

The U.S. Department of Homeland Security (DHS) established the System Assessment and Validation for Emergency Responders (SAVER) program to inform emergency responder equipment selection and procurement decisions.

Located within the Science and Technology Directorate, the National Urban Security Technology Laboratory (NUSTL) manages the SAVER program and works with emergency responders to conduct objective operational assessments of commercially available equipment.

SAVER knowledge products provide information on equipment that falls under the categories listed in the DHS Authorized Equipment List (AEL), focusing primarily on two main questions for the responder community: “What equipment is available?” and “How does it perform?”

To explore the full library, visit SAVER online at [www.dhs.gov/science-and-technology/saver-documents-library](http://www.dhs.gov/science-and-technology/saver-documents-library).

For additional information on the SAVER program, email NUSTL at [NUSTL@hq.dhs.gov](mailto:NUSTL@hq.dhs.gov).

## RESPIRATORY PROTECTION FOR WILDLAND FIREFIGHTERS

*Wildland firefighters – whose mission requires deploying to remote locations – often use bandanas and N95 masks for protection due to their light weight and small size. These traditional masks, however, do not effectively protect against the particulate and gas hazards firefighters may encounter throughout a wildfire response. Air-purifying (APRs) and powered air-purifying respirators (PAPRs) are small and portable and offer protection to users like wildland firefighters from hazardous air particles, smoke and gases. This equipment falls under the Authorized Equipment List (AEL) reference number 01AR-02-APRW, titled “Respirator, Air-Purifying, Negative Pressure Wildland Fire Fighting” and 01AR-03-PAPW, titled “Respirator, Powered Air-Purifying (PAPR) Wildland Fire Fighting.”*

### Overview

APRs and PAPRs are types of personal protective equipment (PPE) that use filters, gas cartridges, and other cartridge types to protect against harmful particulates and gases. The respirators can use particulate filters, targeted gas-capture cartridges, or combination cartridges to remove contaminants from the air. Particulate filters can capture aerosols such as dust, fumes, smoke, and mold. Gas cartridges can remove targeted harmful gases, while combination cartridges remove a broader range of both particulates and gases.

These respirators are available in half-mask and full-face mask configurations. Half masks cover the nose and extend under the chin. Full-face masks cover from above the eyes to under the chin, offering protection to the user’s eyes and nose as well as help with visibility [1]. APRs and PAPRs are available in various sizes, makes, and models, which allow users to select the respirators that best meet their agency and operational needs. The Occupational Safety and Health Administration (OSHA) Respiratory Protection Standard ([29 CFR 1910.134](https://www.federalregister.gov/documents/2019/07/29/2019-14834)) requires fit tests to be conducted upon initial issuance of the unit and annually thereafter to verify each mask has an adequate seal between the respirator and the user’s face.

Due to the portability of APRs and PAPRS, wildland firefighters can use and carry them when deployed to arduous and hazardous conditions in mountain terrains, forests, grasslands [2], and areas that can only be accessed by foot [3]. Firefighters who work in Wildland Urban Interface (WUI) settings can use and carry APRs and PAPRs to protect themselves from burning materials when performing structural triage and defense.

PAPRs require power for the blower that pulls air through filter cartridges. PAPRs typically use rechargeable lithium-ion batteries or disposable alkaline batteries that may be compatible with other equipment, such as headlamps and flashlights, making single-use batteries a preferred option. Single-use batteries may also be more operationally suited to remote environments with limited charging facilities.



Figure 1. APR with combination cartridges installed

Image credit: Moldex

## Particulate Filters

Particulate filters undergo a filter efficiency test and are designated by class as defined by the National Institute for Occupational Safety and Health (NIOSH) in 42 CFR 84. Numerous types of particulate filters for APRs are available. Filters are designated with the letter N, R, or P to indicate their resistance to oil. N filters are not resistant to oil, R filters are resistant to oil, and P filters are oilproof. Filters receive a designation of 95, 99, or 100 to indicate the percentage of particles removed. Type 95 filters remove 95% of particles, 99 filters remove 99% of particles, and 100 filters remove 99.7% of particles. Currently the only filters available for PAPRs are high-efficiency particulate air filters (HEPA) [which remove 99.5% of particles with a size of 0.3 microns]. When purchasing, users should verify their selected filters meet their operational and agency requirements.

## Gas and Combination Cartridges

During different burn phases, wildland firefighters may be exposed to carbon monoxide, nitrous oxides, organic vapors, sulfur dioxide, and other chemicals [4]. Gas and combination cartridges can be used to absorb and filter the chemicals and gases encountered throughout the different environments. Cartridges should be replaced once the service life is met, when the user moves to a different environment, when the user is exposed to a new contaminant, or when the user is feeling resistance while breathing through the respirator. At the time of purchase, users should verify their selected cartridges meet their operational and agency requirements.

## NFPA 1984

The National Fire Protection Association (NFPA) 1984 Standard on Respirators for Wildland Firefighting Operations and Wildland Urban Interface Operations [5] defines the minimum design, testing, and certification requirements for wildland operations. The standard does not apply to chemical, biological, radiological, and nuclear incident operations [6]. No NFPA 1984-certified products are commercially available.



Figure 2. Wildland Firefighter Response

To be NFPA-compliant, products need to be certified by NIOSH in accordance with [42 CFR 84](#) and meet the minimum assigned protective factor of 10. The standard defines three environmental respirators classes. Class 1 respirators are intended for use in environments like a base camp and require only a HEPA or Type 100 filter. Class 2 respirators are intended for use near fire and require gas and particulate filters. Class 3 respirators are intended for use in wildland urban interface activities and require gas and particulate filters (as in Class 2) as well as protection against other specified gases.

## References

- [1] National Urban Science & Technology Laboratory (DHS), "Respiratory Protection for Wildland Firefighters Market Survey Report," 2022.
- [2] Forest Service (USDA), "Managing Fire: Helitack," [Online]. Available: <https://www.fs.usda.gov/science-technology/fire/helitack>.
- [3] Forest Service (USDA), "Managing Fire: Smokejumpers," [Online]. Available: <https://www.fs.usda.gov/science-technology/fire/people/smokejumpers>.
- [4] G. Brayles, "Wildland Firefighter Smoke Exposure," October 2013. [Online]. Available: [fs.fed.us/eng/pubs/pdfpubs/pdf13511803/pdf13511803dpi100.pdf](https://www.fs.fed.us/eng/pubs/pdfpubs/pdf13511803/pdf13511803dpi100.pdf). [Accessed 2021].
- [5] National Fire Protection Agency, "NFPA 1984: Standard on Respirators for Wildland Fire-Fighting Operations and Wildland Urban Interface Operations," 2021. [Online]. Available: <https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=1984>. [Accessed 2022].
- [6] Centers for Disease Control and Prevention, "NIOSH Conformity Assessment Interpretation Notice," January 2019. [Online]. Available: <https://www.cdc.gov/niosh/nppt/resources/pressrel/letters/conformityinterp/CA-2019-1011.html>.