APPAREL SOLUTIONS
Transforming Safety Apparel

18030 107 Avenue
Edmonton, AB
T5S 1P4

Ph: 1 - 780 - 434 - 6100
Fx: 1 - 866 - 291 - 5968

NFPA 2112: Standard on Flame-Resistant Clothing for Protection of Industrial Personnel Against Short-Duration Thermal Exposures from Fire: Edition 2023

Buy NFPA 2112: Standard on Flame-Resistant Garments for Protection of Industrial Personnel

- Initiated in recognition of how clothing worn by personnel was often hazardous by contributing more to burn severity in hydrocarbon flash and short duration fires, than would have the original fire. Victims of these fires typically shared common burn patterns with all or most of their exposed heads having superficial or partial thickness burns -no or little skin grafting required, but areas covered by their clothing having deep partial or full thickness burns requiring skin grafting, while also sometimes still having some areas with no burns at all. This is why compliant flame resistant (FR) clothing[I] is designed to first not contribute to burn severity, and then instead provide a degree of thermal protection in short duration fire incidents[II].
- The FR clothing personal protective equipment (PPE) standard specified by NFPA 2113 Standard on Selection, Care, Use, and Maintenance of Flame-Resistant Garments for Protection of Industrial Personnel Against Short-Duration Thermal Exposures from Fire. (Note: NFPA 2113 includes detailed help for "end users" in determining if their worksites and activities require NFPA 2112 compliant PPE, and if so how to implement FR clothing policies & programs.)
- Compliant FR clothing can also be water repellent, but FR rainwear is specifically addressed by "ASTM F2733-21 Standard Specification for Flame-Resistant Rainwear for Protection Against Flame Hazards" www.astm.org/Standards/F2733.htm
- Compliance requires third party garment certification by an independent accredited certifying organization, complete with its label, symbol, or identifying mark permanently attached to the PPE FR clothing. The specified certification requirements warn how without this required labelling, no claims are to be made on meeting or complying with any part of this standard. This certification, like that of other types of PPE helps ensure the protective properties are there when needed most.
- Provides design, construction, labelling and performance minimum specifications for manufacturers, suppliers, and certifying organizations.
- FR performance specifications provided for:
    - Single layer clothing i.e., shirts, pants, summer coveralls
    - Cold weather multilayer and insulated clothing i.e., vests, jackets, parkas, insulated coveralls
    - Barrier face covering i.e. often called cloth face coverings initiated in response to COVID.
    - Shrouds, hoods, and balaclavas.
        - Exception removes requirement for the ASTM F1930 manikin fabric test.
    - Gloves
        - Exceptions include removal of the ASTM F1930 manikin fabric test, and use of more specific and appropriate test requirements including some ongoing developments posted as TIA's on NFPA 2112's website)
- A "safety net" of performance test procedures are stipulated due to the impossibility of a testing laboratory being able to duplicate all "real world" short-duration thermal exposures from fire.
- Garment components, and not garments are performance tested. Component test criteria includes that for the protective fabric, thread, closure systems (i.e., buttons, snaps, zippers), interior garment labels, and any high visibility striping, linings, or cold weather insulation. (Note: Exterior emblems, heraldry, crests, and embroidery are not required to be FR, but users are cautioned to limit their size and number.)

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NFPA 2112 continued

- The protective -outer, flame resistant fabric [III] layer has the most comprehensive performance testing protocol due to it being:
    - In single layer FR clothing, the protective barrier for both the wearer's skin and any flammable base clothing.
    - In multilayer garments, the protective barrier for the inner heat and melt resistant materials.
- The protective fabric's FR performance test requirements are amongst the highest for PPE clothing, and include:
    - The flame resistance (ignition & melting) test procedures requires flammability testing:
        - "As received", and after 100 launderings[IV] and 100 dry cleanings.
        - With a maximum afterflame time of 2 seconds, and char length of 100 mm (4 in.).
    - The large-scale NFPA 2112 ASTM F1930's instrumented manikin fabric test[V] as the final protective fabric thermal heat test – fabric is exposed to large burners/torches at 2 cal/cm^2, for 3 seconds resulting in a 6 cal/cm^2 heat flux exposure.
- NFPA 2112's ASTM F1930 specially designed test (not production) coverall is used to predict the protective FR fabric's overall thermal protective performance using the heat flux of a simulated flash fire. Results are provided as a percentage of the predicted 2nd and 3rd degree burns from sensors on the manikin, and do not include burns on the hands and feet[VI]. Fabric failure occurs when these predicted burns exceed a maximum of 50%. (Note: some other PPE standard's max. is 40%)

Notes:

- [I]NFPA 2112 compliant FR clothing is designed to be "work" clothing, worn all day in different weather and work environments. This makes it different from task specific PPE such as that worn by fire fighters for structural and proximity firefighting. Therefore, selecting FR clothing must also consider work environments i.e., very hot versus cold, and job tasks such as monitoring instrument controls versus those exposed to welding slag and/or heavy soiling.
- [II]Engineering clothing from being a significant contributor to burn severity, to instead being protective, is conceptually similar to that done in the AR clothing PPE standard ASTM F1506. However, NFPA 2112's flame resistance testing is more severe/restrictive to better simulate field incident exposures i.e. clothing contamination by flammable materials, and flammable vapor clouds.
- [III]When/if using mesh venting material, be aware that to the best of my knowledge there is no "mesh" that complies with the protective fabric's requirements, and consequently garment design must also be considered to ensure the protective integrity of this PPE.
- [IV]The laundering procedure specified in NFPA 2112 flammability testing uses an "acid/sour rinse" process similar to that of most industrial/commercial laundries, and therefore different from that of home laundering procedures. Sometimes home laundering with "hard water" can be a flammability concern as discussed in NFPA 2113.
- [V]ASTM F1930 is not a flame resistance test, and sometimes fabric's meeting and exceeding its performance requirements have been found in field incidents to be flammable and thereby contribute to burn severity, instead of providing thermal protection.
- [VI]ASTM F1930 burn percentages should not be confused with the TBSA percentages used by medical burn treatment units as those include all the body surface area.