Chapter 13
Personnel Protection

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13.1 Introduction

For adequate protection and prevention of contaminant exposure to workers at hazardous waste sites in all phases of investigation, personal protective equipment must be utilized and personnel contamination reduction practices must be implemented (see Chapter 14). The procedures must be appropriate to protect against the potential or known hazards at a site. All personal protective clothing and equipment utilized at hazardous waste sites must comply with 29 CFR 1910.120 of the OSHA Standard for Hazardous Waste Site Operations and with 29 CFR 1910. 134 and 139 which are the OSHA requirements for the use of Respiratory Protection

The information in this chapter on Personal Protective Clothing and Equipment (PPE) is excerpted from the, *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*, developed by NIOSH, OSHA, USCG and EPA in October 1985. Included here are key factors in the selection and use of PPE and discussion of heat stress and other physiological factors for consideration when planning site activities. Chapter 4 of this manual, *Site Entry Activities*, addresses other factors for consideration prior to site entry.

In addition to general guidance provided here on levels of protection, a more subjective determination must be made of the PPE required for initial safety should situations exist where the type of materials/contaminants have not been identified, the potential for contact with contamination is unknown and/or the hazards are not clearly identifiable. Level B protection is the minimum level recommended for initial entries until the hazards have been further identified and defined through monitoring, sampling and other reliable methods of analysis, and PPE corresponding with these findings can be utilized. The appropriate level of protection shall be determined prior to the initial entry into an area suspected of containing hazardous materials, or contamination, base on the best available information. Subsequent information may suggest changes in the original level selected.

13.2 Selection of Respiratory Equipment

13.2.1 Self-Contained Breathing Apparatus (SCBA)

A self-contained breathing apparatus (SCBA) usually consists of a face-piece connected by a hose and a regulator to an air source (compressed air, compressed oxygen, or an oxygen generating chemical) carried by the wearer. Only positive-pressure SCBAs are recommended for entry into atmospheres that are immediately dangerous to life and health (IDLH). SCBAs offer protection against most types and levels of airborne contaminants. However, the duration of the air supply is an important planning factor in SCBA use. This is limited by the amount of air carried and the rate of consumption by the user, which can be highly variable. Also, SCBAs are bulky and heavy, thus they increase the likelihood of heat stress and may impair movement in confined spaces. Generally, only workers handling hazardous materials or operating in highly contaminated areas (exclusion zones) require SCBAs.

13.2.2 Supplied-Air Respirators (SARs)

Supplied-air respirators (also known as airline respirators) supply air, never just oxygen, to a face-piece via a supply line from a stationary source. SARs are available in positive-pressure and negative-pressure modes. Pressure-demand SARs with escape provisions provide the highest level of protection (among SARs) and are the only SARs recommended for use at hazardous waste sites.

SARs are not recommended for entry into IDHL atmospheres (MSHA/NIOSH 30 CFR Part II) unless the apparatus is equipped with an escape SCBA.

The air source for supplied-air respirators may be compressed air cylinders, or a compressor that purifies and delivers ambient air to the face-piece.

13.2.3 Combination SCBA/SAR

A relatively new type of respiratory protection is available that uses a regulator to combine the features of an SCBA with a SAR. The user can operate the respiratory in the SCBA or SAR mode, through either the manual or automatic switching of air sources. This type of respirator allows entry into and exit from an area using the self contained air supply, as well as extended work periods within a contaminated area while connected to the airline. It is particularly appropriate for sites where workers must travel an extended distance to a work area within a hot zone and remain within that area for relatively long work periods (e.g., drum sampling). In such situations, workers would enter the site using the SCBA mode, connect to the airline during the work period, and shift back to the SCBA mode to leave the site.

13.2.4 Air-Purifying Respirators

Air-purifying respirators consist of a face-piece and an air-purifying device, which is either a removable component of the face-piece or an air-purifying apparatus worn on a body harness attached to the face-piece by a corrugated breathing hose. Air-purifying respirators selectively remove specific airborne contaminants (particulates, gases, vapors, and fumes) from ambient air by filtration, absorption adsorption, or chemical reactions. They are approved for use in atmospheres containing specific chemicals up to designated concentrations, and not for IDLH atmospheres. Air-purifying respirators have limited use at hazardous waste sites and can be used only when the ambient atmosphere contains sufficient oxygen (19.5 percent) (30 CFR Part 11.90(a)). Conditions that may exclude the use of air-purifying respirators include:

- Oxygen deficiency.
- IDHL concentrations of specific substances.
- Entry into an unventilated or confined area where exposure conditions have not been characterized.
- Presence or potential presence of unidentified contaminants.
- Contaminant concentrations are unknown or exceed designated maximum use concentration(s).
- Identified gases or vapors have inadequate warning properties and the sorbent service life is not known and the unit has no end-of-service-life (ESLI) indicator.
- High relative humidity (may reduce the protection offered by the sorbent).

There are three types of air-purifying devices: 1) particulate filters; 2) cartridges and canisters, which contain sorbents for specific gases and vapors and; 3) combination devices. Their efficiencies vary considerably even for closely related materials.

MSHA and NIOSH have granted approvals for manufacturers' specific assemblies of air-purifying respirators for a limited number of specific chemicals. Respirators should be used only for those substances for which they have been approved. Most chemical sorbent canisters are imprinted with an expiration date. They may be used up to that date as long as they were not opened previously. Once opened, they begin to adsorb humidity and air contaminants whether or not they are in use. Their efficiency and service life decreases and therefore they should be used immediately.

Cartridges should be discarded after use but should not be used for longer than one shift or when breakthrough occurs, whichever comes first.

Where a canister or cartridge is being used against gases or vapors, the appropriate device shall be used only if the chemical(s) has "adequate warning properties" (30 CFR Part 11.150). NIOSH considers a substance to have adequate warning properties when its odor, taste, or irritant effects are detectable and persistent at concentrations below the recommended exposure limit (REL). A substance is considered to have poor warning properties when its odor, or irritation threshold, is above the applicable exposure limit. Warning properties are essential to safe use of air-purifying respirators since they allow detection of contaminant breakthrough, should it occur. While warning properties are not foolproof, because they rely on human senses which vary widely among individuals and in the same individual under varying conditions (e.g., olfactory fatigue), they do provide some indication of possible sorbent exhaustion, poor face-piece fit, or other malfunctions. OSHA permits the use of air-purifying respirators for protection against specific chemicals with poor warning properties provided that (1) the service life of the sorbent is known and a safety factor has been applied or (2) the respirator has an approved end-of-service-life indicator.

13.3 Selection of Protective Clothing and Accessories

In this manual, personal protective clothing is considered to be any article offering skin and/or body protection. It includes:

- Fully encapsulating suits.
- Non-encapsulating suits.
- Aprons, leggings, and sleeve protectors.
- Gloves.
- Boots, or protective footwear
- Firefighters' protective clothing.
- Proximity, or approach, garments.
- Blast and fragmentation suits.
- Cooling garments.
- Radiation-protective suits.

Each type of protective clothing has a specific purpose; many, but not all, are designed to protect against chemical exposure. Accessories that might be used in conjunction with a PPE ensemble include:

- Knife
- Flashlight or lantern
- Personal locator beacon
- Inactivity/non-movement alarm
- Personal dosimeters
- Two-way radio
- Safety belts and lines

13.3.1 Selection of Chemical-Protective Clothing (CPC)

Chemical-protective clothing (CPC) is available in a variety of materials that offer a range of protection against different chemicals. The most appropriate clothing material will depend on the chemicals present and the task to be accomplished. Ideally, the chosen material resists permeation, degradation, and penetration. Permeation is the process by which a chemical dissolves in and/or moves through a protective clothing material on a molecular level. Degradation is the loss of or

change in the fabric's chemical resistance or physical properties due to exposure to chemicals, use, or ambient conditions (e.g., sunlight). Penetration is the movement of chemicals through zippers, stitched seams or imperfections (e.g., pinholes) in a protective clothing material.

Selection of chemical-protective clothing is a complex task and should be performed by personnel with training and experience. Under all conditions, clothing is selected by evaluating the performance characteristics of the clothing against the requirements and limitations of the site- and task-specific conditions. In all cases, the employer is responsible for ensuring that the personal protective clothing at the work site is adequate and of safe design and construction for the work to be performed (see OSHA standard 29 CFR Part 1910.132-1910.137).

13.3.2 Other Considerations

In addition to permeation, degradation and penetration, several other factors must be considered during clothing selection. These affect not only chemical resistance, but also the worker's ability to perform the required task. The following checklist summarizes these considerations.

- Durability: strength for task at hand.
- Flexibility: should not interfere with worker's ability to perform task.
- Temperature effects: maintain protective integrity under hot and cold extremes.
- Ease of decontamination: can it be decontaminated or should disposable clothing be used?
- Compatibility with other equipment: should not preclude the use of another piece of protective equipment.
- Duration of use: will it break through or will degradation occur during use?

13.3.3 Special Conditions

Fire, explosion, heat, and radiation are considered special conditions that require special-protective equipment. Unique problems are associated with radiation and it is beyond the scope of this manual to discuss them properly. A qualified health physicist should be consulted if a radiation hazard exists. When using special-protective equipment, it is important to also provide protection against chemicals, since the specialized equipment may provide little or no protection against chemicals that may also be present.

13.4 Selection of Ensembles/Level of Protection

Table 13.1 lists ensemble components based on the widely used EPA Levels of Protection: Levels A, B, C, and D. These lists should be considered a starting point for ensemble creation however, each ensemble must be tailored to the specific situation in order to provide the most appropriate level of protection.

The type of equipment used and the overall level of protection should be reevaluated periodically as the amount of information about the site increases, and as workers are required to perform different tasks. Personnel should be able to upgrade or downgrade their level of protection with concurrence of the Site Safety Officer and approval of the Field Team Leader.

13.5 PPE Use

PPE can offer a high degree of protection only if it is used properly. The following aspects of PPE use must be considered and depending on the hazards and complexity of hazardous site work anticipated must be implemented as part of a PPE and Respiratory Protection Program as per OSHA requirements.

Table 13.1 Sample Protective Ensembles – Level of Protection – A

Equipment	Protection Provided	Should be Used When:	Limiting Criteria
RECOMMENDED: • Pressure demand, full face-piece SCBA or pressure demand supplied-air respirator with escape-SCBA • Fully-encapsulating chemical-resistant suit • Inner chemical resistant gloves • Chemical-resistant safety boots • Outer chemical resistant gloves • Chemical-resistant shoes • Two-way radio communications	The highest available level of respiratory, skin, and eye protection	• The chemical substance is identified and requires highest Level of protection for skin, eyes and the respiratory system based on either: – measured (or potential for) high concentration of atmospheric vapors gases, or particulates or – site operations and work functions involving a high potential for splash immersion, or exposure to unexpected vapors, gases or particles of materials that are harmful to skin or can be absorbed through the intact skin • Substances with a high degree of hazard to the skin are known or suspected and contact with the skin is possible • Operations must be conducted in confined, poorly ventilated areas until the absence of conditions requiring Level A protection are determined	Fully encapsulat-ing suit material must be compatible with the substances involved
OPTIONAL: • Cooling unit • Coveralls • Long cotton underwear • Hard hat • Disposable gloves and boot covers			

- Training
- In-use monitoring
- Work mission duration
- Doffing
- Personal use factors
- Inspection
- Fit testing
- Storage
- Donning
- Maintenance
- Medial surveillance

13.5.1 Training

Training in PPE use is recommended and, for respirators, required by federal regulation in the OSHA standards in 29 CFR Part 1910 Subparts I and Z. This training:

- Allows the user to become familiar with equipment in a non-hazardous situation.
- Instills confidence of the user in his/he equipment.
- Makes the user aware of the limitations and capabilities of the equipment.
- Increases the efficiency of operations performed by workers wearing PPE.
- May increase the protective efficiency of PPE use.

Table 13.1 Sample Protective Ensembles – Level of Protection – B

Equipment	Protection Provided	Should be Used When:	Limiting Criteria
RECOMMENDED: • Pressure-demand, full face-piece SCBA or pressure-demand supplied air respirator with escape SCBA • Chemical-resistant clothing (overall and long sleeved jacket; hooded one or two piece chemical splash suit; disposable chemical-resistant one-piece suit) • Inner and outer chemical-resistant gloves • Chemical-resistant safety boots/shoes • Hard hat • Two-way radio communication	The same level of respiratory protection but less skin protection than Level A. It is *the* minimum level recommend-ed for initial site entries until the hazards have been further identified	• The type and atmospheric concentration of substances have been identified and require a high level of respiratory protection, but less skin protection. This involves atmospheres: – with IDHL concentrations of specific substances that do not represent a severe skin hazard; or – that do not meet the criteria for the use of air purifying respirators. • Atmosphere contains less than 19.5% oxygen • Presence of Incompletely identified vapors or gases is indicated by direct-reading organic vapor detection instrument, but vapors and gases are not expected of containing high levels of chemicals harmful to skin or capable of being absorbed through the intact skin	• Use only when the vapor or gases present are not suspected of containing high concentrations of chemical that are harmful to skin or capable of being absorbed through the intact skin • Use only when it is highly unlikely that the work being done will generate either concentrations of vapors, gas or particulates or splashes of material that will affect exposed skin
OPTIONAL: • Coveralls • Disposable boot of containing covers • Face shield • Long cotton underwear			

Table 13.1 Sample Protective Ensembles – Level of Protection – C

Equipment	Protection Provided	Should be Used When:	Limiting Criteria
RECOMMENDED: • Full face-piece, air purifying canister-equipped respirator • Chemical-resistant clothing (overall and long sleeved jacket; hooded one or two piece chemical splash suit; disposable chemical-resistant one-piece suit) • Inner and outer chemical-resistant gloves • Chemical-resistant safety boots/shoes • Hard hat • Two-way radio communications	The same level of skin protection as Level B, but a lower level of respiratory protection	• The atmospheric contaminants, liquid splashes, or other direct contact will not adversely affect any exposed skin • The types of air contaminants have been identified, concentrations measured, and a canister is available that can remove the contaminant • All criteria for the use of air purifying respirators are met	• Atmospheric concentration of chemicals must not exceed IDHL levels • The atmosphere must contain at least 19.5% oxygen
OPTIONAL: • Coveralls • Disposable boot covers • Face shield • Escape mask • Long cotton underwear			

Table 13.1 Sample Protective Ensembles – Level of Protection – D

Equipment	Protection Provided	Should be Used When:	Limiting Criteria
RECOMMENDED: • Coveralls • Safety boots/shoes • Safety glasses or chemical splash goggles	No respiratory protection	• The atmosphere contains no known hazard • Work functions preclude splashes, immersion, or the potential for unexpected inhalation or contact with hazardous levels of any chemicals	• This level should not be worn in the Exclusion Zone • The atmosphere must contain at least 19.5% oxygen
OPTIONAL: • Gloves • Escape mask • Face shield			

- Reduces the expense of PPE maintenance.

Training should be completed prior to actual PPE use in a hazardous environment and should be repeated at least annually.

The discomfort and inconvenience of wearing PPE can create a resistance to the conscientious use of PPE. One essential aspect of training is to make the user aware of the need for PPE and to instill motivation for the proper use and maintenance of PPE.

13.5.2 Work Mission Duration

Before the workers actually begin work in their PPE ensembles, the anticipated duration of the work mission should be established. Several factors limit mission length.

- Air supply consumption rate
- Suit/ensemble permeation and penetration
- Ambient temperature extremes
- Physical condition of the user (extremely variable from user to user, and even day to day for individual user)

13.5.3 Personal Use Factors

As described below, certain personal features of workers may jeopardize safety during equipment use. Prohibitive or precautionary measures should be taken as necessary.

Facial hair and long hair interfere with respirator fit and wearer vision, and should be prohibited.

Eyeglasses with conventional temple pieces (ear piece bars) will interfere with the respirator-to-face seal of a full face-piece. A spectacle kit should be installed in the facemasks of workers requiring vision correction.

When a worker must wear corrective lenses as part of the face piece, the lenses shall be fitted by qualified individuals to provide good vision, comfort, and a gas-tight seal (29 CFR Part 1910.134(e)(5).

Gum and tobacco chewing should be prohibited during respirator use since they may cause ingestion of contaminants and may compromise the respirator fit.

13.5.4 Donning an Ensemble

A routine should be established and practiced periodically for donning a fully encapsulating suit/SCBA ensemble. Assistance should be provided for donning and doffing. These operations are difficult to perform alone, and solo efforts might increase the possibility of suit damage.

13.5.5 Respirator Fit Testing

The "fit" or integrity of the face-piece to face seal of a respirator affects its performance. A secure fit is important with positive pressure equipment, and is essential to the safe functioning of negative-pressure equipment, such as most air-purifying respirators. Most face pieces fit only a certain percentage of the population; thus each face-piece must be tested on the potential wearer in order to ensure a tight seal. Facial features such as scars, hollow temples, very prominent cheek-bones, deep skin creases, dentures or missing teeth, and the chewing of gum and tobacco may interfere with the respirator to face seal. A respirator shall not be worn when such conditions prevent a good seal. The workers' diligence in observing these factors shall be evaluated by periodic checks.

For respirator fit testing protocols, refer to 29 CFR 1910.134, Appendix A *Part I. OSHA – Accepted Fit Test Protocols*. For specific quantitative testing protocols, literature supplied by manufacturers of quantitative fit test equipment should be consulted. Note that certain OSHA standards require quantitative fit testing under specific circumstances (e.g., 29 CFR Parts 1910.1018 (h) for arsenic, 1910.1025 (f) for lead (3)(ii), and 1910.1045 (h) for acrylonitrile.

13.5.6 Doffing an Ensemble

Exact procedures for removing fully encapsulating suit/SCBA ensembles must be established and followed in order to prevent contaminant migration from the work area and transfer of contaminants to the wearer's body, the doffing assistant, and others. (See Chapter 14)

13.5.7 Inspection

An effective PPE inspection program features five different inspections:

- Inspection and operational testing of equipment received from the factory or distributor.
- Inspection of equipment as it is distributed to workers.
- Inspection after use or training and prior to maintenance.
- Periodic inspection of stored equipment.
- Periodic inspection when a question arises concerning the appropriateness of the selected equipment, or when problems with similar equipment arise.

13.5.8 Storage

Clothing and respirators must be stored properly to prevent damage, contamination or malfunction due to exposure to dust, moisture, sunlight, damaging chemicals, extreme temperatures, and impact. Procedures must be specified for both pre-issuance warehousing and, more importantly, post-issuance (in-use) storage. Many equipment failures can be directly attributed to improper storage.

SCBAs, supplied air respirators, and air purifying respirators should be dismantled washed and disinfected after each use.

13.6 Heat Stress and Other Physiological Factors

Wearing PPE puts a hazardous waste worker at considerable risk of developing heat stress. This can result in health effects ranging from transient heat fatigue to serious illness or death. A number of interacting factors, including environmental conditions, clothing, workload, and the individual characteristics of the worker may lead to heat stress. Because heat stress is probably one of the most common (and potentially serious) illnesses at hazardous waste sites, regular monitoring and other preventative precautions are vital.

Individuals vary in their susceptibility to heat stress. Factors that may predispose someone to heat stress include lack of physical fitness, lack of acclimatization, age, dehydration, obesity, alcohol/ drug use, infection, sunburn, diarrhea and chronic disease.

The amount and type of PPE worn directly influence reduced work tolerance and the increased risk of excessive heat stress. PPE adds weight and bulk, severely reduces the body's access to normal heat exchange mechanisms (evaporation, convection, and radiation), and increases energy expenditure. Therefore, when selecting PPE, each item's benefit should be carefully evaluated in relation to its potential for increasing the risk of heat stress. Once PPE is selected, the safe duration of work/rest periods should be determined based on the anticipated work rate, ambient temperatures and other environmental factors, protective ensembles used, and individual worker characteristics and fitness.

13.6.1 Monitoring

Because the incidence of heat stress depends on a variety of factors, all workers, even those not wearing protective equipment, should be monitored.

To monitor the worker, measure:

- Heart rate. Count the radial pulse during a 30-second period as early as possible in the rest period. If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third and keep the rest period the same. If the heart rate still exceeds 110 beats per minute at the next rest period, shorten the following work cycle by one-third.
- Oral temperature. Use a clinical thermometer (3 minutes under the tongue) or similar device to measure the oral temperature at the end of the work period (before drinking). If oral temperature exceeds 99.6°F (37.6C), shorten the next work cycle by one-third without changing the rest period. If oral temperature still exceeds 99.6°F (37.6°C) at the beginning of the next rest period, shorten the following work cycle by one-third. Do not permit a worker to wear a semi-permeable or impermeable garment when his/her oral temperature exceeds 100.6°F (38.1°C).
- Body water loss, if possible. Measure weight on a scale accurate to ñ0.25 lb. at the beginning and end of each workday to see if enough fluids are being taken to prevent dehydration. Weights should be taken while the employee wears similar clothing or, ideally, is nude. The body water loss should not exceed 1.5- percent total body weight loss in a workday.

13.6.2 Prevention

Proper training and preventive measures will help avert serious illness and loss of work productivity. Preventing heat stress is particularly important because once someone suffers from heat stroke or heat exhaustion, that person may be predisposed to additional heat injuries. To avoid heat stress, management should take the following steps:

- Adjust work schedules
- Provide shelter or shade during rest periods

- Maintain worker's body fluids at normal levels
- Encourage physical fitness
- Provide cooling devices
- Train workers to recognize heat stress (see Table 13.2)

Table 13.2 Signs and Symptoms of Heat Stress

- Heat rash may result from continuous exposure to heat or humid air.
- Heat cramps are caused by heavy sweating with inadequate electrolyte replacement. Signs and symptoms include:
  - muscle spasms
  - pain in the hands, feet, and abdomen
- Heat exhaustion occurs from increased stress on various body organs including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms include:
  - pale, cool, moist skin
  - heavy sweating
  - dizziness
  - nausea
  - fainting
- Heat stroke is the most serious form of heat stress. Temperature regulation fails and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury and death occur. Competent medical help must be obtained. Signs and symptoms are:
  - red, hot, usually dry skin
  - lack of or reduced perspiration
  - nausea
  - dizziness and confusion
  - strong, rapid pulse
  - coma

References

National Institute for Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA),

U.S. Coast Guard (USCG), and Environmental Protection Agency (EPA), Occupational Safety and Health Guidance

Manual for Hazardous Waste Site Activities, DHHS (NIOSH) Publication No. 85-115, October, 1985.

13.6.3 Other Factors

PPE decreases worker performance as compared to an unequipped individual. The magnitude of this effect varies considerably, depending on both the individual and the PPE ensemble used. This

section discusses the demonstrated physiological responses to PPE and the individual human characteristics that play a factor in these responses. The physiological factors, which may affect worker ability to function using PPE, include physical condition, level of acclimatization, age, gender, and weight.

13.6.3.1 Physical Condition

Physical fitness is a major factor influencing a person's ability to perform work under heat stress. The more fit someone is, the more work they can safely perform. At a given level of work, a fit person, relative to an unfit person, will have: less physiological strain, lower heart rate, lower body temperature (less retained body heat), more efficient sweating mechanism, slightly lower oxygen consumption, and slightly lower carbon dioxide production.

13.6.3.2 Level of Acclimatization

The degree to which a worker's body has physiologically adjusted or acclimatized to working under hot conditions affects his or her ability to do work. Acclimated individuals generally have lower heart rates and body temperatures than unacclimated individuals, and sweat sooner and more profusely. This enables them to maintain lower skin and body temperatures at a given level of environmental heat and work loads than unacclimated workers. Sweat composition also becomes more dilute with acclimatization, which reduces salt loss.

13.6.3.3 Age

Generally, maximum work capacity declines with increasing age, but this is not always the case. Active, well-conditioned seniors often have performance capabilities equal to or greater than young sedentary individuals. Age should not be the sole criterion for judging whether or not an individual should be subjected to moderate heat stress. Fitness level is a more important factor.

13.6.3.4 Weight

The ability of a body to dissipate heat depends on the ratio of its surface area to its mass (surface area/weight). Heat loss (dissipation) is a function of surface area and heat production is dependent on mass. Therefore, heat balance is described by the ratio of the two.

Since overweight individuals (those with a low ratio) produce more heat per unit of surface area than thin individuals (those with a high ratio), overweight individuals should be given special consideration in heat stress situations. However, when wearing impermeable clothing, the weight of an individual is not a critical factor in determining the ability to dissipate excess heat.

References

National Institute for Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA), U.S. Coast Guard (USCG), and Environmental Protection Agency (EPA), Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, DHHS (NIOSH) Publication No. 85-115, October, 1985.

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