



PPE

FR Protective Clothings

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Heat and flame resistant garments are made of fabrics which are aramid glass fibers or aramid blends and manufactured with highly advanced technology. Performance of the fabric is determined by the blend rate of the aramid used in the fabric. With the determined performance properties, these fabrics can be used in various areas as stated below.

- Industries such as Oil & Gas, Cement, Aluminum and Iron&Steel, Foundries, Marine, Search and rescue eg.
- Electricity Distribution Companies, Military and Police Forces, Wildland Firefighting
- Marine Firefighting, Fire Brigades
- Places or situations where heat and flame may occur, for example, at the airports.

The main priority is the risk of the environment. After making a proper risk analysis, what type of fabric and what kind of garment to be used is determined and types of the protective clothing that can be chosen. We will introduce some of FR protective clothings that is used in firefighting and industry mostly.

Structural Firefighting Suits

Firefighting suits are manufactured as per EN 469 standard and certified under (EU) 2016/425 PPE Regulation as a requirement of European Regulations.

Firefighting suits are Multi-layered and specially designed for the purposes which are more risky and dangerous. These suits protect the user against flame and also prevent the contact of chemicals and water to the skin (thanks to its moisture barrier that is breathable and has high penetration resistance).

Protective clothings used in firefighting are technical garments for professional purposes that need to be used by trained individuals. For this reason, not only manufacturers but also resellers should learn the technique and present it to end-users. Manufacturers should not content of what they have and must apply to the latest versions of the standards and follow the innovations in their production.

Authorities in the firefighting departments, where these clothings have to be used, must be selective in choosing the garments, that is because they are protective equipment against fatal injuries and examine the conformity of the related standards.

IST Safety Ltd releases technical firefighting suits to the market in the brand of FYRPRO® and aluminized fire proximity suits, which are used in different firefighting techniques, in the brand of FYRAL®.

EN 469, which is the standard of fireman suits, defines the lowest limits of fire resistance of different heat types, and also includes the lowest value of the suit against water pressure and highest resistance values against water vapor permeance. They are categorized as Level 1 and Level 2 according to these factors. Level 2 suits provides the best protection and maximum comfort.

Main purpose of fireman suits is protection of the user against heat stress. This is provided by using the high heat resistant layers and keeping the user dry. The greatest fact in the firefighting “Water” is fatal if stays on the firefighter.

Because, water transmits heat faster than air (21 times faster at 90 C), if the water is vapor, this may be much faster. In this respect, it is very important to preserve air spaces between layers used in the fireman suit. For this reason, moisture barriers are used in layer system. This barrier shows resistance to the water from outside and does not let the water in, also

evacuates the moisture from sweating through the micro pores, provides comfort and keeps the user dry.

Fireman suits are generally formed with 4 main layers.

- Outer layer (Fire retardant fabric which is resistant against heat, flame and mechanical effects, water repellent)
- Moisture Barrier (PU or PTFE membrane laminated on aramid based fabric)
- Heat Barrier (Double or single layered, generally non-woven fire retardant layers)
- Inner Liner (May be quilted on heat barrier, low weight and comfortable fire retardant fabric)

What is the meaning of X, Y, Z and Level 1, Level 2 Protection Levels at fireman suits?

Two different performance levels are described in EN 469 standard; level 1 and level 2. Level 2 suits provide higher protection than level 1 suits. Fireman suits must be marked according to their performance levels. For instance, X2, Y2, Z2 indicates level 2 suit or X2, Y2, Z1 indicates level 1 suit.

X defines the heat transfer level for flame and radiant heat.

Y defines the water penetration level.

Z defines the water vapor resistance level.

Following table shows related test methods and requirements for level 1 and level 2.

| TESTS | TEST METHOD | PERFORMANCE LEVELS | | | |
|---------------------------------|-------------|-------------------------------------|---------|------------------------------------|---------|
| | | Level 1 | Marking | Level 2 | Marking |
| HEAT TRANSFER-FLAME | EN 367 | HTI24≥ 9 s HTI24-HTI12≥ 3s | X,1 | HTI24≥ 13 s HTI24-HTI12≥ 4s | X,2 |
| HEAT TRANSFER-RADIANT HEAT | EN 6942 | RHTI24≥ 10 s RHTI24-RHTI12 ≥ 3 s | X,1 | RHTI24≥ 18 s RHTI24-RHTI12 ≥ 4s | X,2 |
| RESISTANCE TO WATER PENETRATION | EN 20811 | Level 1 < 20 kPa | Y1 | Level 2 ≥ 20 kPa | Y2 |
| WATER VAPOUR RESISTANCE | EN 31092 | Level 1 > 30 m2Pa/W | Z1 | Level 2 ≤ 30 m2Pa/W | Z2 |



Fireman suits should be inspected in every six months, and after each use regardless of the last inspection date. When performing a routine inspection for a fireman suit, it must be checked whether any thin spots, holes, tears, discoloration, embrittlement, bad smell due to humidity or fumigation are available.

- ✓ If a fireman suit has reinforcements on knees, elbows and/or shoulders, the reinforcements must also be examined.
- ✓ Elasticity of knitted cuffs and thumbhole must be checked for any damage.
- ✓ Seam integrity must be checked. Any missing, loose, burn, torn or melted seams must be noted, and authorised persons must be informed.
- ✓ The functionality of reflective trims must be checked in a dark place at least 20 feet away from the suit by holding a flashlight and checking the reflectiveness of the reflective tapes.
- ✓ All closure systems must be inspected to make sure each is intact and operates properly.
- ✓ Hook and loop closures must be checked for worn, abraded or melted pieces. Objects that accumulated on hook portion may affect the performance of the closure system.

- ✓ All zippers must be checked for functionality including quick release feature and corrosion.
- ✓ Shoulder suspenders on trousers must be checked and be made sure they are attached securely and there are no loss of elasticity.
- ✓ The labels of the suit and the standards including the markings should be up to date.

Shelf life of the fireman suits is generally 10 years under the proper storage conditions in its own packaging. If any damage occurs, it is recommended not to use the suit and to consult the fire fighting department or employer immediately.

Aluminized Fire Proximity Suits

Fire proximity suits are professional technical suits that are need to be used by trained individuals. They are used in various firefighting techniques apart from the special designed FYRPRO® series structural firefighting suits. The firefighter should decide which firefighting suit should be used after making the risk analysis in case of fire.

FYRAL® series expert aluminized fire proximity suits: They are used in the most dangerous fire zones. Protects entire human body including head, hands, eyes and feet by covering entirely. It is produced as multi layered. Aluminized outer shell fabrics are used to reflect the radiant heat in the areas where the radiant heat occurs.

Fire proximity suits are manufactured as per EN 1486 standard and certified under (EU) 2016/425 PPE Regulation. Basically, the standard defines the lowest heat resistant limits for different heat types.

Fire proximity suits which have EN 1486 standard and extended SCBA pouch on back are used with a self-contained breathing apparatus (SCBA) and aims to protect the user

from heat stress by reflecting radiant heat. For this reason, special aluminized fabric is used as the outer layer which has the property of reflecting the radiant heat.

The suits are formed with 3-7 main layers depending on the model. Moisture barrier in the layer system is optional and can be added according to area of use.

- Outer layer (Fire retardant aluminized fabric which is resistant against heat, flame and mechanical effects)
- Heat Barrier (Multi or single layered, generally non-woven fire retardant layers)
- Inner Liner (May be quilted on heat barrier, low weight and comfortable fire retardant fabric)
- Moisture barrier is optional.

FYRAL® series suits are delivered with special aluminized gloves and rubber fireman boots in a special carrying bag. These complementary products must also conform to their own standards and must be supplied as a complete set as the suits is certified entirely with all accessories which are made of the same layer system as jacket and pants. In these kinds of suits, no body parts remains uncovered and a head protective helmet and gold vaporized reflective visor are included in the hood.



FR and Antistatic Clothings for Industry and General Purpose

General purpose heat and flame protective clothings are produced for industrial workers who expose to heat and/or flame. Area of use is briefly forest firefighting, working with oil and gas which has risk of explosion at industry, welding, for protection against molten metal splash and can also be used by law enforcement forces. It is generally produced in single or double layered.

Under normal circumstances, a healthy body temperature is controlled by skin and sweating mechanism. But, if the worker exposes to direct flame or high temperatures for a long time, natural body mechanism may not stabilize the heat. This may cause serious injuries at industry and other working places. According to area of work, workers are subject to various types of thermal dangers such as direct exposure to the flame, radiant heat, convective heat, molten metal and welding splashes etc.

General purpose FR clothings are designed to provide protection against these dangers mentioned above. Different European standards have been published to define the performances of these protective clothings by European Standardization Institutes. Our company releases the general purpose FR clothings to the market in the brand of FYRTEX® and these series of heat and flame protective clothings, developed by IST Safety Ltd, are produced to satisfy the needs and expectations in hazardous areas.

EN 1149-3/5:2008 standard is used to minimize the risk of accident that may occur due to electrostatic discharge that may cause fire or explosion in environments where explosive substances may be present, and thanks to the anti-static fiber contained in the fabric of a protective suit, it is called anti-static suit.

| | |
|----------------------------------------|---------------------------|
| Protection against heat and flame | EN ISO 11612 |
| Protection against molten metal splash | EN ISO 11612 / ISO 9185 |
| Protection against welding splashes | EN ISO 11611 |
| Protection against radiant heat | EN ISO 11612 / EN ISO 694 |
| Anti-static properties | EN 1149-5 |



General purpose FR protective clothings certified under EN ISO 11612 standard, are categorized according to the performance levels below.

| TEST STANDARD | MARKING | CLASSIFICATION |
|-----------------------------------|---------|--------------------------------------------------|
| EN ISO 15025/Limited flame spread | A1 | According to Procedure A |
| | A2 | According to Procedure B |
| ISO 9151/Convective heat | B1 | 4.0sec < HTI ₂₄ < 10.0sec |
| | B2 | 10.0sec < HTI ₂₄ < 20.0sec |
| | B3 | 20.0sec < HTI ₂₄ |
| EN ISO 6942/Radiant Heat | C1 | 7.0sec < RHTI ₂₄ < 20.0sec |
| | C2 | 20.0sec < RHTI ₂₄ < 50.0sec |
| | C3 | 50.0sec < RHTI ₂₄ < 95.0sec |
| | C4 | 95.0sec < RHTI ₂₄ |
| ISO 9185/Molten aluminium splash | D1 | 100g < D1 < 200g |
| | D2 | 200g < D2 < 350g |
| | D3 | 350g < D3 |
| ISO 9185/Molten iron splash | E1 | 60g < E1 < 120g |
| | E2 | 120g < E2 < 200g |
| | E3 | 200g < E3 |
| ISO 12127/Contact heat | F1 | 5.0sec < T (sec) threshold value time < 10.0sec |
| | F2 | 10.0sec < T (sec) threshold value time < 15.0sec |
| | F3 | 15.0sec < T (sec) threshold value time |

***D3 and E3 level are the highest protection levels for molten aluminium and iron splashes.**

Arc Flash Protective Suits

An arc flash (also called a flashover) is the light and heat produced as part of an arc fault, a type of electrical explosion or discharge that results from a low-impedance connection through air to ground or another voltage phase in an electrical system.

Our company releases the arc flash suits to the market in the brand of ELECTPRO® which is a series of arc flash suits against electrical arc thermal effects and are certified IEC 61482 standard and categorized **Class 1** (tested against 4 kA) and **Class 2** (tested against 7 kA). **Class 2** is the highest level that can be reached in order to enable protection against electric arc according to the European standard.

Effects of electric arc

Depending on the power and burning time of electric arc, different physical effects can be seen due to the high temperature. Electric arc energy is discharged in multiple ways, such as electrical, thermal, mechanical, photonic or luminous energy. Mechanical energy usually occurs in the form of explosions. Many various factors affect the energy created by electric arc (See; Factors affecting the damage of electric arc).

According to NFPA 921 Sections 14-1 and 14-9 through 14-12.2 Electricity and Fire, an arc is a high-temperature luminous electric discharge across a gap. Temperatures within the arc are in the range of several thousand degrees depending on circumstances including current, voltage drop, and metal involved. For an arc to jump even the smallest gap in air spontaneously, there must be a voltage difference of at least 350 V. In the 120/240-V systems being considered here, arcs do not form spontaneously under normal circumstances. In spite of the very high

temperatures in an arc path, arcs may not be competent ignition sources for many fuels. In most cases, the arcing is so brief and localized that solid fuels such as wood structural members cannot be ignited. Fuels with high surface-area-to-mass ratio, such as cotton batting and tissue paper and combustible gases and vapors, may be ignited when in contact with the arc.

| | |
|-----------------------------------------------------------|------------------------------------------------------------------------------------------------|
| Protection against the thermal hazards of an electric arc | IEC 61482 1-2 Class 2 (7 kA) *Class 2 : Highest protection level according to the standard. |
|-----------------------------------------------------------|------------------------------------------------------------------------------------------------|

Some PPE standards for protection against electric arc

IEC 61482 1-1 (Protective clothing against the thermal hazards of an electric arc - Part 1-1: Test methods - Method 1: Determination of the arc rating (ELIM, ATPV and/or EBT) of clothing materials and of protective clothing using an open arc): This is a standard specifies test method procedures to determine the arc rating of flame resistant clothing materials and garments or assemblies of garments (layer system eg.) intended for use in clothing for workers if there is an electric arc hazard.

IEC 61482 1-2 Protective clothing against the thermal hazards of an electric arc - Part 1-2: Test methods - Method 2: Determination of arc protection class of material and clothing by using a constrained and directed arc (box test): This is a standard specifies procedures to test material and garments intended for use in heat and flame resistant clothing for workers if there is an electric arc hazard. A directed and constrained electric arc in a test circuit is used to classify material and clothing in two defined arc protection classes. This international standard is not dedicated toward measuring the arc rating values (ATPV, ELIM, or EBT). Procedures determining these arc rating values are prescribed in IEC 61482-1-1, using an open arc for testing. IEC 61482 1-2 standard has

been published by IEC in order to determine the test methods of the materials and heat and flame resistant protective clothings to be used by workers who may expose to electric arc. This standard is a mandatory standard for certification of the product and obtaining the CE mark.

ATPV : (Arc Thermal Performance Value) This value is measured in calories per square centimeter and represents the maximum performance capability for arc flash protection of a particular suit or fabric. It is the highest thermal accident energy that will prevent the user from being exposed to a second degree burn at 50% rate. It expresses the maximum incident thermal energy per surface area, in units cal/cm², that the protective suit can withstand the fabric before second degree burn occurs.

EBT : (Energy Break-open Threshold) The incident energy on a material that results in a 50% probability of breakopen, in units cal/cm². It represents the highest incident energy exposed in the fabric of the protective suit, causing 50% probability to break open the fabric. Holes in the fabric caused by breaking open cause heat or flame to enter inside of the suit. Breakopen is defined as any open area at least 1.6 cm². The fabric did not overheat to the point that caused the burn reading on the sensor and there is only a very small hole in it.

HAF: (Heat Attenuation Factor) This is the amount of heat blocked by the fabric. In other words, it is the percentage of arc flash heat energy blocked by the fabric or material. The average of HAF's in electric arc shots in all these tests is taken.

NFPA 70E Standard (Standard for Electrical Safety Requirements for Employee Workplaces): The National Fire Protection Association (NFPA) published the latest edition of the NFPA 70E Standard in 2021 which has been originally developed at OSHA's request,

NFPA 70E helps companies and workers avoid workplace injuries and fatalities due to shock, electrocution, arc flash, arc blast and assists in complying with OSHA 1910 Subpart S and OSHA 1926 Subpart K. NFPA 70E states, "employees shall wear FR clothing wherever there is a possible exposure to an electric arc flash." This requires workers working on or near energised parts and equipment to wear flame resistant clothing that meets the requirements of ASTM F1506 and is appropriate to the potential energy of the hazard.

In NFPA 70E, it does not matter the fabric's EBT or ATPV. The important thing is the cal/cm² that the fabric can support. According to NFPA 70E, HRC classifications are as follows;

Category 0 – 2 cal/cm²
(Required minimum ATPV)

Category 1 (HRC1) – 4 cal/cm²
(The required minimum ATPV – arc rating)

Category 2 (HRC2) – 8 cal/cm²
(The required minimum ATPV – arc rating)

Category 3 (HRC3) – 25 cal/cm²
(The required minimum ATPV – arc rating)

Category 4 (HRC 4) – 40 cal/cm²
(The required minimum ATPV – arc rating)

In environments with an electric arc hazard, arc flash protective equipments that comply with the standards must be used.



Why is the product label so important in PPEs?

The label on the protective clothing is an important part of product safety as legislation based on the 'new approach' aligned to the new legislative framework policy. The product label is crucial for personal protective equipments and protective clothings and it is the identity card of the PPE you purchase.

The accuracy of the information on the label is jointly the responsibility of the manufacturer and the seller/distributor. In terms of market control, end users and authorized institutions and organizations are obliged to check the accuracy of the product and its label.

What information must be on the label?

- Trade name and address of the manufacturer
- Fabric content (content and blends of fabrics in the whole layer system if it is multi-layered) including registered brands
- Brand name, model, stock code (P/N) information of the product
- The standard for which the product is certified and standard performance values
- 4-digit code number of the independent notified body that certifies the product
- Pictograms related to product standard and washing instructions

Checking the certificate and label of the product you purchase is necessary for you to use the right product. CE is the mark showing that the product meets the basic health and safety requirements specified in the relevant regulation in accordance with the new regulation.

NEW PPE REGULATION (EU) 2016/425

In April 2016, the 2016/425 Personal Protective Equipment Regulation was published, which has replaced the 89/686/EEC Personal Protective Equipment Directive. The transition process has started on April 21, 2018, and the final adaptation date was April 2019. The old PPE Directive 89/686/EEC has been repealed as of 21 April 2019.

The PPE Regulation (EU) No 2016/425 is a rigorous control and balance system that will ensure the safety of workers in the industry more confidently in the presence of an increasingly global network of PPE manufacturers, distributors, importers and test laboratories. The new regulation facilitates the removal of dangerous products from the market by increasing traceability.

In the new regulation, the risk categories remained the same, but some product groups were redefined.

Regardless of the risk category, all PPE must now contain a Declaration of Conformity.

The validity period of product certificates has been clarified as only 5 years.



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