

PROTECTIVE CLOTHING FOR USE IN WELDING AND ALLIED PROCESSES

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Summary: A worker who is welding or doing some allied process, during his job could be easily exposed to the heat of el. arc, gas explosion, UV radiation, splashing of molten metal drops and flying chips of metal. Personal protective equipment of every welder is also a heat /flame resistant clothing made from textile. The scope, all requirements on the design and outer materials, and specific safety requirements on welders protective clothing are described in European Standard EN 470-1 which is in use from May 1995. Through better informing of potential users, about the advantages of using this clothing for the employer and the employee, it is expected to achieve faster transfer of new technologies into domestic practice. This work is based on the results of studying of main factors, which influence on the criterion for the design of welders garment and generally offers suggestion in respect of quality improvement. Having in mind all above stated this elaboration desires to provides simpler selection and use of welder garments including wholesome comprehension of relative rules.

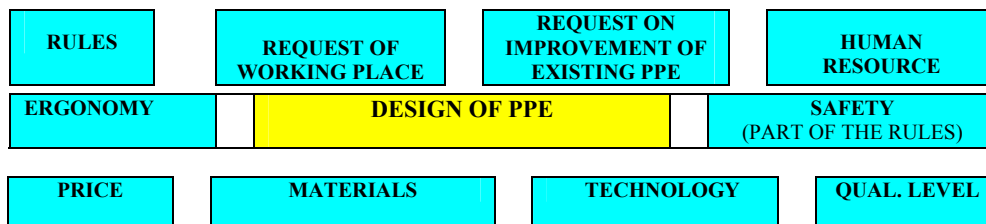
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1. INTRODUCTION

Because of specific working conditions, welders have isolated sences from their environment and they are not able to spot danger around their working area while doing their job. Therefore consequences of such working condition are professional deseases and injuries and among them burnings are most difficult and present ones.

Personal protective equipment (PPE) are very important segment of safety on work. Goal of this presentation is to explain necessity of these accessories, focusing on european rules and regulations, explain necessity of certificates and quality development and finally give contribution to better quality, comfortability and functionallity to prevent avoidance of use by welders in their daily work.

Diagram 1: Main design impacts for PPE



2. COMFORT

Every worker on his working place must be provided with the highest possible level of safety and comfort for the expected level of risk (it is also one of the basic requirements of the Directive EU 89/686).

Comfort is defined as freedom from pain, freedom from discomfort. Textile scientists say that people are „comfortable” in their garments when they are unaware of them both psychologically and physiologically. Therefore there are three main types of comfort states:

- **Thermophysiological Comfort:** Attainment of a comfortable state of thermal and wetness state; involves transport of heat and moisture through a fabric.

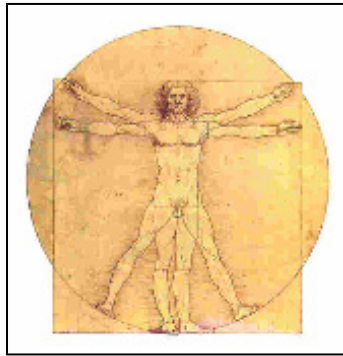


Figure 1: Unprotected human

- **Sensorial Comfort:** The elicitation of various neural sensations when a textile come into contact with the skin.
- **Body – movement Comfort:** Ability of a textile to allow freedom of movement, reduced burden, and body shaping, as required. [8]

3. WELDERS WORKPLACE IN CROATIA

Every welder in Croatia is entitle of leather suit for the period of 4 years. While working, grease and other burning components adhere to the suit and it is impossible to clean them. Appart from that, these suits are very uncomfortable due to it's rigidness. It is to emphasize that leather is not only rigid (movement limitation) but lack of ventilating abillity causes avoidance of wearing such suites especially in summer period and in shipbuilding as specifically difficult area of work. Blockage of body heat transfer causes enormous sweting and phisical exhaustion after very short period of work. Under the leather suits very often cotton-poliester suits are present what caused number of injuries.

Often happened that sparkle or melted partickles entered through the collar and caused burns. Cotton-poliester is not only highly flammable but also adhere to the welder skin. Sametime leather suit exposed to the heat becomes stiff and has tendency to break therefore any emergency procedure of saving the welder is almost impossible. Welders PPE in Croatia mostly is DISCOMFORT for welders and they are exposing themselves to the risk with full awarenes of the consequences. These risks are in fact approved by work safety experts, employers and by the state which did not accept and apply european standards.



Figure 2: Rigid safety

4. WELDERS WORKPLACE IN EUROPEAN UNION

Significant efforts on prevention and burns protecting programs are held all over the world. Particulary on fields where is constant interaction between human and his environment (working place, living place, technologies,etc.). Experience has shown improvement of 50% less burns when such methods have been applied.

In these countries without heat/fire-resistant suit made of textile in accordance with EN 470-1 norms, applied already in 1995, worker can not start his work regardless his experience and skill. In developed european countries welding PPE means **PROTECTION**.

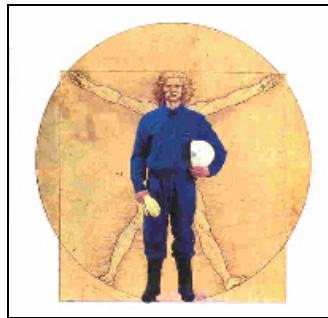


Figure 3: Comfort safety

5. RULES

According to European rules, personal protective accessories are defined by convention i.e. directives with effective force in whole territory of European Union: Directive EU 89/391, Directive EU 89/656, Directive 89/686, harmonised European norms.

Global relation towards PPE is common for Croatian and European rules.

Basic and significant difference between Croatian and European rules are in definition of elementary demands for fulfilling them.

Croatian rules define very precisely demands in regards of material, production technology and other characteristics of protecting equipment.

Croatian rules and regulations are specifying only leather suits.

European rules permits use of suits made out of other materials providing they meet all specified requirements.

6. EUROPEAN STANDARD EN 470-1

In Europe workers who are welding or doing other allied processes on their working places must wear fire-retardant clothing according to the standard EN 470-1, which is in use since 1995.

This standard is specifying methods of testing and basic requirements on the design of PPE for all workers who are welding or doing some allied processes. Allied processes are all the processes which have the similar levels of risk as welding has (flame cutting)

7. ANTROPOMETRIC DESIGNING OF PPE

PPE have to be designed and made so that it fits the size and the shape of the end users body as well as possible.

7.1. Control Dimensions

It is necessary to determine control dimensions which will serve to make the major distinction between body types and sizes, and at the same time must be ones which largely determine the fit of a garment to a given body size.

The other dimensions have to be related to the control dimensions, within a given body type, usually by averaging. Every body type is determine with chest girth and with the mean drop value (CHEST-WAIST) cm .

Table 1: Division of body types determine by mean drop value (chest-waist) cm

BODY TYPE	Athletic	Regular	Portly	Stout	Corpulent
Mean drop value (CHEST-WAIST) cm	16	12	6	0	- 6

This is not the end of matter, because the population is also divided according to STATURE (total body height).

Table 2: Division of body types determine by body height

BODY TYPE	SHORT	MEDIUM	TALL
TOTAL BODY HEIGHT Cm	less than 167 cm	from 167 to 181 cm	Greater than 181 cm

7.2. Stretch

When people move, their skin stretches; it elongates and recovers (Figure 4). Skin is a highly elastic material. As it loses elasticity with age, it wrinkles and sags. Clothing, also must be elastic. It must elongate to accommodate body movement and then recover. Stretch is the ability of a textile to extend when pulling force is applied and then to recover relatively quickly and fully to its original dimensions when that pulling force is removed. [8]

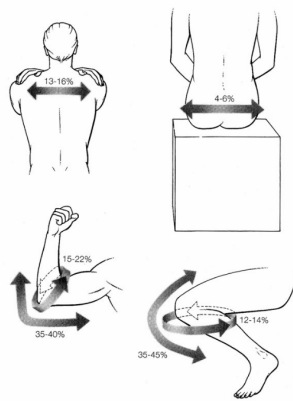


Figure 4: Key stretch points on the body

According to this the fabrics should be divide:

- STRETCH FABRICS (elongation \geq 15%)
- RIGID FABRICS (elongation \leq 15%)

8. GARMENT DIMENSIONS

Garment dimensions must be according to the standard EN 340 (General requirements). Body measurements is according to ISO 3635:1981. Control dimensions determine by this standard are the following: BODY HEIGHT, CHEST GIRTH AND WAIST GIRTH. Garment sizing is determined with two control dimensions expressed in cm: body height as a constant dimension with chest girth or/and waist girth. [2]

9. DISTRIBUTION OF TEXTILE ACCORDING TO FLAMMABILITY

1. **NONCOMBUSTIBLE TEXTILE:** A textile that will neither ignite nor give off vapors that will ignite when subjected to external sources of ignition
2. **COMBUSTIBLE TEXTILE:** A textile that will ignite and burn or that will give off vapors that will ignite and burn when subjected to external sources of ignition.
 - a) **FLAMMABLE TEXTILE:** Any combustible textile that burns with flame
 - b) **NONFLAMMABLE TEXTILE:** Any combustible textile that burns without flame.

FLAME-RESISTANT (FR): A relative term used to compare one fabric to another. A textile whose flaming combustion is prevented, terminated, or inhibited following application of a flaming or nonflaming source of ignition with or without subsequent removal of ignition source.

NORMAL FLAMMABILITY: Textiles in this category differ in: ease of ignition, ease of extinction, rate of flame spread, amount of heat generated, density of smoke generated when exposed to an open-flame source. During and after burning, these textiles differ in whether or not they melt, exhibit a melt and drip phenomena, char, have afterglow, or tend to smolder.

HIGHLY OR DANGEROUSLY FLAMMABLE: A textile that ignites so easily and burns so rapidly that escape from burn injury or death is unlikely.

10. QUALITY CONTROL

After the selection of appropriate materials (with all test reports), PPE have to be made according to the design prescribed in standard (EN 340 and EN 470-1) and needs of the end users - WELDERS. First sample-coverall (Figure 5) should be made in 16 sizes, i.e. for 4 body height; the range of every body height is divided in 4 ranges determined with chest girth (difference in chest girth is 8 cm).



Figure 5: First sample

After the first sample is made the quality control system of coverall manufacturing should start. The quality control system includes the examination of:

- System of closure (legs, arms and neck), pockets (internal and external), all seams (internal and external), and other requirements prescribed by the standard EN 470-1.

First samples should be given to the end users (welders) for testing in the period of 6 months. After the testing time an examination of destroyed sample (Figure 6) should give us a whole picture about the mistakes and failures that has been made in designing and manufacturing of the mentioned coveralls.



Figure 6: Destroyed sample

12. CONCLUSION

In one part of the constitution of World Health Organisation the following is written:

“Health is a state of complete physically, menthaly and socially wealth, not only the absence of disease and physical weakness. Possesion of the highest health standard is one of the main rights of the human being exclusive of race, religion, political conviction, economical and social level. Today this rights enjoy only a small part of humanity, mainly fortunates one and reach enough to achieve this rights.”

Since every decision is result of choice among number of alternatives, repeating of old paterns should be avoided as they were valid for different time, different political situation and different techological level. Implementation of sofisticated protective equipment should by all means demand implementation more sofisticated welding equipment. Resolvance of the problems should be constant but not sporadic, based on well known facts and experiences with constant applications of new scientific achievements and practice. Most of these problems are resolved worldwide. It is only to spot them, focus on them and apply them in appropriate way.

One of proposals for resolvance the problem is of technical nature, welder's environment must be improved. Besides standard welding protection equipment: leather suit, helmet, screen, boots, glowes, welder should wear heat/fire-resistant suit made of fabrics and manufactured in accordance with European norm EN 470-1.

Heat/fire-resistant suit will not only directly improve quality of welding but will definitely enable welder to perform his work far better in such ergonomically,

comfortably and safely garment. It will enable him to use in best possible way all available welding technology with highest possible performance. Last but not least it will enable him to escape from possible life or health threat in dangerous situations.

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