

RETHINK LEVEL A ASSESS. SELECT. DEPLOY.

AN OVERDUE MODERNIZATION OF HAZMAT PPE

Can NFPA protection standards be compared to OSHA/EPA levels?

Yes. The OSHA levels were first established in the 1980s by the U.S. Environmental Protection Agency and then codified into OSHA 1910.120 for both hazardous waste site operation and emergency response. These levels describe how ensembles look in relation to the threats to both skin and the respiratory system but did not define performance. NFPA standards for hazardous materials protective clothing were introduced in the early 1990s to define minimum levels of protection and performance. The NFPA standards have evolved to keep up with current and emerging threats and the table below shows how ensembles certified to NFPA standards compare to the OSHA and EPA levels.

NFPA Standard	Respirator*	OSHA / EPA Level
NFPA 1991	SCBA	A
NFPA 1994 Class 1	SCBA	A
NFPA 1994 Class 2/2R	SCBA	B
NFPA 1992	SCBA	B
NFPA 1994 Class 3/3R	APR/PAPR	C
NFPA 1994 Class 4/4R	APR/PAPR	C
NFPA 1999	P100/HEPA	C

* SCBA = self-contained breathing apparatus, APR = air-purifying respirator, PAPR = powered air-purifying respirator; P100 = air-purifying filter with 99.99% efficiency; HEPA = high efficiency particulate air [filter]

Does OSHA require the use of Level A ensembles for response to unknown materials?

No. OSHA designates Level B PPE as the appropriate ensemble for initial entry. Title 29, part 1910, subpart 120 (29 CFR 1910.120), states “If the preliminary site evaluation does not produce sufficient information to identify the hazards or suspected hazards of the site, an ensemble providing protection equivalent to Level B PPE shall be provided as minimum protection, and direct reading instruments shall be used as appropriate for identifying IDLH conditions.”

Do Level A suits need to encapsulate the SCBA in addition to the wearer?

No. Level A ensembles differ from Level B ensembles by providing a higher level of skin protection for preventing absorption of hazardous materials as defined in OSHA 29 CFR 1910.120. The protection of responder’s skin from exposure to hazardous materials is the key attribute that defines Level A performance, not total encapsulation or inflation testing. Suits certified to NFPA 1994 for Class 1 are considered Level A regardless of whether they are totally encapsulating. OSHA 29 CFR 1910.120 requires totally encapsulating suits to be capable of maintaining positive pressure (typically demonstrated by inflation or pressure testing suits) and preventing inward vapor leakage of more than 0.5%.

Are there better tests for qualifying the performance of protective ensembles other than inflation testing?

Yes. While inflation testing of totally encapsulating ensembles is a relatively easy test to perform, it is only a suggested test within the non-mandatory Annex A of the OSHA 1910.120 regulations. While inflation testing is sensitive to small leaks, it is performed statically with the suit exhaust valves closed off and is not sufficient by itself to determine if the ensemble is safe. The Man-in-Simulant Test (MIST) used in NFPA 1994 provides a dynamic, human subject assessment for whether a surrogate chemical will leak through ensemble closures and interfaces into the suit. MIST combined with a rigorous manikin-based liquid inward leakage test provides a comprehensive evaluation of protective ensembles to fully qualify the ensembles for needed levels of overall integrity to prevent exposure to hazardous materials.

Are totally encapsulating Level A suits being used more frequently than the risk assessment or hazard might dictate?

Yes. The purpose of PPE in emergency response is to provide sufficient protection from potential exposures identified in the initial risk assessment at the emergency scene and allow first responders to safely carry out their respective tasks or mission. All PPE causes restrictions in wearer functionality that generally worsen as protective performance is increased. If protective performance is set too high based on unrealistic levels of chemical exposure, then the ensemble is generally over-designed for its intended use, which results in decreased wearer functionality. Over-designed PPE creates hazards just as under-designed PPE does and can lead to issues such as increased likelihood of heat stress or entrapment of first responders.

Are there situations where a total encapsulating NFPA 1991 suit is still needed for protection?

Yes. Totally encapsulating NFPA 1991 certified suits have utility in responses involving direct contact with pressurized liquids and pressurized vapors, particularly as may occur at chest level or higher, such as might occur in the mitigation of broken chemical lines. However, there are many more situations where a non-encapsulating suit certified to NFPA 1994 Class 1 offers appropriate protection. This is particularly true for missions not involving direct contact with pressurized hazardous materials and where there is the need for greater maneuverability and physical challenges present in non-line of site rescue for chlorine or ammonia gas environments and during urban search and rescue missions.

NFPA 1994: DESIGNED FOR RESPONDERS, BY RESPONDERS

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OPERATIONALLY RELEVANT ENSEMBLE DESIGNS AND PERFORMANCE SPECIFICATIONS

Is there substantial value for more form-fitting, greater functional high-end protective ensembles?

Yes. Physical restrictions in movement, hand function, vision, hearing, and loss of comfort all limit first responders during hazardous chemical responses. In most cases, these limitations create more likely risks to first responders than exposure to hazardous materials. In some types of missions, first responders require a high level of functionality in order to carry out specific tasks and missions. The balance of protective performance with functionality and other human factors (e.g., thermal comfort) is a key consideration in the selection of appropriate PPE for hazardous materials responses.

Has research been performed on the effects of chemicals on the SCBA and its components?

Yes. Intertek Testing Services, one of the independent organizations that evaluates and certifies SCBA systems against the NFPA standards, has performed extensive evaluations of the SCBA and its components in chemical environments at high gas/vapor exposure or liquid splash levels. This work, funded by the Department of Defense, has demonstrated that SCBAs and their components maintain their performance capabilities during and after chemical exposure with negligible chemical in the breathing zone. It is also important to note that decontamination of the SCBA should be done as soon as possible to minimize any effects of chemicals on exposed SCBA components.

Are hazardous materials protective ensemble tests set at appropriate levels to define the barrier performance of ensemble materials?

Yes and No. It depends on the standard being applied. For NFPA 1994 protective ensembles, testing is carried out for the individual classes under different conditions, which are matched appropriately with the protection offered by an SCBA or other respiratory protective equipment. These classes are based on the high end of realistic exposure concentrations. Industry often tests PPE clothing materials against chemicals at 100% concentration for relatively long periods of time (8 hours). This results in garments with outstanding barrier performance, but it often creates serious trade offs such as material flexibility that affects mobility and other attributes important for the operational and functional effectiveness of the wearer.

Is it possible to use test data based on a limited number of chemicals to qualify the barrier performance of ensemble materials?

Yes. It is impossible to have permeation test data on every possible chemical. Moreover, chemical exposures may involve other factors, including their concentrations, exposure times, temperature, and combinations in mixtures. For this reason, groups of selected chemicals are used as part of NFPA standards, which generally use smaller molecule chemicals (which permeate faster and are a greater exposure hazard) to represent entire classes of chemicals and thus broaden the use of data. In addition, NFPA standards apply these groups of chemicals to qualify not only the base garment or suit material, but also the gloves, footwear, seams, and other components of the ensemble. Reliance on garment/suit material test data only is considered a dangerous practice in the selection of protective ensembles.

Can issues of field testability and confidence in gross decontamination affect perceptions of protection?

Yes and No. Detailed inspections are needed to assure that PPE remains viable for its intended use, but field testing may not provide a “full” picture of protective capabilities. It is essential that information be offered that shows contaminants can be removed, but there are often circumstances in which chemical exposure occur where disposal of the ensemble will be the result of a post-incident review. What is important is the ability to perform gross decontamination to allow the safe doffing of ensembles without contaminant transfer to first responders or those assisting them.

Are there other forms of evidence that are important for demonstrating the use of non-encapsulating ensembles for high end protection?

Yes. NFPA 1994 sets a framework of minimum design, protective performance and labeling requirements for certified ensembles used both in hazardous materials emergency and CBRN terrorism incidents. Additional demonstrations of ensemble performance are necessary to show how the ensemble can protect against accidental flash fires or other short-duration high heat/flame sources; ease of decontaminating ensembles and limiting contaminant transfer during doffing.

CERTIFIED ENSEMBLES TO MEET YOUR LEVEL OF RISK

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