



Protecting Women Who Protect Us: Designing Female-Specific Firefighting Personal Protective Turnout Coat and Pants

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In 2019, the National Fire Protection Association (NFPA) estimated that there were 88,800 female firefighters in the United States (Fahy et al., 2021). Currently, NFPA 1971 is the standard on protective ensembles for structural firefighting and proximity firefighting in the United States. NFPA 1971 states that “men’s and women’s sizing shall be accomplished by men’s and women’s individual patterns” (NFPA, 2018, p.1971-27). However, currently, many firefighting personal protective equipment (PPE) brands do not provide female-specific sizes of firefighting gear (Islam & Wu, 2020). For safety, it is critical and urgent to design and develop female-specific turnout gear, particularly turnout coats and pants, as it can be hard to perform essential tasks such as walking, stair climbing, and reaching overhead (McKinney et al, 2021). The objectives of this research are two-fold: 1) understanding female firefighters’ concerns on existing turnout coats and pants using qualitative research methods, and 2) proposing new female-specific firefighting turnout coats and pants accordingly.

Method

The undergraduate researcher first studied firewomen’s concerns and needs for turnout ensembles, distinctly fit and size issues related to firewomen’s female body shape, by conducting a systematic literature review and analyzing the design and fit of turnout coats and pants currently in the market. The researcher started with a systematic search with keywords, such as female firefighters, turnout gear, functional designs, and dissatisfaction, in a database search engine. The search period was 2000–2021, and both peer-reviewed research articles and technical reports were included in the search. The researcher identified key articles and later scrutinized them for understanding firewomen specific fit and functional design issues. The researcher also examined NPFA 1971 to learn related regulations and standards. To understand the design and fit of turnout ensembles currently available in the market, the researcher analyzed the following fire service PPE brands: Globe, Fire-Dex, Honeywell, Lion, and Crewboss. The researcher recorded the offerings of turnout coat and pants provided by each brand and noted the features, materials, and sizing system used. The researcher further detailed if the brand offered female-specific turnout gear and whether the brand claimed NFPA 1971 certification.

Second, based on the findings of systematic literature review and market research, the undergraduate researcher then proposed new designs of firefighting turnout coat and pants after experimenting with functional design details and studying material and construction requirements of firefighting turnout gear.

Results & Discussion

The researcher found research focusing on fit issues amongst firefighters, particularly firewomen, is limited. After screening initial search results, the researcher identified two articles that are most relevant to the current project. McKinney et al. (2021) researched firewomen fit issues, and Lee et al. (2015) examined firefighter functional design concerns. To summarize, McKinney et al. (2021) found firewomen experiencing discomfort across most regions of their turnout coats and pants. Garment proportions were a recurring issue, as PPE brands disregard the female body shape when they produce unisex gear. Internationally, Lee et al. (2015) found firefighters to be displeased with turnout gear that did not include enough pockets, padding, or reinforcement in prone-to-tear locations. On top of that, firefighters in this study also proclaimed the need for a female size system, implying a lack of available options within the global market.

Regarding market analysis, the researcher found that Globe, Fire-Dex, Honeywell, Lion, and Crewboss, do not use separate patterns for men and women. Instead, they only make chest, length, and sleeve adjustments for turnout coats, and waist or inseam adjustments for turnout pants. Each brand claimed all their products to be certified by NFPA 1971, but these modifications are simple and indicate the absence of separate patterns for men and women, a guideline which is stipulated as part of the standard (NFPA, 2018, p.1971-27).

Based on literature review and market analysis, the researcher proposes thoughtful, novel, and functional designs for protecting firewomen and allowing them to well-perform their duties on site. Particularly, functional details were made to ensure comfort, fit, function, mobility, and safety (Figure 1). Unique features of this turnout coat include raised waist, flared hip, shorter sleeves, and princess seams with bust pleats. For enhanced mobility, the coat includes an expansion pleat, elbow gathers, and underarm bellows. Additional pockets were added to the sleeve and lining layer. The design also includes a drag rescue device and detachable lining, which are required by NFPA 1971. The new pair of turnout pants has a higher waist which is smaller and widens at the hip. The crotch, kneepads, and patch pockets have all been raised and the inseam shortened accordingly. An adjustable belt, waist pleats, and knee gathers were all included to accommodate movement or fluctuations in weight. Other details include a crotch gusset, tool loops and d-rings.

Conclusions

The research reveals that firewomen are being underserved and under-protected by PPE brands. This study was unique because the researcher visually proposed design adjustments which address firewomen's concerns. By viewing the proposed designs, the researcher is hopeful manufacturers can consider the needs of firewomen to be separate from the needs of firemen, and design turnout coats and pants accordingly. Furthermore, the researcher is hopeful the NFPA will further scrutinize companies who do not properly adhere to their standards regarding patterns for female turnout ensembles or instead, creates new requirements, which further safeguard female firefighters.



Figure 1 Proposed design for female-specific turnout coat and pants.

References

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