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Peculiarities of labor conditions and safety of the electric welder of manual welding

E. V. Staseva, S. G. Demchenko, Yu. M. Oniskovets

Don State Technical University (Rostov-on-Don, Russian Federation)

Introduction. The article considers peculiarities of working conditions of electric welders of manual welding. The analysis of the results of the special assessment of working conditions and protocols of measurement of production factors at the workplace was carried out.

Problem Statement. The purpose of this study is to analyze the results of a special assessment of working conditions and develop measures to improve working conditions.

Theoretical Part. The influence of various factors on the employees of this profession has been studied and the main occupational diseases to which electric welders are exposed have been considered. The article proposes a number of measures to improve the working conditions and safety of workers.

Conclusion. The results of the analysis indicate a high impact of harmful factors on the employee and the need to develop measures to improve working conditions.

Keywords: labor protection, harmful production factors, working conditions, electric welder.

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Introduction. According to statistics of the all-Russian Research Institute of Labor (VNII Truda), from 2001 to 2018, the number of injured workers decreased by more than 6 times (Fig. 1) [1].

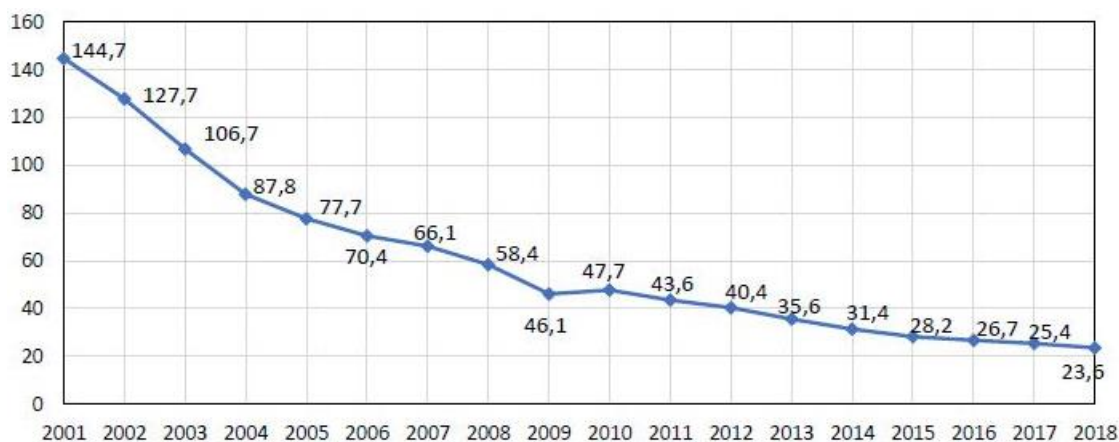


Fig. 1. Dynamics of the number of injured workers (thousand people). Accidents with loss of labor capacity for one day or more and resulting in death from 2001 to 2018

Experts of the Institute of Labor noted that the level of occupational injuries significantly (more than 3 times) decreased from 2001 to 2009. A slight increase was recorded in 2009-2010. Then the situation began to improve again, and by 2018 the number of victims decreased by 2 times. Over the entire period under review, there were 3.6 times fewer deaths.

Fig. 2 provides the data on the demand for electric welders.

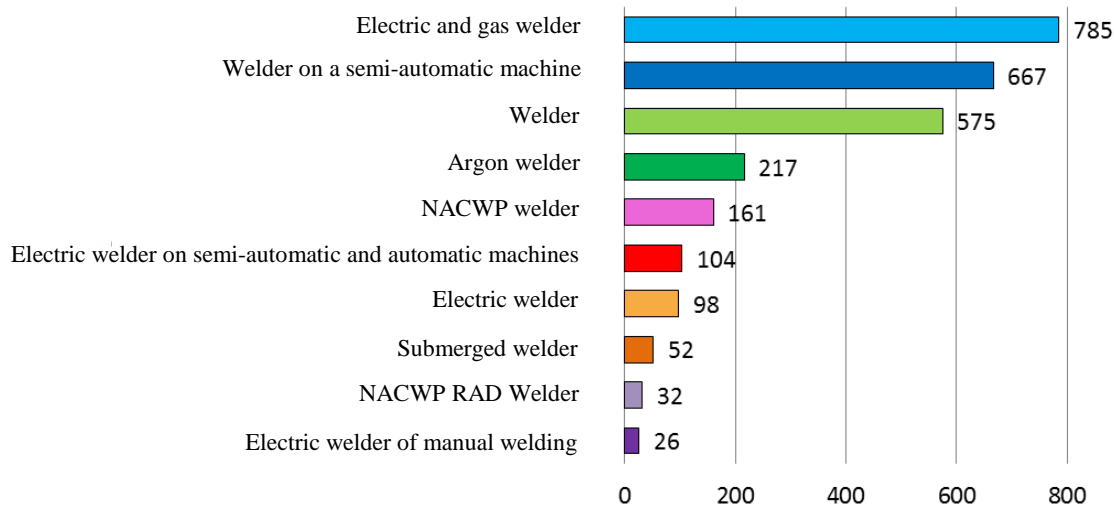


Fig. 2. Number of open vacancies for welders at Russian enterprises in 2019

The study of safety issues for electric welders is becoming increasingly important. Competent organization increases productivity in many times, reduces the possibility of injuries, and occupational diseases associated with the work of welders [2].

Problem statement. The relevance of the topic is confirmed by statistics on injuries and occupational diseases among welders. Welders account for 11.5 % of construction injuries [3]. This is due, among other things, to the failure of employees to comply with safety requirements in the production of electric welding works. Welders are affected by harmful and dangerous production factors of physical and chemical nature: emissions of harmful chemicals, radiation, sparks, dust, etc. [4]. Thus, the welding process is potentially dangerous for the worker. This makes it necessary to take measures to prevent adverse situations during welding operations.

Theoretical part. Welding and cutting with electrodes involves the operation of equipment and the use of substances that can cause injuries, accidents, fires, etc. in case of improper handling or violation of work rules. Some compounds used in welding pollute the environment and can affect the employee's body as toxic substances [2, 5].

The most typical types of injuries during electric welding operations [6]:

- electric shock,
- damage to the eyes and open skin surface by electric arc radiation,
- burn from drops of metal and slag,
- poisoning of the body with harmful gases, dust and fumes.

There are also many other hazards that can lead to accidents at work.

The air of the working area of electric welding contains nitrogen dioxide, carbon oxide and manganese. The most harmful gases released during welding include nitrogen, carbon and ozone oxides. If the work is carried out indoors or for a long time, these elements can cause irritation of the respiratory tract, mucous membranes, eyes, dry mouth, etc. [7]. The severity of labor is a characteristic of the labor process that reflects the load on the musculoskeletal system and functional systems of the body (cardiovascular, respiratory, etc.). The greatest discomfort during welding is caused to electric welders by a forced uncomfortable position when connecting welding joints.

Also, at the workplace of a manual welding specialist, there are fibrogenic aerosols, which include iron particles. Strongly fibrogenic aerosols are dust of industrial origin that contribute to the development of dust diseases of the lungs (connective tissue grows in the lungs, disrupting the normal structure and function of the organ) [4].

The workplace measurement protocols also record the impact of noise on the employee. In the technological process, when working with welding equipment, noise sources are:

- welding process,
- welding equipment,
- preparatory operations (straightening, assembling, cutting, working with hand grinders), etc.

Noise has an irritating effect on a person, reduces performance. The perception of information is getting worse.

Various unhealthy conditions may develop, including hearing loss and deafness.

Thus, welders with more than ten years of experience are predisposed to dust bronchitis, pneumoconiosis, eczema, manganese intoxication, etc. [8].

A special assessment showed that 95 % of electric welders work in harmful conditions. The most harmful factors are:

- chemical (working conditions class 3.1),
- non-ionizing ultraviolet radiation (working conditions class 3.1),
- severity of work (working conditions class 3.1).

Final class of working conditions is 3.2.

Based on the results of calculations of the influence of all production factors, an ultra-high risk was determined — 7.51 [9]. The calculations have shown that the employee's life expectancy is reduced by 739 days due to working conditions. The maximum risk of death for a manual welding specialist in production — 1.22×10^{-4} [9-11].

To reduce the described risks, we should adopt a management strategy that involves the use of modern means of protection [12, 13].

Conclusion. In order to reduce the impact of harmful production factors and prevent the development of occupational diseases for manual welding specialists, the following is necessary:

- inspections, examinations and tests, technical inspections and diagnostics of the ventilation system;
- laboratory control of the content of harmful substances in the air of the working area;
- compliance with the schedule of medical examinations;
- reduction of the impact of elevated levels of chemicals in the work area air;
- certification testing of employees for knowledge of safety and labor protection rules;
- compliance with the rational mode of work and rest, increasing breaks (reducing the severity of the labor process);
- use of new modifications of respirators, protective masks and suits during welding operations.

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Authors:

Staseva, Elena V., Associate professor, Department of Safety of Technological Processes and Production, Don State Technical University (1, Gagarin sq., Rostov-on-Don, 344000, RF), Cand. Sci., ORCID: <https://orcid.org/0000-0002-8973-9471>, elena_staseva@mail.ru

Demchenko, Sergey G., Associate professor, Department of Safety of Technological Processes and Production, Don State Technical University (1, Gagarin sq., Rostov-on-Don, 344000, RF), Cand. Sci., ORCID: <https://orcid.org/0000-0003-3291-2445>, falcon2@rambler.ru



Oniskovets, Yuliya M., Student, Don State Technical University (1, Gagarin sq., Rostov-on-Don, 344000, RF), ORCID: <https://orcid.org/0000-0002-7206-9301>, oniskovets2012@mail.ru

Contribution of the authors:

E. V. Staseva — scientific supervision, analysis of research results, revision of the text, correction of conclusions; S. G. Demchenko — scientific supervision, analysis of research results, revision of the text, correction of conclusions; Yu. M. Oniskovets — formulation of the main concept, goals and objectives of the research, calculations, preparation of the text, conclusions.