



Standard Practice for Chemical Protective Clothing Program¹

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1. Scope

1.1 This practice is intended to promote the proper selection, use, maintenance, and understanding of the limitations of chemical protective clothing (CPC) by users, employers, employees, and other persons involved in programs requiring CPC, thereby limiting potentially harmful and unnecessary skin exposures.

1.2 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:²

F739 Test Method for Permeation of Liquids and Gases through Protective Clothing Materials under Conditions of Continuous Contact

F903 Test Method for Resistance of Materials Used in Protective Clothing to Penetration by Liquids

F1001 Guide for Selection of Chemicals to Evaluate Protective Clothing Materials

F1052 Test Method for Pressure Testing Vapor Protective Suits

F1154 Practices for Qualitatively Evaluating the Comfort, Fit, Function, and Durability of Protective Ensembles and Ensemble Components

F1194 Guide for Documenting the Results of Chemical Permeation Testing of Materials Used in Protective Clothing

F1383 Test Method for Permeation of Liquids and Gases through Protective Clothing Materials under Conditions of Intermittent Contact

F2588 Test Method for Man-In-Simulant Test (MIST) for Protective Ensembles

3. Terminology

3.1 Definitions:

3.1.1 *analytical detection limit, n*—a number, expressed in units of concentration (or amount), that describes the lowest concentration level (or amount) that an analyst can determine to be different from an analytical blank (background level).

3.1.2 *biological monitoring, n*—the chemical analysis of chemicals or metabolites, or both, from a worker's blood, urine, fingernails, sweat, breath, and so forth.

3.1.3 *buddy system, n*—a means of organizing employee work groups whereby each participant is matched with another so that prompt assistance can be rendered in the case of any emergency.

3.1.4 *chemical protective clothing (CPC), n*—an item of clothing that is specifically designed and constructed for the intended purpose of isolating all or part of the body from a chemical hazard.

3.1.5 *decontamination, n*—the reduction, removal, or neutralization of contaminant or contaminants from protective clothing to safely permit the protective clothing to be doffed (taken off), or reused, or discarded.

3.1.6 *elastomer, n*—an elastic polymer that has properties similar to rubber.

3.1.7 *fabric, n*—a planar structure consisting of yarns or fibers.

3.1.7.1 *Discussion*—Unlike a polymer sheet, a fabric is normally subject to penetration by gases and liquids.

3.1.8 *Fick's laws of diffusion, n*—mathematical descriptions of the movement of one type of molecule through another.

3.1.8.1 *Discussion*—Diffusion is not due to holes or pores in chemical protective clothing materials.

3.1.9 *hazard assessment, n*—an examination of the workplace to determine if hazards are present, or are likely to be present, which necessitate the use of personal protective equipment (PPE)

3.1.10 *industrial hygienist, n*—a person who, by experience and academic training, is qualified to recognize, evaluate, and

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

control chemical, physical, and biological agents in the workplace, or a person certified by the American Board of Industrial Hygiene.

3.1.11 *occlusion, n*—the physical process of covering a chemical that has been applied to or spilled on the skin, thereby disallowing its evaporation and generally increasing its absorption through the skin.

3.1.12 *physical-chemical parameters, n*—values for physical or chemical properties of a test chemical or polymer, or both, such as solubility parameters, molecular weight, vapor pressure, and so forth.

3.1.13 *plastic, n*—a material that contains, as an essential ingredient, one or more organic polymeric substances of large molecular weight, is solid in its finished state, and, at some stage in its manufacture of processing into finished articles, can be shaped by flow.

3.1.14 *polymer, n*—a substance consisting of molecules characterized by repetition (neglecting ends, branches, junctions, and other minor irregularities) of one or more chemically bonded types of monomeric units.

3.1.15 *polymer sheet, n*—a continuous polymeric planar structure.

3.1.15.1 *Discussion*—It is not normally subject to penetration by gases or liquids.

3.1.16 *program, n*—a documented policy with procedures for selection and use of CPC.

3.1.17 *program administrator, n*—a person responsible for the formulation and implementation of a CPC program.

3.1.18 *program authority, n*—a person responsible for enforcing the requirements of a CPC program.

3.1.19 *toxicity, n*—the propensity of a substance to produce adverse biochemical or physiological effects.

3.1.19.1 *Discussion*—Such effects are termed toxic effects, as used in this practice.

4. Significance and Use

4.1 This practice presents those elements that constitute a chemical protective clothing (CPC) program and conditions to be used in establishing a program for the selection and use of CPC. Adherence to this practice requires that a written program be developed for any use of CPC.

4.2 Although much remains to be determined regarding the toxicity of vapor and liquid exposure to the skin, this practice outlines the essential information necessary and suggested methods for hazard assessment prior to the selection of CPC (see Practice F1154).

4.3 This practice does not address the various methods for testing CPC or obtaining the data upon which CPC assessments are made. These test methods are listed in Section 2 of this practice.

4.4 This practice does not include recommendations that may apply to personal protection from nuclear radiation, radioactive contamination, or microbiological organisms, or to

clothing that is worn to protect a particular environment from the entry of chemicals, particles, or living matter that may arise from the wearer.

4.5 CPC should be used when other means of control are not available. Its major uses should be limited to the following:

4.5.1 Maintenance operations;

4.5.2 Upset or emergency conditions;

4.5.3 Use in lieu of engineering controls when they are not feasible or are being installed;

4.5.4 Supplementing feasible engineering controls when they fail to control the hazard completely; and

4.5.5 Use in the event that engineering controls fail.

4.6 Engineering controls and substitution of materials should be stressed as the first line of defense in all control situations since effective use of CPC depends on worker compliance, proper selection, quality control, and other variables that may prove to be weak links in an overall control process.

5. Minimum Program Requirements and Objectives

5.1 The primary objective shall be to minimize employee exposures. This objective should be accomplished to the extent feasible by accepted engineering control measures. These include enclosure or confinement of the operation, isolation of the worker from the operation, substitution of less toxic materials, and modification of work practices. When these controls are not feasible, or while they are being implemented or evaluated, appropriate CPC shall be used pursuant to the requirements in this practice and regulatory requirements, where applicable.

5.2 Program Administration and Responsibility:

5.2.1 Responsibility and authority for implementing the CPC program shall be assigned to a single person. This person will normally be a plant manager, supervisor, or other person with line supervisory authority. This person is called the program authority.

5.2.2 Normally, a second person shall have responsibility for preparing the written program. This person is called the program administrator. His duties also include maintaining and updating standard procedures and the CPC written program, based on changes in CPC technology and knowledge; maintaining records; auditing and evaluating the program; directing, interacting with, or supervising those who dispense CPC at the worksite and those who train workers in the use of CPC; and establishing procedures for the purchase of CPC. The program administrator will usually have staff responsibilities. The program administrator shall have knowledge of CPC sufficient to supervise the CPC program properly. (Where possible, the administrator of a CPC program should also be the administrator of the respiratory protection program, if one exists, in order to improve coordination.)

5.3 *Written Programs*—The CPC program shall be established and detailed in a written document.

5.4 *CPC Selection*—The selection of the CPC article shall be based on consideration of the following

5.4.1 Exposure situation (vapor, pressured splash, liquid splash, intermittent liquid contact, and continuous liquid contact);

5.4.2 Toxicity and amount of the chemical(s) (that is, best knowledge or the estimate of ability to permeate the skin and of systemic toxicity);

5.4.3 Physical properties of the contaminant chemicals (for example, vapor pressure, molecular weight, and polarity);

5.4.4 Functional requirements of the task (for example, dexterity, thermal protection, fire protection, and mechanical durability requirements); and

5.4.5 Properties of the CPC that are relevant to the physical and chemical hazards and functional requirements of the task. These properties are determined through appropriate testing techniques and include permeation resistance, degradation resistance, penetration resistance, dexterity, resistance to tear, and so forth, as applicable. (See Test Method **F739**, Guide **F1001**, and Practice **F1052**.)

5.4.6 Selection of the CPC should consider the materials from which the garment, gloves, visor, hoods and boots are constructed, the seam construction and the design of the garments.

5.4.7 Selection of the CPC should also consider the likelihood of coming in contact with the hazardous materials, the duration of the contact, the amount of contact and the direction of liquid contact.

5.5 The selection procedure shall be documented. Minimally, the selection process should consider degradation, penetration, and permeation resistance of the CPC. Degradation could result in an adverse loss of integrity and chemical resistance properties. Penetration could result in direct skin contact by an agent from bulk flow through seams, pinholes, and so forth. Permeation can result in skin contact by an agent without any outward signs of either penetration or degradation since molecular flow of the contaminant through the protective article is occurring.

5.6 *Training*—Each CPC user shall be given training that shall include the following:

5.6.1 A description of the hazards for which the CPC is being selected;

5.6.2 An explanation and discussion of the toxicity of the contaminants for which CPC is being used including symptoms that indicate an overexposure has occurred;

5.6.3 Limitations of CPC use;

5.6.4 Training *how to use CPC*, including donning, decontamination in order to safely doff the garment, doffing, proper storage, maintenance, inspection, and decontamination for safe reuse where applicable; and disposal of CPC.

5.6.5 Each CPC user should be tested after training and periodically thereafter, to verify that they understand and can follow the CPC training, retrained if necessary or restricted from using CPC if they can not understand or follow the training.

5.7 *CPC Use*—The employer shall not use CPC in violation of the written program or the manufacturer's instructions. When using CPC, the employer shall consider special

emergency-use precautions. The buddy system shall be used in conjunction with emergency-use CPC.

5.8 *Maintenance and Storage*—Maintenance and inspection shall be conducted on a schedule that ensures that each piece of CPC delivers the protection for which it was selected. Minimally, each piece of CPC shall be inspected by the wearer prior to its use to ensure its integrity. CPC should be stored in accordance with manufacturer's instructions.

5.9 *Decontamination*—Procedures for decontamination and reuse shall be documented. CPC should not be used after it is contaminated unless it can be demonstrated that the decontamination CPC is safe to wear.

5.10 *Field Evaluation and Biological Monitoring*—The use of methods to estimate actual exposures in the field or estimate doses from biological samples are appropriate when the choice of CPC has uncertainty or when estimates of total doses to employees are necessary. The latter is particularly important for low vapor pressure organic chemicals that are absorbed through the skin readily.

5.11 *Purchasing*—The purchase of CPC shall be coordinated carefully with the selection and use of CPC. Failure to monitor and control the purchase of CPC could result in improper CPC use, leading to worker exposure. The purchaser's action shall be dependent on the requirements from the program administrator. Without clear CPC specification, the lowest price usually dictates purchase.

5.12 *Considerations of Medical and Human Factors*—The possible physiological and psychological effects caused by wearing CPC shall be considered. These effects, which include heat stress and claustrophobic reactions, may be particularly evident when TECP suits are worn. CPC selection is a balance between protection from chemical hazards and performance, physiological, and psychological burdens. Chemical protection should not be compromised, nor should the worker be unnecessarily burdened.

5.12.1 In most cases, use of CPC entails a risk of heat stress. There should be a written heat stress management plan in place to anticipate heat stress, monitor heat stress among CPC users, mitigate the risk by use of engineering controls, work practices of additional PPE and rehabilitate CPC users with elevated core body temperatures.

5.13 *Auditing*—CPC programs shall be audited periodically in order to ensure that all components are functioning as described in the written program. Methods for auditing the program shall be well described, including the ways and means for correcting defects in the program.

6. Program Administration and Responsibilities

6.1 *Employer Responsibility*—Employer responsibility is vested in the program authority. The employer shall be responsible for providing CPC to employees when it is necessary and enforcing its proper use. All CPC shall be selected by the employer using the latest information available to him. The employer shall establish and maintain a CPC program that shall include the minimum requirements for