



# Welding Health and Safety Eye and Face Protection

3M Occupational Health and Environmental Safety Division

 **Speedglas™**

**3M**

# Welding Health and Safety

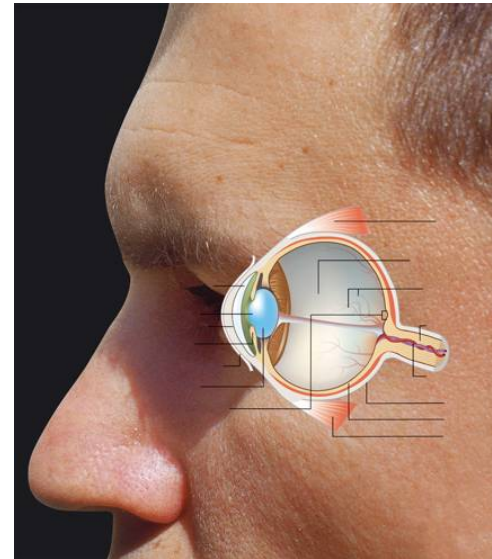
- This training material has been prepared by 3M for the purpose of helping you understand applicable OSHA standards, or other safety regulations, workplace hazards, and safe workplace practices.
- It is the responsibility of both the employer and employees to comply with safety rules and regulations and to use all safety equipment in accordance with product user instructions, limitations, and warnings. Questions regarding proper use should be directed to the employer or the equipment manufacturer. For 3M products call 3M Technical Service 1-800-243-4630.
- Modifications to this copyrighted material is prohibited.



# Eye/Face Injury Risk

- Nearly **one million** Americans have lost some degree of their sight due to an eye injury
- More than **700,000** Americans injure their eyes at work each year
- Workplace eye injuries (all types) > **2000 per day**
- 10-20% result in disabling **vision loss**
- >90% **preventable** with proper protection
- 94,500 people **treated** in US hospital emergency rooms for eye injuries related to workplace or industrial products in 2003
  - **15,338 injuries (16.2%) occurred while using welding equipment**

Source:



**3M**



# 2004 Non-fatal Occupational Eye/Face Injuries in United States Resulting in Lost Work Time

- **52,780 Facial Injuries (includes eye injuries)**
- **36,680 Eye Injuries caused by:**
  - Rubbed foreign bodies (chips, particles, etc.) – 13060 (35.6%)
  - Struck by flying objects – 6960 (19.0%)
  - Contact with skin or exposed tissue – 5070 (13.8%)
  - Exposure to welding light – 1900 (5.2%)
- **Eye Injuries by Occupation**
  - Welders, cutters, solderers, brazers – 2240 (6.1%)
  - Construction laborers – 2130 (5.8%)
  - Laborers/material movers – 2100 (5.7%)
- **Injury statistics would most likely be much worse without existing prevention programs**



# Primary Causes of Welding Eye Injuries

## ■ Flying Particles

- Flying particles have mass and velocity increasing the potential for piercing and cutting trauma
- Grinding, chipping and polishing
  - Grinding wheel/parts
  - Wire brush bristles
  - Metal particles

## ■ Hot Molten Metal

- Potential burn injuries during welding and cutting

## ■ Airborne Substances

- Dust particles suspended in air are potential eye exposure hazards
- Flux materials used in certain welding/soldering/brazing can be eye irritants
- Metal fumes and smoke generated during arc welding

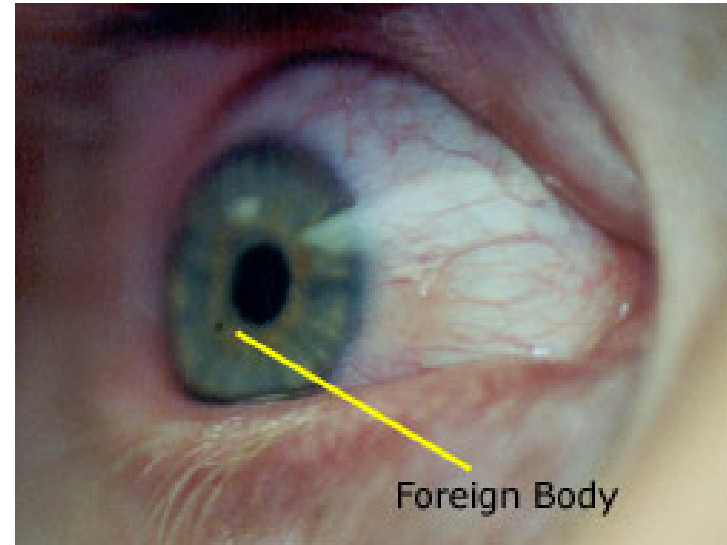
## ■ Arc Radiation

- Exposure to Ultraviolet (UV), Visible Light, Infrared (IR)



# Eye Injuries

- Traumatic incidents
- Often very painful
- Require immediate medical-eye specialist attention
- Can be cause for lost time from work
- May cause permanent loss of vision

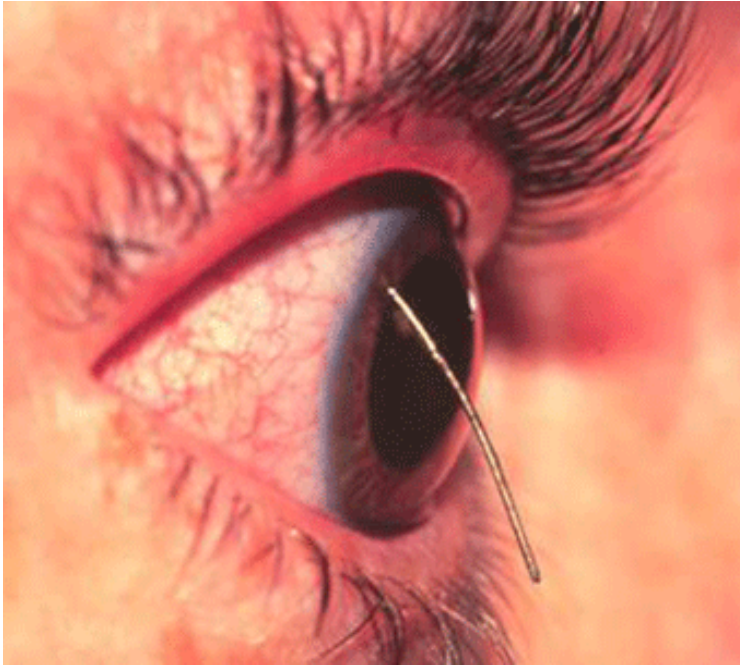


Metal Shard in Eye

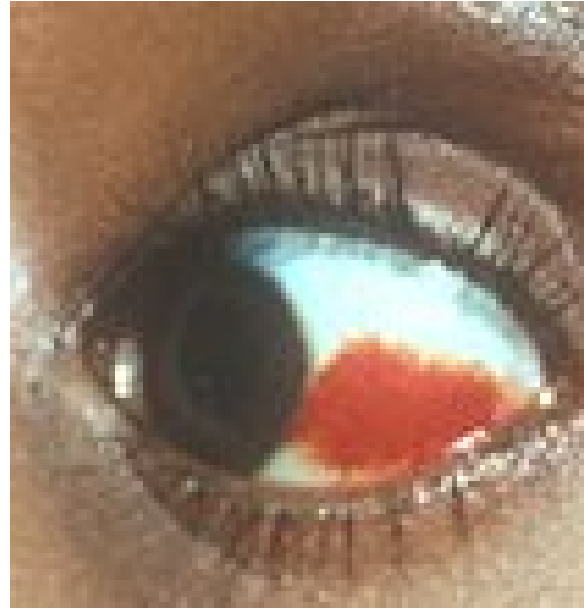
**3M**

# Eye Injuries

- Penetrating injury from radial wire brush



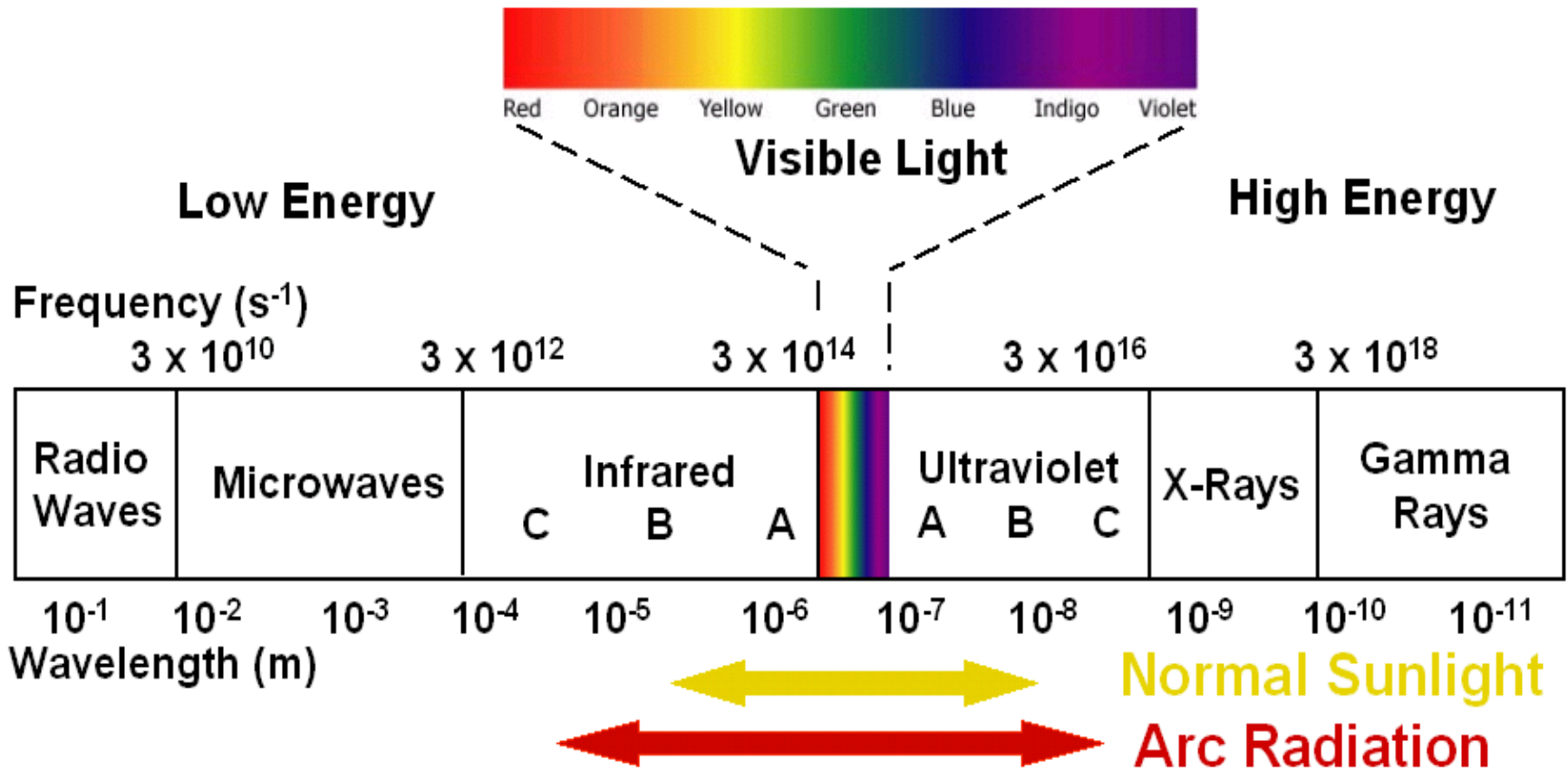
- Blunt trauma eye injury with bleeding of the conjunctiva



**3M**

# Arc Radiation Hazards

- Arc radiation covers a wider frequency range than sunlight

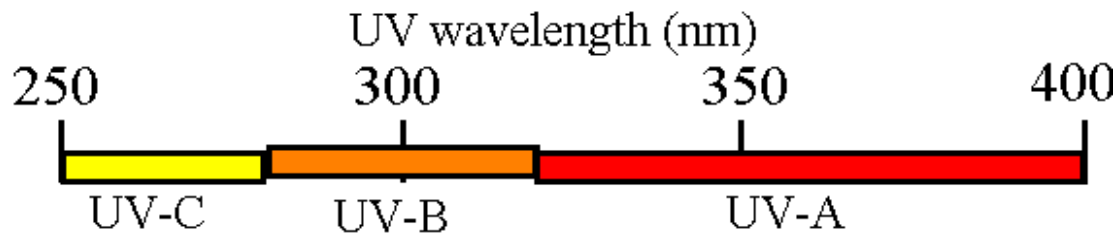


**3M**



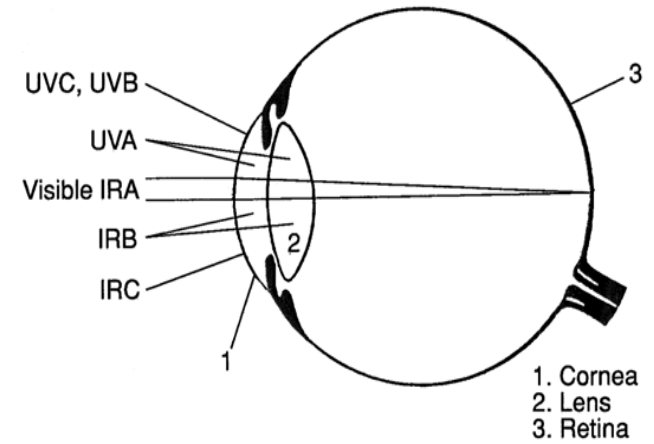
# UV Radiation

- **UV-A** (also known as black light)
  - Wavelengths of 315nm to 400nm.
- **UV-B**
  - Wavelengths between 280nm to 315nm.
  - This type of radiation is associated with photo induced burning of the skin and eyes (sunburn).
- **UV-C**
  - Wavelengths below 280nm.
  - This region of the spectrum is well known for its germicidal action



# How Arc Radiation Effects the Eyes

- **Visible Light**
  - Temporary blindness
  - Retinal burns
- **UV** (primary concern for welders)
  - Arc-eye
  - Cataracts
  - Sunburn - from UVB
  - Skin cancer – from UVA
- **Infrared**
  - Cataracts
  - Retinal and corneal burns



# Overexposure to Arc Radiation



## Potential Symptoms

- **Ultraviolet**
  - Itchy, Tearing
  - “Sand in the Eyes”
- **Visible**
  - “Fire Ball” Spot Blindness
  - Blood Shot
  - Headache
- **Infrared**
  - Dry, Tearing, Itchy, Headache

## Potential Damage

- **Ultraviolet**
  - Can happen in milliseconds
  - Usually to cornea (often temporary)
- **Visible**
  - Can take time to happen
    - Seconds to hours
  - Damage can be immediate or accumulative
  - Usually to macular and retina (always permanent)
- **Infrared**
  - Takes long time to happen - usually years
  - Damage is accumulative
  - Usually to the lens of the eye (cataract)



# Photokeratoconjunctivitis (Arc Eye)

- Also known as flash burn or welder's flash



## Potential Symptoms

- Inflammation of the cornea
- No immediate pain or sensations during exposure
- Symptoms develop several hours after exposure and last up to two days
- Feels like sand in the eyes



**3M**

**Don't Let This Happen to You!**



**Arc Eye**

**15x**



# Eye/Face Personal Protection Equipment



# American National Standard for Occupational and Educational Eye and Face Protection Devices

## ANSI Z87.1-2003

- Establishes **performance** criteria and **testing requirements** for devices used to help **protect** against **eye and face** injuries due to **impact, non-ionizing radiation (e.g. UV)** and chemical exposures in workplaces and schools.
- Covers **all** types of protective devices, including:

- Spectacles (safety glasses)
- Goggles
- Faceshields
- Welding helmets and handshields
- Full facepiece respirators



**3M**



# ANSI Z87.1-2003 Summary



## Requirements:

- Frame and lens tested together as a system
- Required markings must be placed on protective eyewear:
  - Compliance w/ standard “Z87”
  - High Impact will indicate “Z87+” or “+”
  - Manufacturer’s mark e.g. “3M”
  - Special purpose (tinted lenses) “S” **\*NOT FOR WELDING\***

## What to Look For:

- ANSI required mark “Z87, Z87+ or +”

## Where to Look:

- Glasses
  - Frame and/or lens
- Goggles
  - Frame and/or lens
- Faceshields
  - Frame/crown and window/faceshield
- Welding Shield
  - Frame, cover plate, lens, and/or ADF
- Full Face Respirator
  - Faceshield

**Limitations:** Eye and face protection products help provide limited eye and face protection against flying particles. **Misuse or failure to follow warnings and instructions may result in serious personal injury, including blindness, or death.**





# Lens Coatings



- **Coatings protect the lens like paint protects a car**
  - Polycarbonate is very soft – a tissue will scratch it
  - Coated lens will last longer
  - Help provide better vision/acuity over time
  - Less annoyance from scratches
  
- **Hard Coat**
  - Original coating available for polycarbonate lenses
  - Main purpose = abrasion resistance
  - Usually good chemical resistance
  
- **Anti-Fog - Hard Coat**
  - Two coatings in one
  - Provides both abrasion resistance and helps to prevent fogging
  - Eliminates the need to buy glasses with two different coatings



# Lens Cleaning



- If possible **do not** dry wipe a lens
  - Can scratch lens material
- Wash under running water with a mild soap and pat dry
- Use a liquid lens cleaner with a lens cleaning tissue or cloth
- Use a pre-moisten lens cleaning towelette
- If no liquids available, blow off or lightly brush-off particles then gently dry wipe



# Wearing of Contact Lenses While Welding

## ■ OSHA\* States:

- “If properly protected in accordance with the OSHA Standards applicable to eye protection (ANSI Z87.1-1968) during the welding operation the use of **contact lenses** is **acceptable**. The exception to this would be where the welding process may produce gas or vapors that could be harmful to employees wearing contact lenses.”
- A person with contact lenses is to be considered as a person without eye protection.
  - Primary eye protection (e.g. safety glasses) is required if wearing contact lenses.
  - Dust & vapors may pose problems to contact lens wearers.

\*Source: OSHA Standard Interpretation October 22, 1982.



# ANSI Z87.1-2003 Welding Helmet Requirements

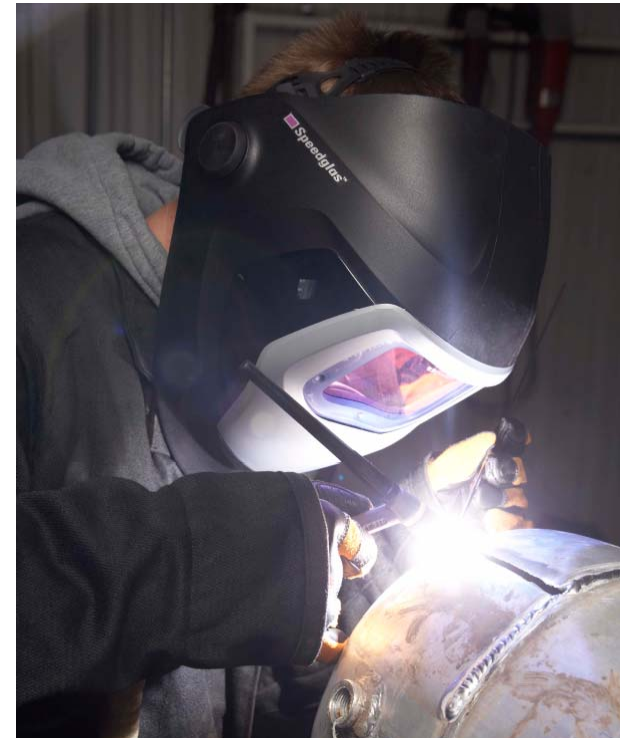


- Specifies testing requirements for welding shade filters and helmets
  - Must meet both impact testing and transmittance requirements for welding filters
  - Switching index defined for Auto Darkening Filters (ADFs)
- Requires use of safety glasses in combination with all welding helmets
  - Applies to any welding shield that can be flipped up
- ANSI approved welding helmets and filters required by OSHA (USA)



# ANSI Z49.1 Shade Recommendations

Welding Process	Arc Current (Amperes)	Minimum Protective Shade	Suggested Protective Shade (Comfort)
Shielded Metal Arc Welding (SMAW)	Less than 60	7	-
	60 to 160	8	10
	160 to 250	10	12
	250 to 550	11	14
Gas Metal Arc Welding (GMAW)(MIG)	Less than 60	7	-
	60 to 160	10	11
	160 to 250	10	12
	250 to 550	10	14
Gas Tungsten Arc Welding (GTAW)(TIG)	Less than 50	8	10
	50 to 150	8	12
	150 to 500	10	14



- Dependent on welding process and amperage
- Varies according to individual and viewing distance

# Eye and Face Protection Products for Welding



**Welding Helmet w/ ADF**

**Welding Helmet over Safety Glasses  
w/ Respirator**



**ANSI Z87.1 Eyewear**



**Welding Goggle**

**Loose-Fitting Welding  
Respirator (PAPR)**



# New Technologies - Eye/Face Protection for Welding and High Heat Applications

- Meet ANSI Z87.1-2003 impact requirements
- Additional eye and face protection for arc flash, UV and IR hazards
- Specialty coatings provide optimal light transmission for greater visual acuity and increased UV/IR attenuation
  - Eliminate need for green shaded safety glasses



# Eye and Face Protection

## Review Questions

1) **According to Prevent Blindness America, how many workplace eye injuries occur per day?**

- a) 1000
- b) 50
- c) >2000
- d) 10

2) **Which of the following may cause welding-related eye injuries?**

- a) Flying particles
- b) Hot molten metal
- c) Airborne substances
- d) Arc radiation
- e) All of the above





# Eye and Face Protection

## Review Questions

3) What is another name for photokeratoconjunctivitis?

**Arc Eye, Flash Burn, Welder's Flash**

4) Where can performance requirements for safety glasses, goggles and welding helmets be found?

a) 29 CFR 1910.134

**b) ANSI Z87.1-2003**

c) Declaration of Independence

5) **True or False** – If I'm wearing a welding helmet, no additional eye or face protection is required.



# Thank you!



## Welding Health and Safety Topics

3M Occupational Health and Environmental Safety Division

 **Speedglas™**

**3M**