Balancing Protection with Comfort, Fit & Style in the PPE Selection Process

Donna McPherson
Senior Category Manager
Kimberly-Clark Professional

March 2008

Kimberly-Clark PROFESSIONAL*

The chief goal of protective apparel is to protect the wearer from hazards in the work environment. To achieve optimal protection, it's important for those involved in the apparel selection process to consider both form and function. Oftentimes, the issue of garment comfort, fit, style and overall "wearability" is not given adequate consideration. This can lead to compliance issues, which in turn may result in unsafe operating procedures.

So it is not surprising that for the second year in a row, a survey of safety professionals has found that noncompliance with personal protective equipment (PPE) protocols continues to be an issue in the workplace.

Eighty-seven percent of respondents said they had observed workers failing to wear PPE when they should have been, according to a survey of attendees at the 2007 National Safety Council (NSC) Congress, conducted by Kimberly-Clark Professional. Eighty-five percent of safety professionals answered yes to the same question in a survey undertaken by Kimberly-Clark Professional at the 2006 NSC Congress.

Despite the undisputed need for PPE when undertaking hazardous tasks, people continue to risk bodily harm by failing to protect themselves. The survey not only asked why people did not comply with PPE protocols, but what could be done to alter these behaviors.

The main "why" was "uncomfortable" PPE, according to 62 percent of respondents who had observed noncompliance in the workplace. This was followed by: workers thinking PPE was not necessary for the task, PPE was "too hot," PPE fit poorly, or was "unattractive looking."

When asked "what" could be improved about the PPE they were currently purchasing, three quarters of survey respondents said they would make it "more comfortable." Safety professionals were also in favor of more fashionable PPE. Eighty-four percent said they would be more apt to purchase fashionable and attractive PPE if workers would be more likely to wear it and the price was comparable to what they were currently paying for similar products.

While selection of task-appropriate protective garments may appear daunting – especially without an established U.S. standard for protective apparel – it does not have to be insurmountable. The key is to balance apparel function (protection factors) and apparel form (style, comfort, and wearability factors) within the scope of a realistic hazard assessment and risk analysis.

Hazard Assessment and Risk Analysis

The first step in selecting protective garments is a thorough and common-sense analysis of the hazards in the work environment, coupled with an assessment of the realistic level of risk each hazard poses.

For example, a hazards analysis may identify the chemical acetone. However, there is a great deal of difference in the protective apparel required for a worker exposed to a quart of

acetone in a well-ventilated room compared with one who is exposed to a large vat of acetone in an enclosed space.

As another example, consider a laboratory where a trained technician is working with 10ml of sulfuric acid at a time to create a dilute solution. Here, the quantity of acid is small, and only the technician's hands and forearms are entering the area of potential exposure. So, even though a splash is possible, the whole body is not exposed, and the volume of chemical is minimal. A hazard analysis and risk assessment of this workplace scenario might drive toward a selection of gloves and sleeve protectors, and possibly a chemical apron, but not a full-body coverall. Climbing in and out of a full-body chemical coverall may not be practical and may deter compliance.

It's important for the hazard analysis and risk assessment procedure to be adjusted to the practical demands of the work task. If not, one runs the risk of either over-protection or under-protection – both of which have serious consequences. Over-protection may lead to immediate problems. For example, heat stress is a common problem in many industrial settings. The result may be users who do not properly comply with wearing protocols by modifying or incorrectly using the garment to avoid overheating. Under-protection may lead to chronic health problems down the road – after years of low-level exposure to certain hazardous substances.

Garment Performance: Chemical Barrier Properties

There are two primary ways to evaluate chemical barrier performance – permeation testing and the less-known and less-understood penetration testing. Permeation testing typically applies to Level A garments that protect against unknown hazards or gaseous/vapor phase chemicals that present the highest level of respiratory and skin threats. The penetration test method applies to Level B and C garments that protect against moderate-skin-threat liquid chemicals.

Permeation testing (ASTM F739) measures a chemical's movement through a material on a molecular level. The permeation test is conducted for up to eight hours, during which the chemical remains in continuous contact with the garment material at full concentration. This scenario is much more severe than situations typically found in industrial settings, where only splash or intermittent contact occurs. In reality, most Level A garments are worn for an hour or less due to time limitations in SCBA air supply, or to prevent heat stress and exhaustion in the wearer.

Penetration testing (ASTM F903) is more appropriate for testing chemical barrier when splash exposure is anticipated, which is far more likely in industrial settings than full immersion in a liquid. It measures the bulk flow of liquids through a material or seam in the garment. Keep in mind that with many cases of liquid chemical splashes and sprays, the liquid either evaporates quickly or runs off the garment before it has a chance to penetrate the garment and reach the skin.

Some in the chemical protective clothing industry overemphasize permeation resistance data in the selection of protective clothing. The result is insufficient focus on garments that provide appropriate protection and may actually improve worker comfort and productivity. Some also do not consider another important criterion: dry particulate hold-out. Although no industry-standard test currently exists for particle barrier, all major fabric and garment suppliers should offer information about the performance of the material against a variety of different size particles.

Garment Performance: Bloodborne Pathogen Resistance

In many occupations, workers run the risk of being exposed to potentially hazardous bloodborne pathogens and bodily fluids. It's important to note that, just because a protective garment offers adequate resistance to certain liquids, one should not assume that the garment will also protect against bloodborne pathogens.

Protective garment purchasers should review the performance of individual protective garments against two test methods: ASTM F1670 and ASTM F1671. With bloodborne pathogens, penetration resistance is the key performance variable for determining both liquid splash and pathogen resistance since bloodborne pathogens are transmitted by the physical passage of liquid.

In addition to barrier performance, the design and construction of the garment affects its ability to protect against bloodborne pathogens. For example, a garment with seams in the back instead of the front provides more protection in primary exposure areas. A seam that is serged with overlap stitching, then reinforced with a film tape will better resist penetration by blood and other liquids compared with unsealed seams. Covered zippers also provide extra protection in splash situations.

The Fit Factor

Clearly, a protective garment's barrier performance should be the most important decision-making criteria. However, "wearability" issues related to comfort, fit and style may have a big effect on compliance with apparel-wearing protocols. Indeed, 57 percent of the NSC Congress attendees polled in the 2006 survey mentioned above (those who observed PPE noncompliance in the workplace), attributed the noncompliance to poor fit or discomfort. And when asked about the most important criteria for selecting PPE for workers, the number one response mentioned by those polled in 2006 was "comfort."

The problem with wearability issues extends to all types of PPE. For example, if coveralls don't provide adequate breathability, if safety glasses pinch behind the ears, or if protective gloves don't allow for hand dexterity, there is a chance that users will avoid wearing the PPE, or that they will modify the PPE in some way, thus compromising its protective features.

Wearability also extends to garment fit and compatibility issues. Fit issues relate to apparel sizing and body geometry. For example, a garment's sleeves must not ride up to expose skin when the wearer reaches forward. From a compatibility standpoint, both specifiers and users need to have a clear understanding of whether gloves should be taped to the outside of the coverall sleeve (if, for example, the use scenario calls for bending over and immersing one's hands in a dangerous liquid) or to the inside of the coverall sleeve (if, for example, the use scenario calls for heavy chemical splash exposure, to prevent the splash from dripping down into the cuff of the glove).

Several other fit and style issues should also play a role in the selection process of protective apparel and other PPE as well as in helping to improve PPE compliance.

First, when PPE is "connected to" the wearer, compliance becomes more automatic. For example, integrating ear plugs with safety glasses via a lanyard makes complying with hearing protection protocols much easier, because the PPE is in easy reach and not left in a bin at the building entrance.

Second, PPE that allows workers to express their individuality leads to greater compliance. Providing a range of options in terms of color and other style aspects gives workers some control over how they look. When people are content with their appearance in the PPE, it follows that they will be more likely to wear the PPE without modification.

Third, PPE that is perceived as "cool" is more likely to be worn. That is why many PPE manufacturers are looking toward the consumer fashion and sports apparel industries for cues on the latest styles, which can be adapted for the PPE market.

Conclusion

While identifying the hazardous chemicals and substances in the work environment is a key part of the hazard analysis process, narrowing apparel selection to just looking for a >480 minutes break-through time for a specific chemical leaves many options unexplored. The details of the application and a realistic understanding of the likelihood for exposure to the chemical are just as important as the chemical itself.

In addition, the answer isn't always a full-body coverall. That's why protective apparel specifiers need to consider appropriate protective accessories either in place of, or in addition to a full coverall, to increase the protection afforded while avoiding unnecessarily burdensome aspects of compliance and functionality. Choosing a PPE supplier that offers a range of garments, accessories, and other PPE helps to ensure that workers have a variety of protection options that are ideally suited to providing the right combination of form and function.

For more information on selecting the right protective garment for a specific task, visit the educational center at www.kc-safety.com/kn.

Donna McPherson is a Senior Category Manager with Kimberly-Clark Professional based in Roswell, Ga.

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www.kc-safety.com

1-800-225-6401
CUSTOMER SERVICE

1-800-579-3555
FAX

1-800-851-7538
TECHNICAL HELPLINE

safetyknowledgenetwork@kcc.com
EMAIL

K00960 K1730-08-01