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PERSONAL PROTECTIVE EQUIPMENT




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Personal Protective Equipment

- PPE is an essential component of a fire fighter's safety system.
- PPE must provide full body coverage and protection from a variety of hazards.



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Donning and Doffing PPE

- Donning PPE must be done in a specific order to obtain maximum protection.
- Firefighters should be able to don PPE in one minute or less.
- To doff PPE, reverse the procedure used in getting dressed.



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Structural Fire Fighting Ensemble

- Structural fire fighting PPE is designed to be worn with SCBA.
- To be effective, the entire ensemble must be worn whenever potential exposure to those hazards exists.



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Why PPE?

- Types of injuries on-scene:
 - ◆ Inhalation/absorption
 - ◆ Puncture/injections
 - ◆ Sprains/strains
 - ◆ Broken bones
 - ◆ Crushing injuries
 - ◆ Internal trauma
 - ◆ Burns



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Sensitive Areas



- Respiratory system:
 - ◆ Inhalation of toxic fumes
 - ◆ Absorption into the blood stream
- Eyes:
 - ◆ Absorb 100% of fumes exposed to them.

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Protection Provided by the Helmet

- Protects against blunt trauma and includes ear coverings.
- A hard outer shell is lined with energy-absorbing material and a suspension system protects against impact from falling objects.



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Absorption design

- An energy absorbing liner
- Came from the transportation & sport fields
- Based on the assumption that time duration of impact is short
- Higher pressures can be absorbed without concussive effects
- 2 criteria are important:
 - ◆ Shell must be quite hard
 - ◆ Liner must fit well to the skull and be capable of absorbing energy.

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Protection Provided by the Helmet

- The shape of the helmet deflects water from the head and neck.
- A face shield, goggles, or both, protect the eyes.
- A chin strap keeps the helmet in the proper position.



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Protection Provided by the Helmet

- When entering a burning building, the firefighter should pull down the ear tabs for maximum protection.
- Helmet shells are often color-coded according to the firefighter's rank and function.

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Problems Provided by the Helmet



- Little protection from heat and cold
- Large rear overhang can become a problem when using SCBA
- Feeling of invincibility

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Helmet Requirements

- Acceptance level of any helmet will depend on comfort to wearer and group acceptance in terms of symbolic tradition.
- Must meet the latest standards



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Standards

- American National Standard Institute (ANSI)
- NFPA Standard #1971
- ASNI 289.1 list requirements for Type D
- ANSI specifies limits of flammability & water absorbency & the requirements of brim strength
- Reflective visibility must reflect current NFPA standard.



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Construction materials

- Plastics
 - ◆ Temperature range is an important consideration since some plastics will melt at much lower temperatures than those encountered by firefighters.



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Construction Material



- Fiberglass
- Leather
- Kevlar

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Inspection

- Inspect the suspension system
 - ◆ Check for deterioration of system
 - ◆ Replace as needed
- Inspect inner & outer shell
 - ◆ For cracks
 - ◆ Separation
 - ◆ Replace as needed



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Inspection

- Inspect the face shield or goggles
 - ◆ Ensure they are clean
 - ◆ Excessive scratches obscure vision
 - ◆ Goggle ventilation should be in place to prevent fogging



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Maintenance

- Remove dirt & all foreign objects
- Remove chemicals, oils & petroleum:
 - ◆ May cause softening of the shell
 - ◆ Reduces its impact protection



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Protection Provided by the Protective Hood

- Covers any exposed skin between the coat collar and the helmet.
- Constructed of flame-resistant materials such as Nomex® or PBI®.
- Worn over the face piece but under the helmet.



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Get the Point



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Protection from Turnout Gear

- Turnout coat and bunker pants have tough outer shells.
 - ◆ Can withstand high temperatures but are designed for a specific range of exposure
 - ◆ Repel water, protect against abrasions and sharp objects
- Leather pads on knees for protection when crawling.

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Protection from Turnout Gear



- Reflective trim adds visibility.
- Insulating layers of fire-resistant materials protect from high heat.
- Moisture barrier keeps hot liquids and vapors from reaching the skin.

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Protection from Turnout Gear

- Materials used today
 - ◆ Nomex
 - ◆ PBI
 - ◆ Kevlar
- Other materials
 - ◆ Aluminized fabrics



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Vapor barrier

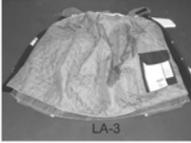
- Prevents or inhibits the transfer of water, corrosive liquids, steam, or hot vapor
- Flame resistant
- Should be light
- Usually neoprene, rubberized, or Gortex
- Must allow air flow for thermal insulation
- Should not stiffen when subjected to freezing conditions

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Inner or insulating liners

- For thermal protection & padding
- Should not be removed
 - ◆ Summer & winter types
- Light weight materials:
 - ◆ Flannel
 - ◆ Wool
 - ◆ Cotton
 - ◆ Nylon quilt



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General Design Features

- Collar:
 - ◆ Should protect the neck & throat
 - ◆ Should be water repellent



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General Design Features

- Closures:
 - ◆ Snap and D-ring
 - ◆ Velcro™
 - ◆ Zippers
 - ◆ Must provide protection against steam & water



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General Design Features

- Trim & color:
 - ◆ Comes in many colors
 - ◆ Lighter color doesn't absorb as much heat
 - ◆ Visibility must be considered
 - ◆ Trimmed in white reflective type trim per NFPA Standard



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Maintenance

- Cleaned after every exposure
- Wash separate from other type of clothing
- Machine wash, warm water
- No starch or bleach
- Can tumble dry, low heat, but best to hand dry
- In accordance with manufacturer's recommendations & directions

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Protection from Turnout Gear

- Sleeves have wristlets to keep out liquids or hot embers.
- Both long and short style turnout coats will protect the body as long as the matching style of pants or coveralls are also worn.



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Protection from Turnout Gear

- Outer shell consideration:
 - ◆ Flame resistant
 - ◆ Limited restriction of motion
 - ◆ Leaning effectiveness
 - ◆ Permeability



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Protection from Turnout Gear



- Research indicates that multiple layers of lightweight materials with air sandwiches between them provide near optimum protection.
- Clothing is fire resistant, **not** fireproof.
 - ◆ Use safe practices and common sense
 - ◆ Standards set by NFPA Standard #1971

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Protection Provided by Turnout Gear

- Bunker pants can have a waist-length or bib-overall design.
- Manufactured with a double fastener system at the waist.
- Should be big enough to allow you to crawl and bend your knees.



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Protection Provided by Boots

- Boots protect feet and ankles from the fire, keep them dry, prevent puncture injuries, and protect the toes.
- Boots can be rubber or leather.
- The outer layer repels water and must be both flame- and cut-resistant.



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Protection Provided by Boots

- Boots must have:
 - ◆ a heavy sole with a slip-resistant design,
 - ◆ a puncture-resistant sole, and
 - ◆ a reinforced toe to prevent injury from falling objects.
- An inner liner constructed of materials such as Nomex® or Kelvar® adds thermal protection.

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Protection Provided by Boots

- Must meet current ANSI standards
- Inspection & maintenance
 - ◆ Check for cracks, splits or punctures
 - ◆ Worn heels should be replaced
 - ◆ Oil, grease, & debris should be cleaned off
 - ◆ May cause deterioration of rubber or leather.

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Protection Provided by Gloves

- Gloves protect the hands from heat, cuts, and abrasions.
- Usually constructed of heat-resistant leather.
- Required wristlets prevent skin exposure and are usually made of knitted Nomex® or Kelvar®.



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Protection Provided by Gloves

- A liner adds thermal protection and serves as a moisture barrier.
- Firefighters need to practice manual skills while wearing gloves to become accustomed to them and to adjust movement accordingly.



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Protection Provided by Gloves

- Made from NFPA recommended materials
- Special care gloves for specialized hazards & exposures should be used



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Disadvantages of Gloves

- Less manual dexterity
- Difficult to get proper fit
- Limited protection with use and age, as well as, extreme hot or cold
- Exposure to chemicals and contact with, will be absorb into the material
 - ◆ Causes deterioration and increased exposure of the hands and fingers
- Inadequate wrist protection

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Respiratory Protection

- Self-contained breathing apparatus (SCBA) provides respiratory protection through an independent air supply.
- PPE ensemble for structural fire fighting is not complete without respiratory protection.



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Personal Alert Safety System (PASS)

- A PASS is an electronic device that sounds a loud audible signal if a fire fighter is motionless for a set time period or if activated by the fire fighter.



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PASS

- A PASS can be separate from or integrated into the SCBA unit.
 - ◆ Integrated—automatically turns on when the SCBA is activated.
 - ◆ Separate—often worn on the SCBA harness and must be turned on manually.

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Use PASS When?

- Whenever entering a structure during fire fighting, salvage or overhaul operations, as well as, in USAR



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PASS Design & Operation



- Specifications
 - ◆ Waterproof
 - ◆ Shock proof
 - ◆ Explosion proof
- Each device is attached differently
 - ◆ Per manufacturer's recommendations and directions

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PASS Operation

- Automatic activation
 - ◆ A lack of motion for 20 to 40 seconds will cause the unit to sound an alarm
 - ◆ If motion is detected within the 20 to 40 seconds, the unit will automatically reset
- Manual activation
 - ◆ Different depending on the manufacturer
 - ◆ Also, some activate due to high heat.

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PASS Operation



- Once the unit activates, the unit's audible alarm should sound continuously until it is turned to the off position
- Clearing the alarm can be done by turning the unit to the off position

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PASS for Life

- The use of a personal alarm device can be a lifesaving factor. Each wearer must thoroughly know the operations of a personal alarm device for their personal safety. In addition, the user should be familiar with all aspects of this unit confirming the reliability of the key safety components and any operational limitations.

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Additional Personal Protective Equipment

- Goggles provide additional eye protection.
- An apparatus intercom facilitates team communication while protecting hearing from sirens.



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Additional Personal Protective Equipment



- Flexible ear plugs are useful in other situations involving loud sounds.
- A firefighter should always carry a hand light.
- At least one member of each team in a hazardous area should have a radio.

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Limitations of the Structural Fire Fighting Ensemble

- Each component must be properly donned and worn to provide complete protection.
- Components must be put on in the proper order and correctly secured.

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Limitations of the Structural Fire Fighting Ensemble

- PPE is heavy and can cause fatigue.
- PPE retains body heat and perspiration.
- ◆ Firefighters in full PPE can rapidly develop elevated body temperatures.



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Limitations of the Structural Fire Fighting Ensemble



- PPE limits mobility and range of motion.
- PPE also decreases normal sensory abilities.

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Wildland Fire Fighting PPE

■ Helmet:

- ◆ Lightweight
- ◆ Small brim
- ◆ Adjustable headband for proper fit
- ◆ Inspect and clean after each use
 - ◆ Soap & water
 - ◆ Do not clean with solvents
 - ◆ Warning: washing can contaminate machine with poison oak and other poisons



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Wildland Eye Protection



- Goggles are the preferred eye protection
- Prevents injuries & irritation from smoke & fire brands, as well as penetration injuries

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Disadvantages of Eye Protection

- Excessive scratches can obscure vision
- Inadequate ventilation causes fogging
- Can melt if exposed to high heat
- Sunglasses are not recommended

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Wildland Ear & Neck Protection



- Designed to protect the neck, ears and in some designs the lower face area
- Usually a part of or attached to the rear & side of the helmet
- Wraparound or as fold down ear & neck flaps

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Wildland Coat

- Wildland fire fighting Nomex type coats are usually a thin single layer
 - ◆ Provide for enhanced body heat loss
 - ◆ Offer minimal insulation



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Wildland Coat

- Cotton undergarments are important for reducing radiant heat exposure
- Sleeves must be fastened
- All closures used (Button, zipper, Velcro™, snap)
- Inspect & clean periodically and after each fire exposure



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Wildland Pants

- Wildland fire fighting Nomex-type pants are usually a thin single layer
 - ◆ Provide for enhanced body heat loss
 - ◆ Offer minimal fire exposure protection



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Wildland Pants

- Cotton and other undergarments are important for reducing radiant heat exposure
- All closures used (button, zipper, Velcro™, snap)
- Inspect and clean periodically & after each fire exposure according to manufacturer's specifications

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Wildland Gloves



- Provide better handling characteristics than structure gloves
- Must fit properly
- Can limit manual dexterity
- Use & age can limit life of the material
- Gloves can be damaged
- Must have adequate wrist protection

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Wildland Foot & Ankle Protection

- Demands offer additional hazards not present in structure firefighting
 - ◆ Uneven terrain, rocks
 - ◆ Animals, snakes
- An above-the-ankle type work boot with lace up capability should be worn
 - ◆ Minimum of 8-inch rise



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Wildland Foot & Ankle Protection

- Steel toe & sole
 - ◆ Puncture protection
 - ◆ Note: Many wildland firefighters do not have steel toes due to heat, use your Departments SOP.
- Lug type sole or equivalent for traction in all types of terrain
- Boots to be kept clean and polished or oiled after each use.

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Storage

- Exposure to high heat and/or sunlight for extended periods of time degrades the materials all turnouts are made of.
 - ◆ Keep cool and dark



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Work Uniforms

- A work uniform is also part of the personal protective package.
- Clothing containing nylon or polyester may melt.
- Volunteer fire fighters should consider these fabric properties when selecting their wardrobe.

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Why Does PPE Fail?

- Safety First by Safeguarding Against Hazards
 - ◆ Eliminate the hazard:
 - ◆ Not possible in all situations
 - ◆ Intercept the hazard:
 - ◆ Erect fences
 - ◆ Establish guards
 - ◆ Construct fire walls, etc.



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Why Does PPE Fail?

- Safety First by Safeguarding Against Hazards
 - ◆ Defensive wall against the hazard
 - ◆ Last resort against the hazard
 - ◆ If the wall fails, the human body is the immediate target

Note: Defensive wall concept applies to personal protective equipment.

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Shortcomings of PPE

- It is the goal of the fire department to minimize hazards and protect its personnel from injuries through the education of its firefighters
- Overconfidence in the degree of protection afforded by a piece of equipment may cause the firefighter to take unnecessary risks which could result in injuries



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Shortcomings of PPE

- Today's technological working environment may be beyond some firefighter's comprehension because of limited experience and/or education.
 - ◆ These limitations may cause firefighters to underestimate the degree of risk in a fire situation
 - ◆ The result is that some emergencies may be attacked that are beyond the capability of personnel, equipment, and known techniques

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Shortcomings of PPE



- Overconfidence and unnecessary risk:
 - ◆ Create an environment for injury
 - ◆ Firefighters must recognize the degree of hazard, even with proper use of PPE

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Limitations

- Inadequate knowledge
- Improper attitude
- Insufficient training



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Limitations

- Inadequate knowledge
- Improper attitude
- Insufficient training
- Improper maintenance
 - ◆ Failure to repair compromised clothing
- Misuse or improper use of PPE
 - ◆ May make a firefighter vulnerable to injuries
 - ◆ Failure to use



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PPE

- Firefighter personnel should be aware of the type of personal protective equipment needed for different exposures and have the equipment readily available. Knowledge of the needs for personal protective equipment will assure that fire fighters are adequately protected.

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END

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