based disinfectant that contains at least 60% alcohol, it should be noted that special coatings, plastics, and optics can be susceptible to damage due to improper cleaning, so be sure to check with your suppliers for the recommended specifications.

As important as it is to protect yourselves, we all have a duty to maintain a safe environment for our colleagues. One important way to achieve this is to maintain an awareness of space; ensuring that those working around you are also observing safe habits or maintaining safe distances can do a lot to prevent injury from accidents. Communicating these dangers should be an important and regular part of treatment setup. Signage, staff email announcements, and simple verbal questions are very effective in getting the word out that dangerous activities are or will be underway in common space. Further, all staff should receive training on emergency shower and eye-wash usage, and someone on staff should be designated to be sure it is clean, functions well, and remains accessible. [See accompanying PPE Eye/Face Protection Article for more details]

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RESOURCES

American Optometric Association (AOA). *Protecting your eyes at work*. Accessed November 05, 2015. http://www.aoa.org/patients-and-public/caring-for-your-vision/protecting-your-vision

American Optometric Association (AOA). *Conjunctivitis.* Accessed November 05, 2015, http://www.aoa.org/patients-and-public/eye-and-vision-problems/glossary-of-eye-and-vision-conditions/conjunctivitis

Canadian Centre for Occupational Health and Safety (CCHOS). *Contact Lenses at Work*. Accessed October 22, 2015 http://www.ccohs.ca/oshanswers/prevention/contact_len.html

Centers for Disease Control and Prevention. *Preventing the Spread of Conjunctivitis.* Accessed October 22, 2015. http://www.cdc.gov/conjunctivitis/about/prevention.html

Goldberg, L., D. Kushel, N. Odegaard, and A. Sigel. 2010. Conservation. In *Health & Safety for Museum Professionals,* ed. C. Hawks et al. New York: Society for the Preservation of Natural History Collections. 569-607.

Hovander O.D, M. 2015. Personal communication. University Vision Clinic. Seattle WA.

LASIK Vision Institute. *LASIK Laser Eye Surgery Results.* Accessed 22 October 2015. http://www.lasikvisioninstitute.com/lasik-results/

Makos, K., D. C. Ertel and Michael McCann. 2010. Occupational Hazard Control. In *Health & Safety for Museum Professionals,* ed. C. Hawks et al. New York: Society for the Preservation of Natural History Collections. 127-178.

Occupational Health & Safety Administration (OSHA). *Laboratory Safety Ergonomics for the Prevention of Musculoskeletal Disorders.* Accessed October 22, 2015. https://www.osha.gov/Publications/laboratory/OSHAfactsheet-laboratory-safety-ergonomics.pdf

Occupational Health & Safety Administration (OSHA). *Laboratory Safety Guidance.* Accessed October 22, 2015. https://www.osha.gov/Publications/laboratory/OSHA3404laboratory-safety-guidance.pdf

Occupational Health & Safety Administration (OSHA). *Eye and Face Protection E-tool.* Accessed October 22, 2015. https://www.osha.gov/SLTC/etools/eyeandface/faqs.html

Rath COT, S. 2015. Personal Communication. University of Washington Eye Institute. Seattle, WA.

Shulte PH.D, P.A., H.W. Ahlers J.D., L.L Jackson Ph.D., B.D. Malit M.D., and D.M. Votaw. Contact Lens Use in a Chemical Environment. 2005. NIOSH (National Institute for Occupational Safety and Health). http://www.cdc.gov/niosh/docs/2005-139/pdfs/2005-139.pdf

Thompson M.D., V. How Long is the LASIK Recovery Time. 2015. All About Vision. Accessed October 22, 2015. http://www.allaboutvision.com/visionsurgery/faq-recovery-time.htm

U.S. Department of Energy National Laboratory. *Microscopy and Ergonomics: Recommendations and Simple Tips for Adjusting your Microscope Workstation*. Accessed November 02, 2015. http://www2.lbl.gov/lsd/Safety/assets/Microscopy%20and%20Ergonomics%20v2.pdf

University of California, Davis. *Microscope Ergonomics.* Access October 22, 2015. http://safetyservices.ucdavis.edu/ps/ebm/le/microscope-ergonomics

Waldhausen RN3, J. 2015. Personal Communication. University of Washington Medical Center. Seattle, WA.

PPE III: WORKING ON A JOB REQUIRING EYE OR FACE PROTECTION?

HERE'S WHAT YOU NEED TO KNOW!

Work hazards are minimized through engineering controls or eliminated altogether through safer methods or non-toxic materials. But sometimes, Personal Protective Equipment (PPE) must be worn as well. PPE can serve as an effective safety barrier as long as it is selected to protect the worker against the specific hazards (See "Job Hazard Analysis," *AIC News*, Vol. 39, No. 6, Nov. 2014, pp. 13-16). PPE has to be properly maintained and worn because if it fails, you are exposed to the full force of the hazard. Remember: PPE only protects the worker wearing it, not other bystanders in the area. Even in museum work, industrial hazards exist and industrial controls must be enforced.

Eye and Face Protection

Eye and face protection is required when employees are exposed to flying objects, particles, or other impact hazards; burns from sparks or molten metal; splashes from hazardous liquid chemicals; irritation from gases and vapors; or hazardous light radiation. OSHA eTool website has an excellent training tool and guide to help you select the proper eye/face protection based on the task hazard (OSHA 2015).

SAFETY GLASSES

Basic safety glasses (spectacles) offer frontal impact protection only, and will not protect the eyes from mists, dusts, gases, vapors, or liquid splashes. The addition of side shields offers additional but limited eye protection from lateral hazards.

Safety glasses with specially tinted lenses are designed to protect against impact and optical radiation hazards by reducing transmittance of specific wavelengths of concern (e.g., ultraviolet light sources, sunlight in outdoor work, lasers, blast furnaces). They are designated by shade numbers corresponding to the radiation hazard. (see Markings section)

People who wear eyeglasses can obtain prescription safety glasses through a qualified optician, have a special prescription built into their goggles, or can wear flexible or cushioned goggles over their eyeglasses. Regular eyeglasses or contact lenses are not considered adequate protection against flying particles because they do not meet American National Standards Institute (ANSI) impact-resistant standards.

SAFETY GOGGLES

Safety goggles are the choice for protection against splash or irritation from liquid chemicals, gases, or fine particulates. They are also rated for impact protection and may provide optical radiation protection if tinted to the appropriate shade. They are designed to fit snugly and are designed in three basic configurations:

- ***Direct vented*** goggles have air holes or slits on the top and sides of the goggle and provide direct air passage (fig 1). While this air circulation prevents fogging, it offers the least protection against chemical splash and should not be used where splash hazards are a real possibility. This design minimizes entry of large dust particles.
- ***Indirect vented*** goggles have deflector caps over the side and top ventilation holes and may prevent the direct entry of chemicals into the goggle, while providing some relief from fogging. (fig 2).
- ***Unvented goggles*** (fig. 3) prevent air circulation and are to be used when the hazard is a gas or vapor that can be irritating to the eyes or easily absorbed through the eye (such as ammonia, formaldehyde and methylene chloride). OSHA's Methylene Chloride Standard (29CFR1910.1052) App A, for instance, recommends splash-proof goggles to prevent the highly injurious effects to the eye from vapor. Safety Data Sheets and chemical container labels must indicate whether the chemical is classified as an irritant and should also specify whether a non-ventilated goggle is required. Look up those chemicals on OSHA's regulatory website to see if specific recommendations are offered. Tight-fitting, closed design prevents chemical splash entry, and are to be used when the risk is high of substantial liquid chemical splash.

FACE SHIELDS

When working with large volumes of hazardous materials, where the potential exists for significant chemical splash to the face, neck, and ears, face shields, in addition to safety glasses or goggles, should be worn. Face shields do not offer adequate impact protection and so must never be worn alone (if impact is a concern), but always over the appropriate type of safety spectacle or goggle.

Fig. 1. Direct vented goggles

Fig. 2. Indirect vented goggles

Fig. 3. Unvented goggles

WELDING HELMETS (WITH TINTED WINDOWS) AND GOGGLES FOR OPTICAL RADIATION HAZARDS

Welding helmets are a type of face shield designed to provide substantial protection to the user's eyes, ears, face, and front of neck against weld splatter, and have a tinted window (meeting the appropriate transmittance requirements) to protect against optical radiation. As with any face shield, welding helmets are only to be worn over safety glasses or goggles. Ultraviolet, infrared, and visible glare radiation require goggles with appropriate degrees of shading to protect against the intensity of the radiation. Processes in which this type of protection is needed include welding, brazing, furnace operations (including kilns), molten metals, and carbon arcs, for example. A general rule of thumb is to use the darkest shade possible, while still having visibility.

FULL-FACE RESPIRATORS

Full-face respirators are typically designed with, and certified for, impact resistant face windows; be sure that the model selected has this certification marking on it as well as certification as a respiratory protection device.

Standards for Eye and Face Protectors

Eye and face protectors should meet the professional consensus standards incorporated into a given country's regulations. These types of performance standards focus on selection, use, and maintenance, and will typically test eye and face protectors for various levels of impact and penetration resistance (using different masses and varying velocities), thickness, degree of light transmittance, flammability, corrosion resistance, cleanability, and ventilation circulation requirements. In Canada, for example:

- CAN/CSA-Z94.3-07 *Eye and Face Protectors* (Canadian Standards Association (CSA) 2007a)

In the U.S., eye and face protection requirements are outlined in OSHA 29 CFR 1910.133, which requires that eyewear be constructed in accordance with any of the last three ANSI standards:

- ANSI Z87.1-2015 (or -2010, or -2003), *American National Standard for Occupational and Educational Personal Eye and Face Protection Devices*

The latest standards are organized by the nature of the hazard–impact, optical radiation, droplet and splash, dust and fine dust, and mist. This focus encourages users to evaluate the specific hazards that they are exposed to and to select appropriate protection based on that evaluation. Users will have to match the hazard that they need protection from with the marking on the device (ANSI/ISEA 2015). This is another reason to strongly encourage conservators to use the Job Hazard Analysis process explained in *AIC News*, November 2014.

MARKINGS

The consensus setting organization (see above) will designate what markings to look for on duly tested and certified eye protectors. ANSI Z87.1-2015 requires that protector markings shall be placed in relatable proximity to each other on the product in the sequence specified below:

1. Manufacturer's distinct marks or logos
2. Designation of standard (Z87 or Z87-2, for prescription devices)
3. Followed by individual claims of compliance based on test results per this standard:
    - "+", if rated for impact protection
    - Lens Type and Shade Number
        - Clear-no mark;
        - Welding filter; W and Shade Number (Shades range from 1.3 to 14 – the higher the number the darker the lens)
        - UV filter; U and Scale Number (Scale ranges from 2 to 6 – the higher the number the highest protection from far and near UV)
        - Visible Light filter; L and Scale Number (Scale ranges from 1.3 to 10 – lower numbers providing greater light transmittance)
        - IR filter R and Scale Number (Scale ranges from 1.3 to 10 – lower numbers
        - Variable Tint=V
        - Special Purpose Lenses=S
    - Use Applications
        - D3 = Splash/Droplet
        - D4 = Dust
        - D5 = Fine Dust

Example provided by Sperian Eye and Face Protection, Inc (2015): The marking BDZ87+U6D3D4 indicates a Sperian [logo=BD] impact rated goggle [Z87+] that provides superior UV filtration [U6] and protection against splash and dust hazards [D3D4].

INSPECTION AND USE

Protectors that have been subjected to impact, have broken parts, or have lenses with distortion or excessive scratches should be discarded and replaced. Reasonable care and cleaning (non-abrasive cleaners) and sensible storage methods should be followed.

The Use of Contact Lenses in an Eye Hazard Environment

Contact lenses do NOT provide ocular protection from hazards such as particles, bioaerosol droplets, chemicals, and radiant energy. Therefore, individuals who wear contact lenses (provided there are no other prohibitions against their use, see below) are required to combine them with appropriate industrial safety eyewear. Without such added eyewear protection, dust intrusion under the lens will cause corneal scratching, and soft contact lenses may absorb hazardous gases and vapors. Various studies have indicated that the benefit of optimum visual acuity for the worker outweighs any potential problems from, for instance, dry eyes in an unvented goggle or full-facepiece respirator (ACOEM 2008).

However, an eye hazard job evaluation must first be conducted by a competent industrial hygienist or safety professional (preferably in consultation with the facility medical personnel) to ensure that the use of contact lenses in any particular work situation is: 1) not banned by regulations, 2) not contraindicated by medical recommendations, or 3) not restricted under current OSHA standards such as working with acrylonitrile, 1,2 dibromo-3-chloropropane, ethylene oxide, methylene chloride, or 4,4'-methylene dianiline.

Workplaces need to conduct an eye hazard job evaluation, provide suitable eye and face protection to all workers exposed to eye hazards (regardless of contact lens wear), establish and communicate any restrictions in that workplace for use of contact lens, instruct workers who wear contact lenses to remove them at the first sign of eye irritation or redness, and instruct all workers who wear contact lenses and any first aid personnel to begin eye irrigation and lens removal immediately in the event of a chemical exposure (NIOSH 2005).

Emergency Eyewash and Safety Showers

OSHA 29CFR1910.151(c) states "Where the eyes or body of any person may be exposed to injurious corrosive [or irritant] materials, suitable facilities for quick drenching or flushing of the eyes

and body must be provided within the work area for immediate emergency use." "Immediate" means installed in an area that is well-lit, on the same level as the hazard, and can be reached in less than 10 seconds. That also means the path of travel must be kept completely unobstructed and as straight as possible from the work site since the injured person may not have assistance and may be temporarily blinded by the chemical.

These placement requirements are very important to consider if you decide to (or need to due to space limitations in your work room) install a faucet-mounted emergency eye wash over a sink. The sink still must be near to the hazard source AND you must ensure there is enough overhead clearance for under-cabinet faucet-mounted eyewashes to prevent head injuries and not provide an obstacle to reaching that eyewash. You will need to consult with (or make sure your maintenance/installer follows) the most current ANSI/ISEA Z358.1 standards for important performance specifications, such as the ideal pressure, temperature, and duration of delivery of the water (or flushing fluid), as well as testing and maintenance requirements.

There are two types of eye wash stations:

- Plumbed, where an eye wash is permanently connected to a continuous source of potable water
- Gravity-fed (self-contained), a stand-alone system that contains its own flushing fluid which must be refilled or replaced after every use and changed out regularly within the manufacturer's shelf-life instructions, to minimize microbial growth.

In each case (and most importantly for self-contained units) the eye wash system must be capable (and have enough fluid in the self-contained units) of delivering tepid fluid for at least 15 minutes at continuous flow and pressure.

The on/off flow valve, once activated by the user, should be able to remain on without additional force from the user (i.e., hands-free). Eyewash jets should be covered when not in use to prevent contamination; most units have loose-fitting plastic covers on chains that easily pop off when flow is activated. Units should be completely inspected and tested at least annually, or in accordance with your local regulations, and tagged with the inspection date. However, each eyewash and showerhead should be activated briefly at least weekly to remove any sediment or microbial growth that will most likely accumulate in standing waterlines. Inspections must also ensure that both eyewash jet streams cross each other properly and with sufficient pressure flow.

Corrosive damage to the eyes and body tissue starts immediately upon contact so everyone at risk should be drilled as to the proper response. This type of drill should include a practical exercise in finding the eyewash and shower station with eyes closed, and then trying to hold your eyelids open during a continuous flush period (much more difficult than it sounds).

DISPOSABLE PERSONAL EYEWASH BOTTLES AND DRENCH HOSES

(These should be considered "supplemental" devices, NOT your primary eye wash equipment!) "Personal wash units" are containers that contain a fluid of dubious composition; however, they cannot provide enough pressure or volume to flush adequately and should only be used as a first response *while on the way to an approved eyewash or shower.* They are cheap and easy to mount especially in remote locations.

But beware! Pay careful attention to the expiration date on the container, as the fluid will eventually support harmful microbial growth. Plus, they only rinse one eye at a time! Is that a choice you want to make after a corrosive eye splash? Either install a plumbed eye wash station near your lab sink or invest in a self-contained unit with robust pressure delivery power and enough fluid to provide you with 15 minutes of continuous flow.

A drench hose is another supplemental device usually found as a sink attachment with typically one nozzle. These can be considered effective and approved eyewashes but only if they provide adequate water pressure, duration of flow, and can deliver a wide enough stream radius to flush both eyes simultaneously. With this in mind, drench hoses can be effective skin wash as well but only for situations in which the risk of skin contact is of a small area (otherwise a full drenching shower would be needed).

CITATIONS

Credit: Partial reprint from Ch 5 of *Health and Safety for Museum Professionals* (2011), Hawks et al, Society for the Preservation of Natural History Collections, New York

American College of Occupational and Environmental Medicine (ACOEM). 2008. Use of contact lenses in an industrial environment. http://www.acoem.org/ContactLenses_IndustrialEnvironment.aspx 22 Oct 2015.

American National Standards Institute/International Safety Equipment Association (ANSI/ISEA). 2015. American National Standard Occupational and Educational Personal Eye and Face Protection Devices ANSI/ISEA Z87.1-2015. American National Standards Institute, New York, NY

American National Standards Institute/International Safety Equipment Association (ANSI/ISEA). 2014. American National Standard for Emergency Eyewash and Shower Equipment. ANSI/ISEA Z358.1-2014. American National Standards Institute, New York, NY.

Grainger Personal Protective Equipment (PPE) Requirements: Eye & Face Protection Quick Tips #125. https://www.grainger.com/content/qt-personal-protective-equipment-requirements-125. Accessed 30 Nov 2015.

National Institute for Occupational Safety and Health (NIOSH). 2005. *Current Intelligence Bulletin 59: Contact Lens Use in a Chemical Environment*. http://www.cdc.gov/niosh/docs/2005-139 22 Oct 2015.

Sperien/Uvex. 2015. https://www.uvex.us/uploadedfiles/productconfiguration/productliterature/Uvex-Ansi-Z871-FAQ.pdf Accessed 2 Dec 2015.

US Department of Labor, OSHA. 2015. Eye and Face Protection eTool. eToolhttps://www.osha.gov/SLTC/etools/eyeandface/ppe/selection.html. Accessed 4 Dec 2015.

US Department of Labor, OSHA. Methylene Chloride. 1910.1052 App A. https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10095. Accessed 3 Dec 2015.

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