

Above the Shoulders PPE for Flood and Hurricane Recovery

Description

The devastation and human toll brought on by natural flooding and hurricanes can be enormous. Individuals participating in flood and hurricane related activities face a range of work-related hazards, such as:

- hazardous materials,
- biological agents,
- eye/head/face hazards,
- noise,
- and heat stress.

From the start of the recovery period as waters recede, through the clean-up and eventual rebuilding, the need for personal protective equipment (PPE) is essential.

The requirement for PPE applies not only to the professional worker, but also the businesses and homeowners attempting to protect and salvage their property, and the numerous volunteers who are willing participants. As these individuals represent such a diverse group, their knowledge and experience in the use of PPE may vary significantly. At a minimum, a basic understanding of the use and limitations of each type of PPE is necessary. For professional workers falling under the scope of the Occupational Safety and Health Administration (OSHA), specific regulatory requirements apply when using PPE. For others, following basic best practice guidelines will help reduce exposures to flood and hurricane related hazards. If questions arise concerning the proper use of PPE, refer to the product *User Instructions* or contact the manufacturer directly.

The following is a discussion of above the shoulders PPE including respiratory, hearing and head/eye/face protection during flood recovery and cleanup efforts. Clearly, there may be a need in many situations for other full body protection in the form of protective footwear, clothing, gloves, etc. Refer to the following websites for a comprehensive discussion on this topic.

- Centers for Disease Control and Prevention (CDC) <https://www.cdc.gov/disasters/index.html>
- Environmental Protection Agency (EPA) <https://www.epa.gov/natural-disasters>
- Department of Homeland Security <https://www.ready.gov/prepare-for-emergencies>
- National Institute for Occupational Safety and Health (NIOSH) <https://www.cdc.gov/niosh/topics/emres/natural.html>
- Occupational Safety and Health Administration (OSHA) <https://www.osha.gov/SLTC/emergencypreparedness/index.html>

Respiratory Protection

Workers involved in flood recovery and clean-up face both obvious and hidden respiratory hazards. Many of these hazards do not become apparent until the waters have receded.

Mold¹

The flood aftermath can create optimal conditions for mold growth. On August 29 and September 24, 2005, hurricanes Katrina and Rita, respectively, made landfall along the Gulf Coast resulting in massive flooding in New Orleans and surrounding parishes. The duration and extent of flooding in these areas made the likelihood of massive mold contamination a certainty.

Many structures remained flooded for weeks after the hurricane. An assessment of homes in New Orleans and surrounding parishes of St. Bernard, East Jefferson, and West Jefferson (excluding the 9th Ward) identified an estimated 46% (>100,000 homes) with some mold contamination, and approximately 17% (40,000 homes) with heavy mold contamination. Similar massive flooding occurred in August 2016 in Louisiana, and on the on the coasts of Florida, Georgia, South Carolina and North Carolina in October 2016 after Hurricane Matthew.

Although molds can be found almost anywhere indoors or outdoors, they need moisture and nutrients to grow. Mold grows best in damp, warm environments. The availability of nutrients in indoor environments rarely limits mold growth as building materials including wood, wallboard, wallpaper, and upholstery can be nutrient sources. The main factor that limits mold indoors is lack of moisture. Flooding, particularly when floodwaters remain for days or weeks, provides an almost optimal opportunity for mold growth.

Subsequent to water damage, mold may begin to grow on a variety of building materials and surfaces, both in open and hidden locations. Hidden mold may occur in places such as the back-side of drywall, wallpaper or paneling, top side of ceiling tiles, and the underside of carpets and pads. Other areas of hidden mold may include areas inside walls around pipes, surface of walls behind furniture, inside ductwork, and in roof materials above ceiling tiles. Mold growth can occur in a relatively short time. Building contents constructed of absorbent materials (paper, cloth, wood, etc.) that have been wet for more than 48 hours are a likely location for mold growth. Disposal is typically the only remediation option for these materials. Smooth, hard surfaces such as metal and plastics can often be cleaned effectively.

Molds reproduce by means of tiny spores. The spores are invisible to the naked eye and become easily airborne. They're considered an inhalation hazard in that they release spores that are small enough to remain airborne. The typical size range for a mold spore is 2 microns (μm) – 10 μm aerodynamic diameter. Disturbing the mold in any manner can result in higher air concentrations. Aerosolization can occur in many ways, including disturbance of mold contaminated areas by human activity and dispersal of spores in contaminated surfaces of HVAC systems. Molds can also release low levels of volatile organic compounds (VOCs) that are thought to be the source of mold/mildew odors.

The Centers for Disease Control and Prevention (CDC) reports people with respiratory conditions (e.g. asthma) or allergies might be effected to a greater extent to mold than the majority of healthy adults. Those with weakened immune systems: patients with HIV infection, auto immune diseases, patients receiving chemotherapy, and people who have received an organ or bone marrow transplant may also be affected to a greater extent than the majority of healthy adults.¹

Dusts Containing Asbestos, Lead and Crystalline Silica

Cleanup and demolition in older buildings, both residential and commercial, can present exposure concerns to asbestos, lead and silica. All structures built prior to 1975 may contain significant amounts of asbestos. Asbestos containing materials were commonly used in boiler/pipe insulation, fireproofing, floor and ceiling tiles, roofing and siding materials. Many homes built prior to 1978 may contain lead-based paint. Prior to discovering the harmful health effects of lead, it was used in paint, gasoline, water pipes and many other products. Crystalline silica may be present naturally and in pulverized concrete. Any cleanup activity that involves disturbing debris can create airborne dusts, which may contain these and other harmful substances.

Bioaerosols

Floodwater often contains infectious organisms, including intestinal bacteria such as E. coli, Salmonella, and Shigella; Hepatitis A Virus; and agents of typhoid, paratyphoid and tetanus.² Pools of standing or stagnant water become breeding grounds for mosquitoes, which increase the risk of encephalitis, West Nile Virus or other mosquito-borne diseases. Although most cases of illness associated with flood conditions are brought about by ingesting contaminated food or water, exposures may also occur via skin contact and, to a lesser extent, inhalation. As a respiratory hazard, infectious agents may become airborne during certain clean-up activities such as pumping/aeration of floodwater.

Key Considerations for Respirator Selection

The general approach to respirator selection requires knowledge of the specific contaminant, the air concentration and the occupational exposure limit such as the OSHA permissible exposure limit (PEL) or (if lower) the threshold limit value (TLV) published by the American Conference of Governmental Industrial Hygienists (ACGIH). In the case of mold, lack of recognized exposure limits requires use of other criteria in the selection process. The CDC, EPA, OSHA, and the New York Department of Health and Mental Hygiene have published recommendation for selecting respirators for mold remediation activities based upon the size of the contaminated area.^{1,2,3,4} OSHA offers the following general guidance for respirator selection:

- For areas smaller than 100 ft²; use an approved respirator, at a minimum, either a half-face N, R, or P-95 respirator in conjunction with non-vented goggles, or full-face N, R, or P-95 respirators.
- For areas greater than 100 ft², areas where mold is heavy (blanket coverage rather than patchy), or areas where substantial dust is generated during cleaning or debris removal (e.g., abrasives are used to clean surfaces); use an approved respirator, at a minimum, either a half-face N, R, or P-100 respirator in conjunction with non-vented goggles, or full-face N, R, or P-100 respirators.
- Charcoal-impregnated filters may be used for odors.

Professional judgment that considers toxicity of the mold (if known), possibility of hidden mold, potential for aerosolization, and needs of the individual wearer should also be used when selecting respiratory protection. For low-level microbial VOCs that may be produced by mold, a carbon-loaded particulate filter offering nuisance level organic vapor relief, or an organic vapor cartridge used with an appropriate particulate filter may also be used. Gases and vapors associated with disinfectants (chlorine, chlorine dioxide, ammonia, etc.) should be measured, and may also warrant the use of an appropriate chemical cartridge with a particulate filter. The presence of lead or asbestos may require more protective respirators.

The CDC has prepared a chart containing population-specific recommendations for PPE, including respiratory protection, for protection against mold in flooded buildings. Refer to http://www.cdc.gov/disasters/mold/report/pdf/2005_moldtable5.pdf

Respirator selection for other potential air contaminants must also be considered. In many cases, respirators used for mold exposures may also be used for other anticipated air contaminants as well. Employers must select respirators based on OSHA requirements under 29 CFR 1910.134 Respiratory Protection Standard with consideration to the respirator manufacturer's product *User Instructions*. Consistent with current respirator selection practices, the following additional guidelines are offered when selecting respiratory protection for flood and hurricane recovery and clean-up applications:

- A 42 CFR Part 84 approved N-Series particle filter (e.g., N95, N100) may be used where no oil aerosols are present.
- An R-Series or P-Series particle filter may be used for both oil and non-oil aerosols. When used for oil aerosols, refer to the manufacturer product packaging for time use limitations.
- Dusts containing asbestos require a minimum of a half mask elastomeric respirator with a 100 level particulate filter. OSHA prohibits use of filtering facepiece respirators (disposables) for asbestos. Refer to 29 CFR 1926.1101 Asbestos Construction Standard for specific OSHA mandated respirator selection requirements.
- Dusts containing lead require a minimum of a 100 level filtering facepiece respirator or half facepiece respirator with 100 level particulate filters. Refer to 29 CFR 1926.62 Lead in Construction Standard for specific OSHA mandated respirator selection requirements.
- A filtering facepiece respirator or half facepiece respirator with appropriate cartridges/filters may be used up to 10X the PEL.

A comprehensive exposure assessment conducted by a qualified health and safety professional is recommended prior to completing work tasks in flood and hurricane affected areas. For homeowners, use of a properly qualified contractor to handle and remove common clean-up hazards including mold, asbestos and lead is often recommended in order to minimize exposures and potential adverse health effects.

Considerations for Respirator Training

Employers providing respiratory protection must comply with all requirements of OSHA's Respiratory Protection standard, 1910.134, including, but not limited to, medical evaluations, training and fit testing, prior to using respirators. The medical evaluation, which is used to determine if the person is physically able to wear a respirator, must be completed prior to the fit test. Fit testing provisions require that all workers wearing a tight-fitting, half or full facepiece respirator must pass a quantitative or qualitative fit test. Both respirator fit testing and employee training must be completed on a minimum annual basis.

Homeowners and volunteers, who do not necessarily have access to respirator training and fit testing programs, should, at a minimum, be made aware of basic information on the use and limitations of respirators. The following guidelines are offered for non-occupational users of respiratory protection during flood and hurricane clean-up:

- Homeowners should check with the local health department for recommendations on selecting the proper respirator.
- Volunteers should check with the organization/agency to determine if they have a respirator program for their volunteers. If not providing respirators, ask if they can recommend an appropriate respirator for the anticipated work.

IMPORTANT NOTE

All users should read and follow the manufacturer's *User Instructions* for the specific respirator to be used. Contact the respirator manufacturer if assistance is needed selecting a respirator.

- Wearing a respirator adds physical stress in the form of additional weight and increased breathing resistance. If you have any doubts concerning your ability to wear a respirator, contact your physician. Discuss the type of work you will be doing, the respirator you intend to use and the anticipated contaminants.
- Follow the respirator manufacturer's instructions for proper respirator donning and doffing procedures. A user seal check is required each time the respirator is worn. Also check instructions to determine if there are any time use limitations for the respirator.
- If wearing a reusable respirator, follow the respirator manufacturer recommendations for cleaning. Daily cleaning is typically recommended.

Other conditions including work rate, physical condition, and ambient temperature and humidity, should also be considered by the non-occupational user when making the personal decision to wear a respirator.

Hearing Protection

Between September and December, 2005, OSHA collected a variety of exposure data, including noise levels, on response and recovery workers in Gulf Coast regions impacted by hurricanes Katrina, Rita, and Wilma.⁵ Twenty percent of the 324 employees evaluated had noise exposure levels above the 90 dBA 8-hour permissible exposure limit (PEL). Over 40 percent of the monitored employees were exposed to noise levels at or above 85 decibels (dBA) 8-hour time weighted average (TWA). Hazardous levels of noise were most common among workers involved in debris collection, debris reduction, site clearing and transportation restoration activities. Some of the highest exposures (above 90 dBA) were associated with workers operating heavy equipment, chippers, chain saws and industrial vacuums.

In the United States, employers are required by OSHA to limit the 8-hour TWA noise exposure to 90 dBA or less. Employees exposed above 85 dBA 8-hour TWA must be enrolled in an employer-sponsored hearing conservation program, which includes annual audiometric testing and training. Homeowners and volunteers may also be subjected to high noise levels from the use of powered equipment. Refer to the following website for a comprehensive discussion on this topic.

https://www.cdc.gov/nceh/hearing_loss/how_do_i_prevent_hearing_loss.html

Key Considerations for Selection of Hearing Protection

Hearing protection is usually necessary when operating heavy machinery or power tools. Both earplugs and earmuffs are available. Hearing protectors are required under regulation to have a Noise Reduction Rating (NRR), which is the reduction (in decibels) that the hearing protection device (HPD) can provide when worn correctly in a controlled laboratory test. In the real world, a specific individual may receive less noise reduction than indicated by the NRR due to factors such as variation in hearing protector fit, fitting skill and motivation of the user. 3M strongly recommends fit testing of hearing protectors. If the NRR is used to estimate typical workplace protection, 3M recommends that the NRR be reduced by 50% or in accordance with applicable regulations.

Comfort is also an important factor to consider. If the HPDs are comfortable, they are more likely to be worn and to be worn correctly. Likewise, the hearing protectors must be compatible with the other gear that needs to be worn during a natural disaster response. Selecting a hearing protector that also offers communication capabilities is a vital consideration when both noise attenuation and communication between response workers is needed. Hearing protectors are available that physically connect to portable radio systems, or provide all-in-one, fully contained wireless protective communication solutions. Level-dependent environmental microphones are also available to help wearers maintain important situational awareness and face-to-face communications, while still protecting them from harmful noise levels. Environmental microphone capabilities can commonly include:

- Sampled impulse/impact and steady-state sound levels are limited to 82 dB or less
- Quiet or softer sounds can be amplified

Dual active hearing protection (electronic earmuff with electronic earplugs) will provide a slightly increased level of hearing protection while still allowing audibility and situational awareness.

Additionally, the hearing protectors must be compatible with the other gear that needs to be worn during a natural disaster response.

Head, Eye and Face Protection

NIOSH has identified potential eye, head and face hazards during emergency response and disaster recovery to include impact and airborne dusts from concrete and metal particles; falling or shifting clean-up debris, building materials and glass; smoke and noxious or poisonous gases; chemicals (acids, bases, fuels, solvents, lime, and wet or dry cement powder); cutting or welding light and electrical arcing; thermal hazards and fires and; bloodborne pathogens from (hepatitis or HIV) from blood, body fluids, and human remains.⁷ Common injuries include corneal abrasions and conjunctivitis, concrete or metal particles or slivers embedded in the eye, chemical splash or burn, welder's flash, lacerations, facial contusion and black eye.

Head Protection

Head protection is necessary in any situation where:

- There is a risk from being struck by falling objects.
- A person may strike their head against a fixed or protruding object.
- Accidental head contact with an electrical hazard exists.
- If required to do so by an employer or other authority in control of the job site

Selection of an appropriate safety helmet is dependent on the task performed. Look for a safety helmet that meets necessary impact and electrical insulation requirements of the American National Standards Institute (ANSI) Z89.1-2014. This standard describes the minimum physical and performance requirements for protective helmets. These requirements are classified by impact type and electrical class.

A Type I helmet is intended to reduce the force of impact resulting from a minor blow only to the top of the head. These are the most common helmets in the industry. A Type II helmet is intended to reduce the force of impact resulting from a minor blow to the top or sides of the head. These helmets are used where there is higher risk from objects swinging and bumping the worker on the side of the head. Electrical ratings include Class C (Conductive), Class G (General) and Class E (Electrical). Class G and Class E helmets are intended to reduce the danger of contact with low and higher voltage conductors and are tested at 2,200 volts and 20,000 volts (phase to ground), respectively. These voltages are not intended as an indication of the voltage at which the helmet protects the wearer.

The safety helmet consists of two main components, the outer shell and the suspension. The outer shell is a rigid material generally made from high density polyethylene, which offers a barrier against impact. The suspension is an integral part of the safety helmet. It is designed to act as an energy-absorbing mechanism during an impact incident. In combination, the safety helmet is designed to provide limited protection against impact, flying particles or electric shock. It is important to select an appropriate safety helmet for the hazards specific to the tasks performed.

Eye and Face Protection

Eye and Face Protection Prevent Blindness America (www.preventblindness.org/ten-ways-prevent-eye-injuries-work) reports that more than 700,000 workers suffer eye injuries at work each year in the United States, yet 90% of them could have been prevented by using proper protective eyewear. Common eye hazards to protect from include:

- Impact hazards from flying objects such as large chips, fragments, particles, sand, and dirt
- Heat hazards from hot sparks, molten metal, or high temperature exposures
- Chemical splash, droplets, fumes, vapors, and irritating mists
- Nuisance or fine dust
- Optical radiation from radiant energy, glare, and intense light

Additional considerations for eye protection selection include:

- Lens tint and color
- Anti-scratch or anti-fog coatings
- Unobstructed or assisted viewing
- Comfort and security
- Coverage and gaps
- Compatibility with other PPE
- Need for secondary protection such as a face or welding shield.

ANSI Z87.1 standard provides minimum requirements for protectors including selection, use, and maintenance of these protectors as devices to minimize or prevent eye and face injuries. The protectors include spectacles (safety glasses), goggles, face shields, welding helmets and respirators. ANSI Z87.1-2015 "Z87" marked non-prescription eye and face protectors must meet the general requirements, which include optical, physical, markings, and other requirements. Replaceable and after-market components have additional conditions that must be satisfied.

Optional non-prescription markings include:

- Impact rated, "Z87+"
- Filter lenses for infrared, visible light, and ultraviolet are marked with a scale or shade number.
- Special purpose lenses, "S"
- Variable tinted, "V"
- Use for splash/droplet, D3
- Use for dust, D4
- Use for fine dust, D5

Safety spectacles, hybrid safety spectacles, and hybrid goggles are minimum protection required. Goggles typically offer better protection by reducing eye exposure and may offer additional hazard protection. Used with spectacles and goggles, secondary protectors may provide a barrier for the face or protection for specific application.⁷

Unlike other PPE that is worn in the presence of a hazard, head, eye, and face protectors are worn as a preventative measure to a potential hazards that should always be worn in designated areas. However, similar to other PPE, it is important to select eyewear based on the potential hazards for the tasks to be performed.

For additional assistance concerning the selection and use of PPE for flood recovery and clean-up, call 3M Technical Service at (800) 243-4630.

References

1. CDC. "Mold Prevention Strategies and Possible Health Effects in the Aftermath of Hurricanes and Major Floods". MMWR Recommendation and Reports, June 9, 2006. Available at <http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5508a1.htm>
2. OSHA. Fact Sheet: Mold Hazards during Disaster Cleanup. September 2013. Available at https://www.osha.gov/Publications/OSHA_FS-3713.pdf
3. EPA. Mold Remediation in Schools and Commercial Buildings. September 2008. Available at <https://www.epa.gov/sites/production/files/2014-08/documents/moldremediation.pdf>
4. NYC Department of Health & Mental Hygiene. "Guidelines on Assessment and Remediation of Fungi in Indoor Environments". November 2008. Available at <https://www1.nyc.gov/assets/doh/downloads/pdf/epi/epi-mold-guidelines.pdf>
5. OSHA. Hurricane eMatrix "Part II: Summary of Air and Noise Sampling results representing Actual or Potential Exposures for Response and Recovery Workers Involved in Hurricane Response and Recovery Activities". December 2005. Available at <http://www.osha.gov/SLTC/etools/hurricane/sampling-part2.html>
6. OSHA. Federal Register, Vol. 46 No. 11 p. 4109, January 16, 1981. "Occupational Noise Exposure; Hearing Conservation Amendment".
7. NIOSH. Eye Safety, Emergency Response & Disaster Recovery. July 2013. Available at <http://www.cdc.gov/niosh/topics/eye/eyesafe.html>

Bulletin Change Summary

For the most current 3M Technical Information available to successfully use this product, please view this Bulletin electronically and click on the blue underlined links to view the relevant documents. Please read the entire Bulletin thoroughly.

Release 2, August 2017

Added "hurricane" throughout document where applicable. Updated hyperlinks throughout document.

Personal Safety Division
3M Center, Building 235-2W-70
St. Paul, MN 55144-1000

3M PSD products are
occupational use only.

In United States of America
Technical Service: 1-800-243-4630
Customer Service: 1-800-328-1667
3M.com/workersafety
In Canada
Technical Service: 1-800-267-4414
Customer Service: 1-800-364-3577
3M.ca/Safety

© 3M 2017. All rights reserved.
3M is a trademark of 3M.
Used under license in Canada.
All other trademarks are property
of their respective owners.
Please recycle. Release 2, August 2017

