

# Hazmat suit

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A **Hazmat suit** is a garment worn as protection from **hazardous materials** or substances. A Hazmat suit is generally combined with breathing apparatus for protection and may be used by firefighters, emergency personnel responding to toxic spills, researchers, specialists cleaning up contaminated facilities, or workers in toxic environments. It is sometimes confused with, or referred to as, an NBC (Nuclear, **B**iological, **C**hemical) suit, which is a military version intended to be usable in combat.



US Air Force firefighters in suits with an outer aluminized shell go through a decontamination line during an emergency management exercise.

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## Capabilities

### Overview

The United States Department of Homeland Security defines a Hazmat suit as "an overall garment worn to protect people from hazardous materials or substances, including chemicals, biological agents, or radioactive materials."<sup>[1]</sup> More generally, Hazmat suits may provide protection from:



DEA agents wearing Level B hazmat suits.

- **Chemical agents**—through the use of appropriate barrier materials like teflon, heavy PVC or rubber and Tyvek
- **Nuclear agents**—possibly through radiation shielding in the lining, but more importantly by preventing direct contact with or inhalation of radioactive particles or gas
- **Biological agents**—through fully sealed systems (often at overpressure to prevent contamination even if the suit is damaged)
- **Fire/high temperatures**—usually by a combination of insulating and reflective materials which reduce or retard the effects

The Hazmat suit generally includes breathing air supplies to provide clean, uncontaminated air for the wearer. In laboratory use, the external air may be provided through air hoses supplied from a 'clean' location. This air is usually pumped into the suit at positive pressure with respect to the surroundings as an additional protective measure against the introduction of dangerous agents into a potentially ruptured or leaking suit.

Working in a Hazmat suit is very strenuous, as the suits tend to be less flexible than conventional work garments. With the exception of laboratory versions, Hazmat suits can be hot and poorly ventilated (if at all). Therefore, use is usually limited to short durations of up to 2 hours, depending on the difficulty of the work. Level A (United States) suits, for example, are limited by their air supply to around 15–20 minutes of very strenuous work (such as a firefighting rescue in a building).<sup>[2]</sup>

However, OSHA/EPA protective level A suits/ensembles are not typically used in firefighting rescue, especially during a building/structure fire. National Fire Protection Association (NFPA) compliant "turnout gear", and NIOSH-certified SCBA, or CBRN SCBA, are the primary protection technologies for structure firefighting in the US.

## Ratings

### In the United States

Hazmat protective clothing is classified as either Level A, B, C, or D, based upon the degree of protection they provide.<sup>[3]</sup>

#### ▪ Level A

The highest level of protection against vapors, gases, mists, and particles is Level A, which consists of a fully encapsulating chemical entry suit with a full-facepiece self-contained breathing apparatus (SCBA) or a supplied air respirator (SAR) with an SCBA escape cylinder. A crew member must also wear boots with steel toes and shanks on the outside of the suit and specially selected chemical-resistant gloves for this level of protection. The breathing apparatus is worn inside (encapsulated within) the suit. To qualify as Level A protection, an intrinsically safe two-way radio is also worn inside the suit, often incorporating voice-operated microphones and an earpiece speaker for monitoring the operations channel.

#### ▪ Level B

Level B protection requires a garment (including SCBA) that provides protection against splashes from a hazardous chemical. Since the breathing apparatus is worn on the outside of the garment, Level B protection is not vapor-protective. It is worn when vapor-protective clothing (Level A) is not required. Wrists, ankles, facepiece and hood, and waist are secured to prevent any entry of splashed liquid. Depending on the chemical being handled, specific types of gloves and boots are donned. These may or may not be attached to the garment. The garment itself may be one piece or a two-piece hooded suit. Level B protection also requires the wearing of chemical-resistant boots with steel toes and shanks on the outside of the garment. As with Level A, chemical-resistant gloves and two-way radio communications are also required.

#### ▪ Level C

Level C protection differs from Level B in the area of equipment needed for respiratory protection. The same type of garment used for Level B protection is worn for Level C. Level C protection allows for the use of respiratory protection equipment other than SCBA. This protection includes any of the various types of air-purifying respirators. Crew members should not use this level of protection unless the specific hazardous material is known and its concentration can be measured. Level C equipment does not offer the protection needed in an oxygen deficient atmosphere.

#### ▪ Level D

Level D protection does not protect the crew member from chemical exposure. Therefore, this so-called level of protection can only be used in situations where a crew member has no possibility of contact with chemicals. A pair of coveralls or other work-type garment along with chemical-resistant footwear with steel toes and shanks are all that is required to qualify as Level D protection. Most firefighter turnout gear is considered to be Level D.

### In Europe

Most suits used in Europe are covered by a set EU Norms, and divided into a total of six types (levels) of protection:

- Type 1: Protects against liquid and gaseous chemicals. Gas tight. (prEN 943 part 1). More or less equivalent to US level A.
- Type 2: Protects against liquid and gaseous chemicals. Non gas tight. (prEN 943 part 1). More or less equivalent to US level B.<sup>1</sup>
- Type 3: Protects against liquid chemicals for a limited period. Liquid tight. (prEN 1511)
- Type 4: Protects against liquid chemicals for a limited period. Spray tight. (prEN 1512). More or less equivalent to US level C.
- Type 5: Protects against liquid chemicals for a limited period. Only covers body partially. (prEN 1513). More or less equivalent to US level D.

- Type 6: Protects parts of body against liquid chemicals (prEN 13034)

<sup>1</sup>: Can be used in places where the chemical in gaseous form isn't harmful to the body exterior.



## Types

Hazmat suits come basically in two variations: splash protection and gastight suits. As the name implies the splash protection suits are designed to prevent the wearer from coming into contact with a liquid. These suits do not protect against gasses or dust. Gastight suits protect the wearer from basically any outside influence apart from heat and radiation.

### Gas / vapor protection

Such suits (Level A in the US) are gas or vapor-tight, providing total encapsulation and the highest level of protection against direct and airborne chemical contact. They are typically worn with a self-contained breathing apparatus (SCBA) enclosed within the suit.

These suits are typically constructed of several layers and, being air tight, include a release valve so the suit does not overinflate from air exhaled by the SCBA. The release valve does retain some air to keep some positive pressure ("overpressure") inside the suit. As noted, such suits are usually limited to just 15-20 minutes of use by their mobile air supply.<sup>[2]</sup>

With each suit described here, there is a manufactured device designed to protect the respiratory system of the wearer while the suit/ensemble is used to protect skin exposed to potential, or actual dermal, hazardous agents. That device is a respirator. A respirator may be something as simple as a headband strap filtering facepiece respirator (FFR), to a headharness negative pressure fullface respirator (Air-Purifying Respirator (APR)), to a full face, tight fitting, closed breathing air, or open circuit, self-contained breathing apparatus (CC-SCBA or SCBA).

### Splash protection

Such suits (Level B in the US) are not vapor-tight and thus provide a lesser level of protection. They are, however, worn with an SCBA, which may be located inside or outside of the suit, depending on the type of suit (encapsulating or non-encapsulating). They more closely resemble the one-piece Tyvek coveralls often seen used in construction and demolition work. Yet, Level B splash suits may also be fully encapsulating suits which are simply not airtight.

Lesser protection (Level C in the US) suits may be coveralls of treated material, or multi-piece combinations, sealed with tape. This kind of protection is still "proof" against many non-invasive substances, such as anthrax.<sup>[2]</sup>

## In fiction

Hazmat suits have long been used as an important device found in fiction, especially science fiction, to dramatize the deadliness of lethal environments. Common dramatic situations usually involve a suit failure leading to rapid death in films such as *The Andromeda Strain* or *Outbreak*. Plot resolutions usually make the removal of a suit a pivotal moment, signifying the end of the threat.

The anonymity provided by hazmat suits has often been used to accentuate sinister motives. The scientists in *E.T. the Extra-Terrestrial* are a good example of this, as are the farcical squad of hazmat-suited characters in

the animation *Monsters, Inc.*.

Hazmat suits are also commonly found in video games, used to navigate otherwise dangerous areas. Popular game series which feature hazmat-like suits include *Maniac Mansion*, *Half-Life*, *Hitman: Contracts*, *Saints Row 2*, *The Conduit*, *Doom*, *Fallout 3*, *Deus Ex*, *S.T.A.L.K.E.R.: Shadow of Chernobyl*, its prequel *S.T.A.L.K.E.R.: Clear Sky* and sequel *S.T.A.L.K.E.R.: Call of Pripjat* and *Left 4 Dead 2*.

In *Ben 10*, a hazmat suit is almost like a symbiote, except that they can protect Ben, Gwen, or Max from dangerous materials like corrodium. Unfortunately, these hazmat suits don't last long in zero atmosphere, and Gwen can't use her spells inside a hazmat suit. These suits are level 10 Plumber Technology.

## See also

- Bunker gear
- Demron
- Fire proximity suit
- NBC suit, military equivalent
- Suitport

## References

- <sup>^</sup> *Dictionary of Homeland Security and Defense, The* (excerpt via Google Books) ([http://books.google.com/books?id=jSLDhP0IFZgC&pg=PR26&vq=hazmat&dq=%22hazmat+suit%22&lr=&as\\_brr=3&source=gbs\\_search\\_s&sig=URgLSYATamddpMWpRBZ1MldRJvM#PPA215,M1](http://books.google.com/books?id=jSLDhP0IFZgC&pg=PR26&vq=hazmat&dq=%22hazmat+suit%22&lr=&as_brr=3&source=gbs_search_s&sig=URgLSYATamddpMWpRBZ1MldRJvM#PPA215,M1)) - O'Leary, Margaret R.; iUniverse, Inc., 2006, Page 215
- <sup>^</sup> *a b c* *Hazmat training reveals dangers* ([http://www.enquirer.com/editions/2001/11/19/loc\\_hazmat\\_training.html](http://www.enquirer.com/editions/2001/11/19/loc_hazmat_training.html)) - *The Cincinnati Enquirer*, Monday 19 November 2001
- <sup>^</sup> Protective Clothing - Hazmat Gear (<http://www.dcfp.navy.mil/library/dcnnews/PPETip001.htm>) (from the Naval Sea Systems Command website)

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