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Standard Guide for Industrial Laundering of Flame, Thermal, and Arc Resistant Clothing[1]

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1. Scope

1.1 This guide provides recommendations for the care and maintenance of clothing that is flame, thermal, and arc resistant.

1.2 These recommendations address the Industrial Laundering process.

NOTE 1—The National Institute for Occupational Safety and Health (NIOSH) recommends leaving clothing soiled with hazardous chemicals at work to be laundered by the employer; or if such clothing is washed at home, to launder separately from the family wash.

1.2.1 This guide does not apply to dry cleaning of flame, thermal, and arc resistant clothing. For more information on dry cleaning, follow label instructions or contact your garment supplier.

NOTE 2—Dry cleaning indicates cleaning by a professional dry cleaner.

1.2.2 This guide does not apply to home laundering of flame, thermal, and arc resistant clothing. For more information on home laundering, follow label instructions or contact your garment supplier.

NOTE 3—Home laundering indicates laundering in a home laundering machine.

1.3 It is important that potentially flammable contaminants are removed from garments during the wash process. If flammable contaminants are not removed, the flame resistance of the garment will be compromised. (See Note 1.)

NOTE 4—Effective cleaning and proper maintenance of the protective characteristics of flame, thermal and arc resistant protective clothing should include consideration of the services a professional processor can supply.

1.4 It is important that the processes and materials used to launder flame resistant garments are compatible with the FR materials to ensure that the FR protection of the garment is not compromised during the laundering process.

1.5 It is the responsibility of the end user to determine if their laundering method is the appropriate care and maintenance procedure for their application. (See Appendix X1 and X1.1.)

1.6 This guide does not apply to specialized protective garments such as specialized firefighter turnout gear and proximity firefighter ensembles.

1.7 This guide also identifies inspection criteria that are significant to the performance of flame, thermal, and arc resistant clothing.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D123 Terminology Relating to Textiles

F1494 Terminology Relating to Protective Clothing

2.2 *Other References:*

Textile Laundering Technology Handbook -2005 Edition by Dr. Charles Riggs, Ph.D. and Michael Klipper

NIOSH, Protecting Workers' Families, A Research Agenda Report of the Workers' Family Protection Task Force – February, 2002

3. Terminology

3.1 *Definitions:*

3.1.1 *care and maintenance, n*—effective cleaning to remove soil and maximize use life of garments while maintaining (not removing) protective properties and procedures for inspection, repair, and removal from service.

3.1.2 *end user, n*—the entity or organization whose employees ultimately wear the flame, thermal, and arc resistant clothing.

3.1.3 *finish, n*—a chemical or mechanical modification, or both, of the fabric for a specific performance result.

3.1.4 *finishing technique, n*—the mechanical means by which the garment is put in its final state (for example, pressing, drying, tunneling).

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

3.1.5 *laundry wash formula, n*—the details related to procedures, cycle times, temperatures, and chemicals used in the laundering process.

3.1.6 *processing launderer (processor), n*—the party performing the operation of cleaning or repairing, or both of the flame, thermal, and arc resistant clothing.

3.1.7 *soil, n*—foreign substances that may be on garments, which are not part of the garment construction or materials.

3.1.8 *soil level, n*—the amount of soil on a garment (very light, light, medium, heavy, and very heavy) are subjective categories of soil levels commonly used in the laundry industry; the definition of each category depends on the soils, fabric type, garment construction, and fabric release properties. (Refer to "The Textile Laundering Technology Handbook" in Section 2. Referenced Documents)

4. Summary of Guide

4.1 This guide provides guidelines for use by suppliers of the flame, thermal, and arc resistant clothing (including the fabric and fibers used in its construction), processors, and end users to effectively care for and maintain flame, thermal, and arc resistant clothing. The guidelines include:

4.1.1 A listing of elements to consider when developing wash procedures and formulas for processor(s).

4.1.2 Recommendations for removing flame, thermal, and arc resistant clothing from service.

4.1.3 Recommendations for the repair, modification and fit of flame, thermal and arc resistant clothing.

5. Significance and Use

5.1 This guide identifies the responsibilities of the fiber, fabric, and clothing manufacturers, as well as the processor, the processor's chemical supplier and the end user.

5.2 This guide describes the key components involved in a program for the care and maintenance of flame, thermal, and arc resistant clothing.

5.3 The guidelines in this standard will provide a processor assistance to develop a processing system that maintains the flame, thermal, and arc resistant characteristics of the clothing during its useful service life.

5.3.1 The development of published formulas for each fabric and level of soiling is difficult at any given point in time due to ongoing continuous improvement of flame, thermal and arc resistant clothing, including new fibers, fabrics, and laundering equipment and procedures.

5.4 The guide also provides suggestions as to when flame, thermal, and arc resistant garments should be removed from service.

6. Procedure

6.1 Garment manufacturers, in consultation with fiber and fabric suppliers, are responsible for providing information on the performance characteristics and maintenance needs of their garments. The end-user is responsible for understanding the hazards present in the workplace and selecting appropriate engineering controls and protective equipment and garments to address those hazards.

6.2 The processor should sort flame, thermal, and arc resistant clothing by fiber, fabric, finish, and soil level in consultation with the chemical supplier, and wash separately from all other clothing.

6.3 The processor, in consultation with the chemical supplier, should develop loading plans and wash formulas to remove soils, while maintaining the flame and thermal protective characteristics of the garments.

6.3.1 Laundry wash formulas should be developed by the processor and wash chemical supplier in collaboration with the clothing and fabric manufacturers based on the following criteria:

(1) Washing Machine Type and Volume
- Machine Loading Factor
- Mechanical Action
- Extraction
- Cycle Times

(2) Product Classifications and Material Construction

(3) Soil types and soil level

(4) Sorting

(5) Wash Room Chemistry
- Water Temperature
- Water Hardness
- Detergent Make-up
- Additives

(6) Finishing Process
- Type Finishing-Drying, Pressing, Tunneling
- Moisture Retention
- Finishing Temperature
- Finishing Time

(7) Special Instructions prohibiting laundering (for example, "Dry Clean Only" or "Do Not Wash".

6.3.2 Based on the preceding criteria, some or all of the following processes may be included in the wash formula:

6.3.2.1 *Flush*—A high-level bath for a short period of time prior to the break. Flushes generally are used for conditioning textiles before subsequent baths and for removing loose soils.

6.3.2.2 *Break (Break Suds)*—The first wash chemical bath. In light and medium-soil formulas, all of the surfactant/detergent and alkali to be used in the entire formula is generally added to the washer in the break bath.

6.3.2.3 *Suds*—A bath occurring between the break and ensuing steps. Suds baths are carried out at low water levels, usually with hot or warm water. If alkali or detergent isn't added on these additional suds baths, they are referred to as carryover.

6.3.2.4 *Carryover (Carryover Suds)*—A cleaning step in a laundry formula in which no supplies are added, but supplies previously added are retained for use.

6.3.2.5 *Rinse*—High water-level bath or baths following the carryover and preceding the sour or finishing bath. During rinsing the final portions of loosened soils are removed along with the bulk of the washing compounds used in laundering. Rinses are used to cool down the wash load. Except for antichlors, chemicals are usually not added to rinse.

6.3.2.6 *Sour Bath*—Normally the final bath in the laundering process. The purpose for the sour (or acid) bath is to

neutralize the alkalinity of the water in the textiles before removing them from the machine for finishing.

6.4 *Load Size*—Since proper loading of the washer is essential to effective processing of flame, thermal, and arc resistant clothing, appropriate consideration of load size should be made by the processor in coordination with the machine manufacturer and the processor's chemical supplier.

6.5 *Removal from Service*—For most practical purposes, garments may be temporarily or permanently removed from service for reasons as determined by inspection based on subjective evaluation and advice by the processor. Ultimately, determination of when flame, thermal and arc resistant clothing should be removed from service is the responsibility of the end user.

6.5.1 The following items, identifiable by visual examination, diminish the effectiveness of the flame, thermal, and arc resistant clothing. Other issues may also have such effects.

6.5.1.1 *Worn Out*—Thin spots, holes, excessive wear at edges

6.5.1.2 *Mechanical Damage*—Evidence of cuts, rips, tears, open seams, and nonfunctional closures

6.5.1.3 *Repairs*—Tears, holes, open seams, lost buttons or snaps are types of repairs. Each processor determines if the number or size of the repairs, or both, are acceptable to a garment before removing the garment from service.

6.5.1.4 *Modifications*—Alteration(s) to a garment that differs significantly from the original design.

6.5.1.5 *Fit*—The flame, thermal, and arc resistant clothing no longer fits the wearer; a garment may be assigned to another wearer if it meets all appropriate usability requirements.

6.5.1.6 *Flammable Substances*—Garments soiled by substances that represent a flammability risk, such as solvents, solids, oils and other petroleum products that cannot be properly cleaned; the presence of a petroleum or chemical odor can be evidence of a flammable substance.

6.6 *Repairs*—Repairs of flame, thermal and arc resistant clothing shall be made using fabrics and components that are equivalent to those used in the original manufacturing. Properly repaired garments may be returned to service in a FR clothing program.

6.7 *Modifications*—Flame, thermal and arc resistant clothing shall be modified using fabrics and components that are equivalent to those used in manufacturing. Altered garments that differ significantly from original design or function should not be worn.

6.8 *Fit*—The fit of flame, thermal and arc resistant clothing significantly impacts its protective performance. Garments should fit comfortably and loosely without compromising other safety considerations. Garments that fit improperly should not be worn.

6.9 *Permanent Removal from Service*—Garments that have unrepairable damage, are worn out, or are unusable for other safety reasons, are not to be reused.

APPENDIX

(Nonmandatory Information)

X1.1 The individual(s) providing the laundering should be adequately informed of the proper cleaning processes needed to ensure the flame, thermal, and arc resistant characteristics of protective clothing are maintained. Normally such advice is provided by the chemical supplier, however additionally the garment manufacturer and fabric supplier may have useful information to pass on. For example, if chlorine bleach is used in laundering, some types of FR clothing can be compromised.

X1.2 Some potentially flammable materials such as solvents, oil, and other petroleum products may not be removed by home laundering, industrial laundering, or dry cleaning. When this occurs, use multiple or a combination of processes, such as dry cleaning followed by laundering which may assist in removing the flammable substances.