

Inspect, Don, Doff a Level of Protection

In order to prevent exposure to harmful substances, Personal Protective Equipment (PPE) must be donned and doffed using the proper techniques. Inspection to ensure the integrity of the protective gear must be done prior to use. For example, respiratory protection training is covered in 29CFR1910.134(k) and the requirement for inspection is in 29CFR1910.134(k)(1)(iv). Training in all PPE to be used on waste sites is covered in 29CFR1910.120(e)(2)(iii); training for TSDF workers is in 29CFR1910.120(p)(8)(iii)(A); for emergency responders, an ability to select and use PPE is required at all levels of responder responsibility 29CFR1910.120(q). Inspection schedules for fire brigade respirators are shown in 29CFR1910.156(d).

Based on your expected job duties during the coming year, you will dressout in a level of protection used to prevent exposure to a hazardous material.

Objectives

When you have completed this exercise, you will be better able to:

- Identify defects or damage to protective gear prior to use
- Demonstrate the ability to dressout in Level A, B or C

Chemical-Protective Clothing

Chemical-Protective Clothing (CPC) consists of special clothing worn to prevent chemicals from coming into contact with the body. CPC generally includes eye/face protection, aprons, boots, gloves, and suits/coveralls. CPC is used to protect employees from both chemical and physical hazards that they are likely to encounter while working. The proper use of CPC can prevent or reduce exposure to a harmful substance. CPC is an important part of a worker's PPE.

Chemical-protective clothing is made of special materials. These special materials provide chemical resistance, which means they act as a barrier to keep chemicals from coming in contact with the skin. Different materials provide protection from different types of chemicals. It is important to select CPC which is designed to protect against the specific chemical or type of chemical that may be encountered during work. Otherwise, you might not be protected, even when you think you are.

Types of Chemical-Protective Suits

Chemical-protective suits are of two general types, totally encapsulating and partially encapsulating.

- **Totally Encapsulating Chemical-Protective Suit (TECP):** Provides head-to-toe coverage to protect the wearer from chemicals. These suits have special seams and zippers to prevent chemicals from leaking into the suit. These suits have a face shield which is made as part of the hood. They are very bulky to wear, and the wearer can become very hot while working. TECPs are the only vapor-resistant suits. TECP suits protect workers from hazards which are identified during hazard evaluation. TECP suits must pass specific positive-air pressure tests and be capable of preventing inward test gas leakage of more than 0.5%. Specific information about pressure tests can be found in OSHA 1910.120, Appendix A.
- **Partially Encapsulating Chemical-Protective Suit (PECP):** Provides less protection from chemicals and may or may not have face shields. These suits are used when less skin protection is needed. The hood can either be part of the suit or detached.

Disposable suits, which provide limited protection from chemicals, can be used in conjunction with these chemical-protective suits. These disposable suits can be worn

either on top of other suits to protect them or inside of protective suits to protect the wearer from chafing.

Selection of PPE

Generally, one person or group is responsible for the selection and purchase of protective equipment; however, it is important for everyone to understand the considerations which go into the selection. The selection process should be detailed in the employer's safety and health plan. Questions about PPE selection may be addressed to the person responsible for the selection.

A hazard assessment with a survey of the facility is useful in developing a list of potential hazards. This list can be used in planning for required PPE. Hazards to take into consideration include:

Impact	Penetration
Compression (roll-over)	Chemical
Heat/cold	Combustible/Harmful dust
Light (optical) radiation	Biologic agents
Sources of electricity	Sources of motion or impact
High temperatures	Chemicals used in the workplace

The type of chemical-protective suits selected will depend on the type and nature of potential exposure. For example, totally encapsulating suits may be required for persons over-packing drums, whereas partially encapsulating suits may be required while operating a remote drum handler. Generally, the level of protection provided will be re-evaluated as additional information is gained. Guidelines for selection of PPE, including CPC suits, are presented in the table on the following page.

CPC Selection Guidelines

Always follow manufacturer's recommendations

Chemical resistance: Different materials are resistant to different chemicals. Management should provide CPC which will provide protection against the chemicals likely to be encountered. This rule is true for whole-body as well as hand and foot protection.

Physical integrity: Construction of the suit is important for the proper functioning of the CPC. Seams and zippers should provide solid barriers to chemicals and should be constructed to provide some flexibility.

Resistance to temperature extremes: Heat and cold can adversely affect CPC. Clothing which will be worn in cold temperatures could crack or become ineffective against chemicals. Likewise, heat may destroy the chemical resistance of clothing or even melt it.

Ability to be cleaned: Clothing must be able to be cleaned and decontaminated after each use. If this is not possible, the clothing must be disposed of after use.

Cost: Initial and ongoing costs of purchasing PPE can be important considerations for management. However, buying less expensive, inferior products which do not adequately protect employees can be more expensive in the long run due to medical costs, lost work time, or, at worst, loss of human life.

Flexibility: Materials need to be flexible enough for the wearer to move and work safely. Overly rigid suits can result in unnecessary accidents from slips, trips, and falls. Gloves which are too rigid may create gripping problems that may lead to other hazards.

Size: CPC should be available in a variety of sizes to accommodate the height and weight of the worker. Suits that are too small will tear easily and provide no protection. Suits that are too large will make walking and/or working difficult. Safety boots that are too big will create both tripping and comfort problems.

Design: CPC should be designed so that all required respiratory PPE can be used at the same time.

Levels of PPE (see 29CFR1910.120, Appendix B)

Level A

Level A is the highest level of protection which can be worn.

What Is Level A Protection?

The following list constitutes Level A equipment; it may be used as appropriate:

- Positive-pressure, pressure-demand, full-facepiece SCBA or positive-pressure, supplied-air to full-face piece with escape SCBA (NIOSH-approved)
- Totally encapsulating chemical-protective suit (TECP) (gas tight or vapor tight)
- Inner and outer chemical-resistant gloves
- Disposable protective suit, gloves, and boots (depending on suit construction, may be worn over totally encapsulating suit)
- Coveralls*
- Long underwear*
- Hard hat (under suit)*
- Chemical-resistant boots with steel toe and shank
- Cooling system (ice vest, water/air circulation)*



*Optional as applicable

Note: Suit must be properly equipped with a pass-through air-line connection, referred to as an air-line egress if using a Supplied Air Respirator (SAR).

When Is Level A Protection Needed?

Level A protection is required when:

- The hazardous substance has been identified and requires the highest level of protection for skin, eyes, and respiratory system.
- There is potential for splash, immersion, or exposure to vapors, particulates, or gases that are harmful to the skin or may be absorbed through the skin.
- Confined-space entry may be involved and the need for Level A cannot be ruled out (but explosion hazard has been ruled out).
- The skin absorption hazard may likely result in immediate death or serious illness/injury or impair the ability to escape.

Level B

Level B is used when maximum respiratory protection is desired but the skin/eye hazards do not require Level A.

What Is Level B Protection?

The following constitutes Level B equipment; it may be used as appropriate.

- Positive-pressure, full-facepiece SCBA or positive-pressure, pressure-demand, supplied-air to full-face piece with escape SCBA (NIOSH approved)
- Hooded chemical-resistant clothing **OR** total encapsulating chemical suit (not gas tight or vapor tight)
- Inner and outer chemical-resistant gloves
- Outer chemical-resistant boots with steel toe and shank
- Boot covers: outer, chemical-resistant (disposable)*
- Hard hat*
- Face shield*
- Cooling system (ice vest, water/air circulation)*
- Coveralls*

*Optional as applicable



New Level B chemical-resistant clothing is designed to go over the SCBA. If appropriate for the potential exposures, this CPC should be used to protect the SCBA and prevent its contamination. In this case, the Level B ensemble will resemble a Level A ensemble, but the suit is not vapor-tight.

When Is Level B Protection Needed?

Level B protection is required when:

- The highest level of respiratory protection is needed but a lower level of skin protection is acceptable.
- The substances have been identified.
- An SCBA is required.
- Less skin protection is needed. (Vapor and gases are not believed to be present at levels harmful to skin or capable of being absorbed through intact skin.)

Level C

Level C provides less skin and respiratory protection than Level A or B.

What Is Level C Protection?

The following list constitutes Level C equipment; it may be used as appropriate.

- A full-face or half-face air-purifying respirator (NIOSH-approved)
- Hooded chemical-resistant clothing
- Inner and outer chemical-resistant gloves
- Coveralls*
- Boots (outer), chemical-resistant steel toe and shank*
- Boot covers: outer, chemical-resistant (disposable)*
- Hard hat*
- Escape mask*
- Face shield*

*Optional as applicable

When Is Level C Protection Needed?

Level C provides protection when:

- The concentration(s) and type(s) of airborne substance(s) are known and the criteria for using an air-purifying respirator are met.
- Direct contact with the hazardous substance will not harm the skin or the substance will not be absorbed through any exposed skin.
- Air contaminants have been identified, concentrations measured, and an air-purifying respirator is available with an acceptable protection factor.
- An adequate level of oxygen ($\geq 19.5\%$) is available and all other criteria for the safe use of air-purifying respirators are met.



Level D

This level offers no respiratory protection and low skin protection.

What Is Level D Protection?

The following list constitutes Level D equipment; it may be used as appropriate.

- Coveralls (work uniform)
- Chemical-resistant boots or shoes with steel toe and shank
- Hard hat*
- Gloves*
- Outer, chemical-resistant boots (disposable)*
- Safety glasses or chemical splash goggles*
- Escape mask*
- Face shield*

*Optional as applicable

When Is Level D Protection Needed?

Level D is required when:

- Minimal protection from chemical exposure is needed. It is worn to prevent nuisance contamination only.
- The atmosphere contains no known hazards.
- Work functions preclude splashes, immersion, or the potential for unexpected inhalation of or contact with hazardous levels of any chemicals.

Typical Uses of Level D

Level D protection is worn by personnel who may be exposed only to nuisance contamination while working with hazardous materials. Typically, workers involved with support activities such as equipment supply, maintenance, off-site vehicle operation, or supervision/management will wear Level D.

Level D may appear similar to typical work clothes. Differences include the chemical-resistant boots with steel shank.

A general rule for which level of protection to use is: **The less you know, the higher you go.**

Remembering Levels of Protection

A helpful way to remember the levels of protection is:

Level A – “**A**”ll Covered, gas/mist tight

Level B – “**B**”reathing Air, splash protection

Level C – “**C**”artridge Respirator or air purifying respirator

Level D – “**D**”on’t Expect Protection”, regular work clothes

Characteristics and Properties of CPC

PPE is effective only if it’s properly selected, worn, and maintained. Standard Operating Procedures (SOPs) for these types of PPE are included in the safety and health plan. SOPs are company-specific versions of the more general Standard Operating Guides (SOGs) often used in training. SOGs are written instructions for safe work practices and are a form of administrative control.

- Whenever possible, a variety of suit sizes should be on hand to fit the various sizes of personnel.
- The adhesive on the tape may cause degradation of the suit and the warranty may be voided.
- Materials used to make most suits do not “breathe.” Rapid heat and moisture build-up will occur in the suit during use.
- All suits have limits as to the temperature at which they can be worn without damage. This information may be particularly important for emergency response or hot-work activities. Check the manufacturer’s data.
- Most suits offer no fire protection and in some cases increase the possibility of injury because they will melt and may burn.

Chemicals can reduce the effectiveness of CPC garments through penetration, degradation, or permeation.

Penetration, Degradation, and Permeation

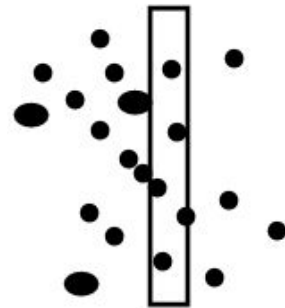
Penetration The flow of a chemical through zippers, stitched seams, or imperfections in the material.



Degradation A reduction in one or more physical properties of a protective material due to contact with a chemical.

Permeation The process by which a chemical moves through a protective material on a molecular level. The rate of permeation is dependent on six major factors:

- Contact time
- Material thickness
- Concentration
- Temperature
- Physical state of chemicals
- Size of the contaminant molecules and pore space

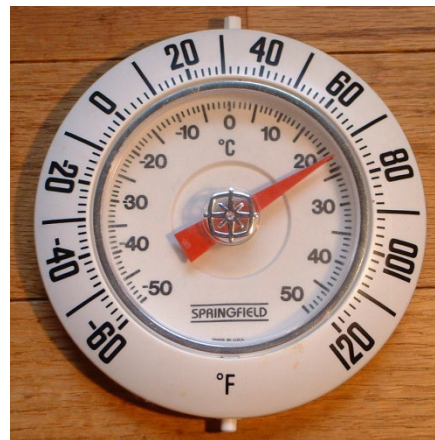


A general rule of thumb is that the permeation rate is inversely proportional to the thickness (2 x thickness = 1/2 x permeation rate). Other important factors are chemical concentration, contact time, temperature, material grade, humidity, and solubility of the material in the chemical. Consult the manufacturer for more information.

Precautions When Wearing CPC

Every level of chemical-protective clothing has limitations. The following precautions should be considered.

- Hearing and speaking are difficult in CPC with respiratory protection. It is important to establish other ways to communicate with each other. Hand signals or audio signals such as horns, sirens, and whistles can be used to communicate. Communication can also be improved by using two-way radios, such as a portable radio with microphone or radio with a microphone and speaker combination attached to the full-face respirator. Remember, any radio must not add an ignition hazard to the area. Be aware of potential traffic areas.
- Due to the size and weight of some suits, motion is restricted, especially when climbing, working in tight areas, or using hand tools.
- Look for signs of heat stress (dizziness, headache, nausea, perspiration ceases), especially at temperatures over 70°F.



- Always wear the correct size of footwear in order to prevent accidents. You should also make certain that the soles provide a proper grip for the surfaces that you will be encountering. Steel shanks, toes, and shin guards help to prevent puncture wounds and/or crushing injuries.

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- Disposable booties may be slippery. Use caution when walking to prevent slips and falls.
- Care should be taken when donning and doffing inner and outer gloves. When donning gloves, make sure that no cracks or tears are present. When doffing gloves, take care not to spread contamination.
- All joints such as suit-to-boots and suit-to-gloves in Levels B and C protection should be secured with tape. Fold the end of the tape back under to make a tab for easy removal. Use special care when removing tape.
- Be sure you are properly hydrated prior to use of CPC



- Goggles and eye/face protection may become clouded due to moisture condensation during use. Use some sort of anti-fog film or spray when needed. When wearing Level A, you may want to keep a cloth inside the suit to wipe fog off the inside face shield.
- Avoid placing your hands or knees on the ground when in the Hot Zone to prevent contamination by chemicals and abrasion to the suit material. Avoid sitting on anything sharp in suits.
- When removing a suit, open and fold into itself as it is removed to prevent contamination of internal clothing.

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- Suits have weak seams, especially if they are disposable. Be careful not to strain and split them. If splitting occurs, report it and follow the appropriate SOP (standard operating procedure).
- Use caution when suits are used in potential fire areas. If fire occurs, get out of the area.
- When dressing out with a team be careful to coordinate your dress at the same speed and level as your team/buddy. The longer you are dressed out, the more stress is being put on your body.
- Completion of dress out should be delayed until ready to enter the work zone.
- Medical clearance is required for usage of respirators

Inspection, Maintenance, and Storage of CPC

It is important to inspect CPC, for evidence of chemical damage. CPC which is torn, degraded, or otherwise non-functional will not offer adequate protection to the wearer. An SOP/SOG for CPC inspection, maintenance, and storage ensures review whenever:

- Received from the distributor
- Issued to workers
- Put into storage
- Taken out of storage
- Used for training
- Used for work or an emergency response
- Sent for maintenance

An inspection checklist should be developed for each item. Factors to consider are:

- Cuts, holes, tears, swelling, and abrasions in seams of fabric
- Weakness in zipper or valve seals
- Signs of contamination such as discolorations or visible chemical residues
- Signs of malfunctioning exhaust valves

Note: CPC may be contaminated even though it doesn't appear discolored.

Proper **maintenance** can prevent CPC deficiencies and prolong its life. A detailed SOP must be developed by the employer and followed rigorously.

Proper **storage** is important in order to prevent suit failures. The written SOP/SOG should describe storage before the CPC is issued to the wearer (in a warehouse, on-site, etc.), as well as storage after use. Check the manufacturer's data, as most CPC used now has specific temperature and humidity storage requirements and a shelf life and an expiration date.

Donning and Doffing PPE

Proper donning and doffing of PPE will preserve the integrity of the PPE and protect the wearer from chemical exposure. An example of an SOG for donning Level B PPE is given below.

Level B Dress Out (Entrant/Decon) SOG

- Receive medical check (Optional)
- Verify that all PPE is ready and in the dress out area
- Perform an operational check of the SCBA
- Remove watches, jewelry, leather shoes and other personal items
- Don inner suit (Optional)
- Inspect suit
- Don Level B suit to waist
- Don chemical resistant boots with boot covers
- Conduct entry briefing
 - Describe Incident
 - Identify Hazards
 - Assign Duties/Jobs
 - Confirm Equipment and Decon Readiness
 - Confirm Primary, Secondary and Emergency Communications

- Identify Emergency Showers/Decon
- Don inner glove
- Don middle glove
- Insert arms into the sleeves of the suit and pulling it over shoulders
- Gloves will be turned inside out over the thumb and palm of hand, then carefully taped making sure to stretch the elastic as far as possible and folded back over suit.
- Don chemical resistant outer gloves, and tape seam between glove and suit leaving a tab
- Don facepiece
- Don attached hood of suit, zip up front zipper, attach zipper flap and tape flap leaving a tab
- Don SCBA
- Conduct a positive and negative pressure check of respirator facepiece
- Don hardhat, if required (tape if needed)
- Assign suit number
- Rapid Intervention Team/Decon people to decon line
- Entrant connects regulator to face piece and enters Hot Zone after Decon line is ready and IC approves
- Ensure wearer is breathing air and indicates readiness with a thumbs-up sign

Exercise - PPE Donning and Doffing

During this exercise you will demonstrate proficiency inspecting PPE and donning and doffing one level of protection (A, B, or C).

The facilitator will provide checklists for the exercise and document your work by signing at the end; this checklist will be retained at the training center. A duplicate, blank checklist will be provided if you want for your own records or future use.

Closing

Using gear included in Levels A, B or C did you:

- Inspect gear for defects or damage prior to use?
- Demonstrate the ability to dressout in Level A, B or C?

Based on this exercise, what takeaways do you have as you go back to work?

Please ask any remaining questions.