscle tissue
- Induction of retinal phosphene
- Induced electric fields

Cardiovascular disorder

- No likely hazardous cardiovascular effect associated with LF fields environmentally or occupationally.

Neurodegenerative disorder

- Links to Alzheimer and ALS
- No conclusive association between LF and neurodegenerative disorder

Cancer

- 50/60 Hz H-field and childhood Leukemia
- IARC category 2B (possibly carcinogenic)



Physical Agents

- Heat related illnesses
 - Radiant heat levels of up to 1,000 kcal/m² have been measured at work points in rolling mills
 - Factors contributing to heat stress:
 - High ambient temperature
 - Humidity
 - PPE
 - Physical exertion
 - Study in high humidity environment: 90% WBGT measurements were higher than recommended threshold limit values (27.2-41.7°C)
 - Highest exposures occur during forging



Ergonomics

- Musculoskeletal injuries are common in steel making
- Manual handling of large, bulky and/or heavy objects Frequent
- Furnace bricklayers have been shown to be at highest risk of work-related upper arm and low back problems



Psychosocial

- High levels of work stress are found in the steel industry
- Continuous operation requires shift work (carcinogen)
- Hot, noisy, heavy industrial environment
- Risk of job losses



4. Controls



Controlling exposures

- Hierarchy idealistic but difficult to rapidly implement
- PPE remains first control option alongside administrative controls
- PPE should be considered a “Key Critical Control”
- Great effort should be placed on correct implementation of PPE programme
- Primary route of contaminant entry into human body through inhalation



Controlling exposures

- RPE deemed a KCC
- Selection
- Training
- Maintenance and care
- Fit testing



Fit Testing

Who needs to be Fit Tested?

- OSHA 29CFR1910.134 (f)

“It is required that, before any employee may be required to use any respirator with a negative or positive pressure tight-fitting facepiece, the **employee must be fit tested** with the same make, model, style, and size of respirator that will be used.”



- UK COSHH Regulation

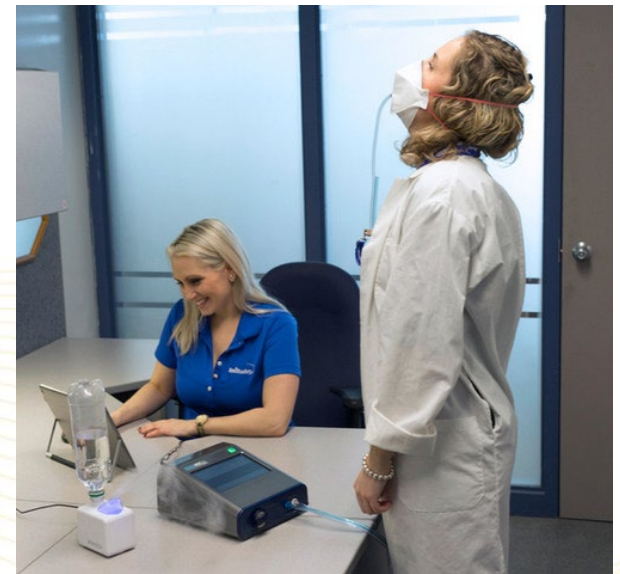
Tight-fitting RPE (i.e. full and half masks) should be **face-fit tested**, using a suitable method, by a competent person (see regulation 7 of the MHSW Regulations and regulation 12(4) of COSHH). Fit testing will need to be repeated when there is any change in equipment or the facial characteristics of the wearer that could affect the fit. Loose-fitting devices, such as powered respirators with a visor or hood, need not be face-fit tested but still need to fit observably close to the face

Fit Testing

1. QLFT – Subjective
2. QNFT – Objective



Qualitative



Quantitative



Fit Testing



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Fit testing method				
RPE (type and mask)		Quantitative (QNFT)		Qualitative (QLFT)
		Ambient particle counting	Controlled negative pressure ^a	Taste
Disposable respirator ^b	Half mask	Yes	No	Yes
Reusable respirator	Half mask	Yes	Yes	Yes
	Full-face mask	Yes	Yes	No
Powered respirator	Half mask	Yes	Yes	Yes
	Full-face mask	Yes	Yes	No
Constant flow airline BA	Half mask	Yes	Yes	Yes
	Full-face mask	Yes	Yes	No
Fresh air hose BA	Half mask	Yes	Yes	Yes
	Full-face mask	Yes	Yes	No
Demand valve BA	Half mask	Yes	Yes	Yes
	Full-face mask	Yes	Yes	No
Escape BA	Full-face mask	Yes	Yes	No



Controlling exposures



The goal is good control!



5. Stay Healthy!

