Infrared Radiation: Defending Against the Invisible Workplace Hazard

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It may be there, but you can’t see it. Infrared radiation (IR) exists wherever there are sources of heat, such as cutting, brazing, welding, laser or furnace operations. It can cause long-term, permanent damage to your eyes that can lead to impaired vision or blindness.

You can’t always see it, but you can feel it. Infrared radiation or “IR” is electromagnetic radiation in the range between visible light and microwaves and is perceptible in the form of heat. Sit by the fireplace and the warmth you feel is infrared radiation. As with most hazards, though, small doses don’t pose a real threat. IR exposure in the workplace, however, is typically more intense and presents a risk for high level exposures in daily work-related tasks.

The infrared range on the electromagnetic spectrum falls just beyond visible light and just short of microwaves, and is categorized as non-ionizing radiation (which also includes ultraviolet, microwaves and radio frequency). Near infrared is the closest to visible light, while far infrared is closest to microwaves. Both are invisible to the eye, but can cause irreversible damage to the eye. Near IR (IR-A; 700-1400 nanometers) has the most energy, due to its shorter wavelengths, and is therefore the most hazardous. It passes through the lens of the eye to the retina, or is refracted from other tissues.

Where do IR hazards exist?

The workplace is host to a variety of IR hazards, including both short and long term exposures that represent real health risks. Examples of operations that produce infrared radiation include welding, cutting, brazing, furnace operations, pouring, casting, hot dipping, glassblowing, lasers and high-intensity light sources. Other less common industrial sources of IR include curing of coatings, forming of plastics, annealing, plastic welding and print drying. Each of these represents a different level of exposure and should be evaluated to determine the proper personal protective equipment (PPE) required.
Occupations that require workers to spend several hours a day in the sun should also be considered for potential IR hazards. Although there is some debate regarding the connection between sun exposure and damage to vision from infrared, precautions should be taken nonetheless. There is evidence that, in some cases, infrared can act as a catalyst to damage caused by ultraviolet radiation. IR exposure also results in dryness and eye fatigue, which can affect worker safety and productivity.

**How does IR exposure damage your vision?**

The eye disease most commonly associated with IR exposure is cataracts. Many people are familiar with the term “glass blower’s cataracts” or “furnace men’s cataracts”, since there is a long-term correlation with those particular occupations and the development of cataracts. The prolonged exposure to infrared radiation emanating from heated glass or molten steel causes a gradual but irreversible opacity of the lens.

Thermal injury from laser or other intense light sources occurs when infrared radiation elevates the temperature of the eye beyond normal, affecting proteins and other components of the retina. A phenomenon called photocoagulation produces tissue damage in the form of retinal scarring. (1) The *American National Standard for Safe Use of Lasers*, ANSI Z136.1, can be referenced when those hazards may exist.

Other forms of damage to the eye from IR exposure include scotoma, which is a loss of vision in a portion of the visual field resulting from damage to the retina where radiation is absorbed. Even low-level IR absorption can cause symptoms such as simple redness of the eye, but higher levels can lead to swelling, hemorrhaging and lesions. (2)

**How do you measure IR exposure in the workplace?**

The American Conference of Governmental Industrial Hygienists (ACGIH) guideline for IR-A exposure of the anterior of the eye is a time-weighted total irradiance of 100 watts per square meter for exposure durations exceeding 1,000 seconds (16.7 minutes) (ACGIH 1992 and 1995).

Measuring IR in various workplace settings can be a complex process involving costly equipment. However, a variety of industrial sources have been measured and guidelines issued for protection against many of these hazards. OSHA requirements regarding filter lenses for various occupations are provided under OSHA Standards 29 CFR 1910.133(a)(3) for general industry, 1915.153(a)(4) for maritime, and 1926.102(b)(1) for construction. In addition, many manufacturers of known IR-emitting equipment, such as high-intensity light sources, provide data that will help determine hazard evaluation.
How do you prevent damage to vision from IR exposure?

If the hazard cannot be engineered out of the operation or effectively shielded from the individual, then a variety of protective equipment can be used to reduce exposure. Protective eyewear, goggles and/or face shields are available with IR absorbing (or reflective) lenses that have shade designations according to the level of protection the lens provides.

Be careful not to mistake a “tint” for a “shade”. This is one of the most common misunderstandings in selecting the proper PPE for IR protection. While tinted lenses and shade lenses have very similar physical appearance, they do not provide the same level of protection. The key difference is that a shade lens (or filter lens) will attenuate up to a certain level of infrared radiation, reducing the level of IR exposure to the wearer, while a tinted lens will not. Many people believe that any green lens provides IR protection, but that is simply not the case. Non-glass lenses that have simply been tinted green provide no IR protection at all.

The fact that green tinted lenses look the same as green glass lenses creates a false sense of security, which may lead to an even more hazardous situation. In the case of a green tinted lens, the reduced light transmission will cause the wearer’s pupil to dilate, allowing more light into the eye. If the wearer is then exposed to IR radiation, the level of exposure to IR has actually been increased as a result.

U.S. Safety provides a range of infrared protection products, including the InfraSpec™.

What about green glass lenses?

Green glass lenses do provide some IR protection due to their inherent IR absorbing properties. Green glass has been used for decades to protect workers from IR, most commonly in steel making and glass blowing operations. Green glass, however, has its limitations. Glass lenses do not meet the ANSI Z87.1 standard for high impact and are much heavier than plastic and polycarbonate lenses. Prescription lenses made with green glass also vary in thickness, resulting in inconsistent levels of IR protection provided to the wearer. This is especially true of green glass bifocal lenses, since the bifocal is typically made of clear glass and infused into the green glass lens, therefore further diluting IR absorption.

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The American National Standard for Occupational and Educational Personal Eye and Face Protection Devices, ANSI/ISEA Z87.1-2003, from the International Safety Equipment Association requires PPE manufacturers to mark lenses intended for infrared protection with a shade number (such as “3.0” for shade 3) according to Table 1 found in the standard. The manufacturer is also required to provide test results supporting this, upon request. Look for this marking and only buy from reputable sources to help ensure that your PPE offers the proper level of protection.
Are there other options for IR protection?

Fortunately, green glass lenses are not the only solution. New technologies have been developed that allow the use of plastic and polycarbonate lenses for IR protection through a specialized process that imbues IR-absorbing dyes into the front of the lens. The result is a consistent level of IR absorption across the entire lens, combined with the superior impact protection and lighter weight of plastic and polycarbonate lens materials. This holds true for prescription and non-prescription wearers alike when using IR-absorbing dyes, since the level of IR protection is not affected by lens thickness.

An even greater advantage of the new IR-absorbing dyes is that you are no longer limited to a green lens. A variety of lens colors are available, including various shades of gray and brown. U.S. Safety even offers a “neutral gray” IR polycarbonate lens that meets both the high-impact requirements of ANSI Z87.1 and the stringent requirements for color recognition specified by the ANSI Z80.3 standard, *Ophthalmics – Nonprescription Sunglass and Fashion Eyewear Requirements*. These lenses are ideal for transportation and utility workers who are exposed to IR from the sun and require the ability to distinguish between certain colors on the job, including traffic signals.

As awareness of IR hazards in the workplace has increased, so has the demand for innovative solutions to protect workers. Some occupations only expose workers to IR for brief periods, but it still presents a hazard. At the same time, their occupation requires 100-percent eye protection from impact. Polycarbonate IR lenses provide impact protection, but they also reduce light transmission, so workers typically switch between clear and IR protective eyewear while on the job. While switching glasses, they are potentially exposed to impact hazards with no protection. U.S. Safety solved this problem by developing the InfraSpec™ with clear polycarbonate lenses and a flip-up IR absorptive lens, so the worker has IR protection available when and where they need it, with a flick of the wrist. The InfraSpec™ is also accepts a prescription.

What next?

Consider the potential IR hazards in your operation, including short- and long-term exposures. Remember that hazardous IR often does not have a visual component associated with it, and therefore is the most dangerous. Refer to OSHA guidelines for specific operations as well as data provided by makers of IR-emitting equipment, and perform a professional evaluation if necessary. If the hazard can’t be eliminated, a variety of PPE is available to reduce exposure to workers. Taking action now will help preserve the immediate and long-term health of individuals in your operation, improve productivity and ensure compliance with OSHA standards.


ABOUT THE AUTHOR

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For more information and a complete list of U.S. Safety products designed to protect workers from IR Hazards, go to [www.ussafety.com](http://www.ussafety.com) and Search for “Infrared Protection”.

U.S. Safety Customer Support:

Call U.S. Safety at 1-800-821-5218, 7:30am – 5:00pm Central Time

Visit the U.S. Safety website at [www.ussafety.com](http://www.ussafety.com) and click on “Contact Us”.