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Assessment of the risks of occupational injury and illness for the position of welder

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Abstract. The paper presents a risk assessment and the action plan implemented for the welder position using the INCDPM method. The method allows the prioritization of risks according to their value and the efficient allocation of resources for labor protection. For the position analyzed by the welder, 37 risk factors were identified. The overall risk level calculated for the analyzed job is equal to 3.46, a value that places it in the category of jobs with an acceptable level of risk. As regards the distribution of risk factors on generating sources, the situation is as follows: 37.84% of the contractor's own factors; 5.41% factors specific to the workload and 37.84% factors specific to the means of production; 18.92% factors specific to the work environment. The purpose of the risk level assessment is to provide the possibility of knowing the real situation at each workplace, from the point of view of occupational safety, in order to take the most appropriate preventive measures for the given situation. In order to avoid or reduce occupational risks, occupational health and safety policies and procedures have been developed, in accordance with the Romanian legislation in force in conjunction with the applicable legislation of the European Union.
Keywords: *risk assessment, accident, occupational disease.*

1. Object of activity of the company

Metalconstruct SRL is a private company, recognized for the quality of medium and heavy metal fabrication **works,** metal structures for civil and industrial constructions, components and construction machinery. Assembly and welding are carried out on the largest area of the section. The pre-assembly of products is also carried out in this area. 4 cranes of 32 TB are used as support for these activities. The main attention is paid to the welding process. Steels can be assembled by welding: carbon, heat-resistant, refractory, HARDOX, CORTEN. The operators are qualified and certified according to European standards by Tuv-Sudderland. Metalconstruct products combine appearance and guarantee of resistance over time due to the high degree of finish obtained in the sandblasting and painting sector. The company respects the legislative norms in the field of safety and health at work [1-17].

2. The organizational structure of the company

Metalconstruct SRL has the organizational structure and personnel that can ensure the performance according to the requirements of the basic activity - the provision of services in the field of metal constructions.

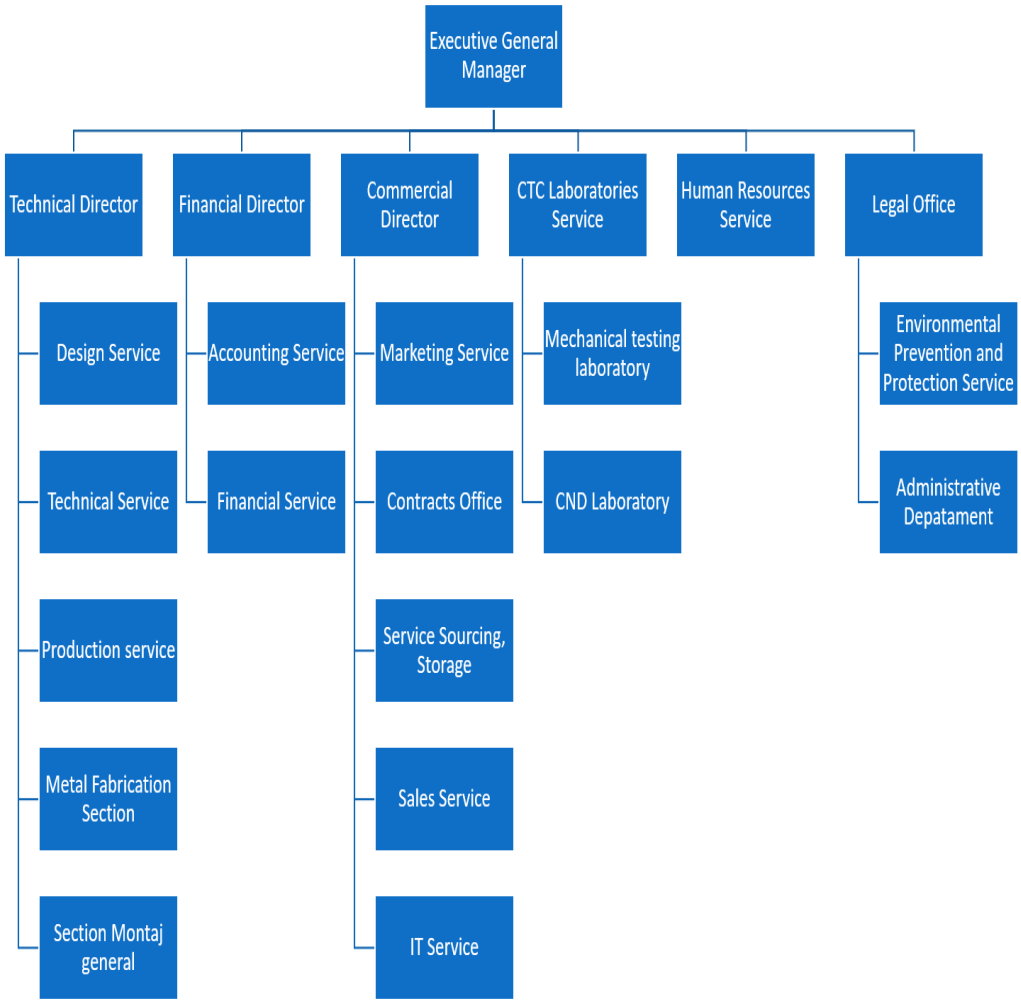

Figure 1. Organizational chart

3. Presentation of the risk assessment method

In this work, the assessment of the risks of occupational accident and disease is carried out by the INCDPM method, for the welder position within the Metalconstruct company. The method used in this paper allows the prioritization of risks according to their value and the efficient allocation of resources for labor protection. The principle of the method consists of: Identification of risk factors at the analyzed workplace; establishing the consequences of the actions of the risks of the performer, including their seriousness; establishing the probability of action of the risks on the contractor; assigning the level of risk according to the severity and probability of the consequences of the risk factors; quantification and prioritization of risks. Assessment of occupational risks and elaboration of the field of measures and prevention for the welder workplace. The welder carries out his activity both indoors and outdoors. Exposure duration is 8 hours per day, means 40hours per week. In carrying out this activity, the elements that may generate risks of injury for the exposed execution personnel are reproduced below.

4. Component elements of the work system.

Systematic analysis of the established activities in order to identify the risk factors dependent on the four components of the work system**:** Executor; Workload; The means of production; Work environment.

Executor: The purpose of the work process is to execute non-dismountable joints by electric arc welding, autogenous welding and oxyacetylene welding.

Means of production: oxygen cylinders; acetylene cylinders; trolley for transporting cylinders; hoses; specific tool kit; stoppers; flame: tube, bulb; welding wire; strippers; wire brush; fixed wrenches for welding; welding group and power generator; electrodes; hammer for removing slag.

Workload: preparation of materials for welding (welding kit, oxygen cylinder, accessories, etc.); compliance with the conditions imposed by the technical documentation, judicious choice of both the filler material and the working regime (tension, intensity, welding speed, etc.); welding in such a way as to avoid the defense of deformations; execution of the fastening by welding points of the parts and subassemblies, in hard-to-reach places as well as profiles of different thicknesses; execution of oxyacetylene flame heating of sheets, pipes, etc.; execution of joints by electric arc welding; storage, storage of subassemblies, finished parts; ensuring cleanliness at work.

Work environment: The welder carries out his activity both indoors and outdoors. During welding operations, the gas complex specific to these activities - natural and artificial lighting - is released. Drafts (working outdoors).

5. Identification of risk factors

Separate tables are made for each element of the work system. The following notations are made in the tables: CG-Gravity Class; CF-Frequency class and NPR-Partial level of risk.

Table 1 presents the risk factors from the executor's side.

Table 1 Risk factors for the Executor

No	Name of risk factor	CG	CF	NPR
F24	Performing unforeseen operations in the work load	7	1	3
F25	Improper electrode positioning	3	3	3
F26	Failure to ensure the stability of the parts to be welded during work	3	3	3
F27	Incorrect adjustment of welding parameters	7	1	3
F28	Handling oxygen cylinders and the blower holder with grease-soaked hands	7	1	3
F29	Use of shorts, gloves, shoe soles, etc. for the annihilation of the "fire on the pipe" effect	3	3	3
F30	Identification, by smell, of the existence of acetylene flux at the welding lamp	3	3	3
F31	Carrying out welding operations without ensuring fire or explosion prevention conditions	7	1	3
F32	Lack of synchronization in teamwork	7	1	3
F33	Travel, parking in dangerous areas (on car access roads, machinery, etc.)	2	5	3
F34	Falling to the same level by slipping, tripping, unbalancing	7	1	3
F35	Falling from a height by stepping into the void, imbalance, slipping	7	1	3
F36	Omission of operations that ensure his/her safety at work	7	1	3
F37	Failure to use personal protective equipment and other means of protection provided	7	3	5

Table 2 presents the risk factors from the workload's side.

Table 2 Risk Factors for Workload

No	Name of risk factor	CG	CF	NPR
F22	. Static and dynamic effort, working in vicious positions	2	5	3
F23	Nervous stress – sometimes a high pace of work with a request to several places in limited time conditions	2	5	3

Table 3 presents the risk factors from the Means of Production's side.

Table 3 Risk Factors for the Means of Production

No	Name of risk factor	CG	CF	NPR
F1	Moving machine parts – the abrasive bodies of mobile electric grinders, rotary hammers	4	2	3
F2	Hit by the means of car transport when traveling on the route to/from work and inside the unit	7	1	3
F3	Rolling cylindrical parts during their positioning for welding	3	3	3
F4	Overturning oxygen cylinders or unsecured tanks against uncontrolled movement	3	3	3
F5	Falling objects from heights (tools, parts, materials)	7	1	3
F6	Spraying of particles (splashes, chips) especially in position welding, grinding and cutting	4	5	5
F7	Design of pieces of grinding wheels upon accidental breakage	7	1	3
F8	Cutting, pricking when in contact with dangerous surfaces or contours (sharp, prickly, undetached)	2	5	3
F9	Containers under pressure - explosion of oxygen cylinders, acetylene.	7	1	3
F10	Thermal burn caused by the contact of the epidermis with splashes, sparks, slag, surfaces with high temperature (weld seams, recently welded parts, etc.)	2	5	3
F11	The low temperature of the parts it comes into contact with when working outdoors in the cold season	2	5	3
F12	Flames, flame during the welding process – burning	3	5	4
F13	. Electrocution by direct touch (making improvised connections), by indirect touch (by accidental damage to some insulation, faults in the welding generator, etc.)	7	3	5
F14	Flammable substances – isopropyl alcohol, etc.	7	1	3

Table 4 presents the risk factors from the Work Environment 's side.

Table 4 Risk Factors for the Work Environment

No	Name of risk factor	CG	CF	NPR
F15	High air temperature in the hot season and low in the cold season (when working outdoors)	2	5	3
F16	Air currents due to working outdoors	2	5	3
F17	Insufficient lighting – especially when working at night; low contrast between the medium and the detail being worked on	2	5	3
F18	Radiation (IR) resulting from the welding or cutting process.	2	5	3
F19	Natural disasters: earthquake etc	7	1	3
F20	Pneumoconiogenic dusts in the workplace atmosphere (flux particles, fine metal powders, etc.)	2	5	3
F21	Gases, toxic vapors specific to the welding process	7	4	6

6.Risk factors and partial levels of ris

Figure 2 shows all risk factors and partial risk levels. An overall risk level of 3.46 was also obtained.

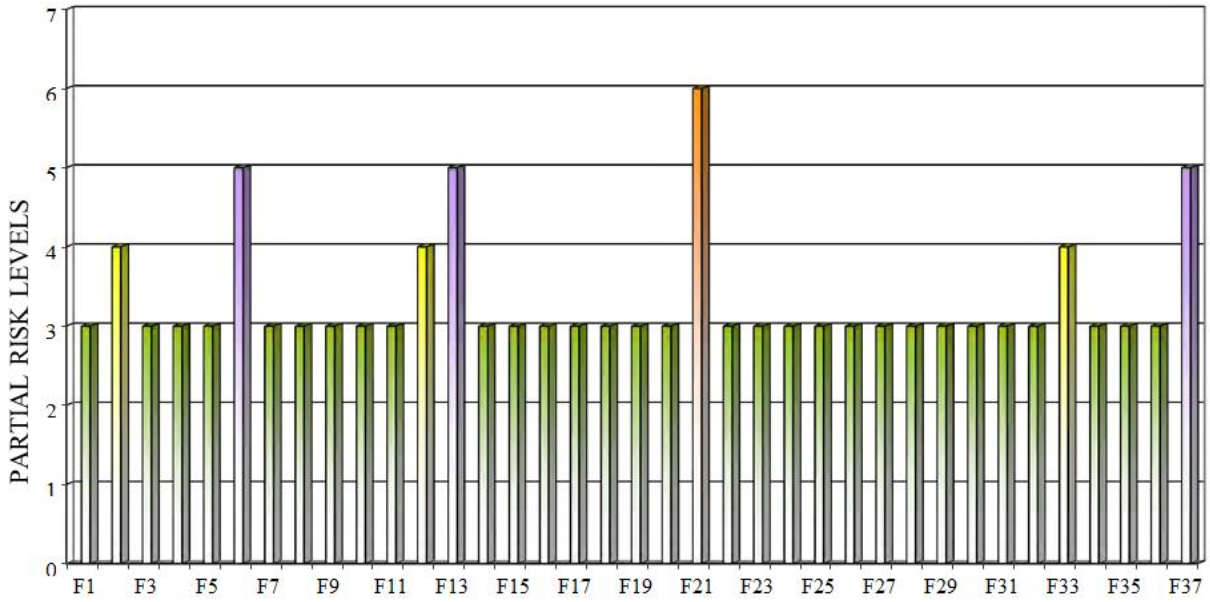

Figure 2 Risk factor and partial risk levels

7. Weight of risk factors by elements of the work system

Figure 3 shows the weight of risk factors according to the elements of the work system.

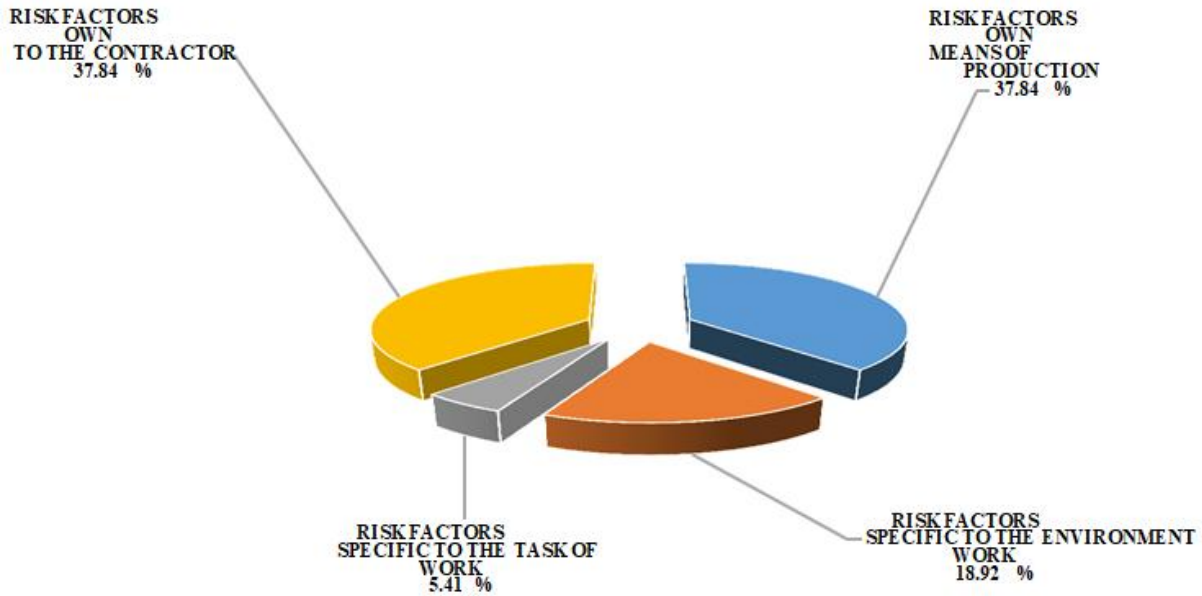

Figure 3. Weight of risk factors by elements of the work system

8.Overall level of risk

The calculation of the overall risk level-ORL is presented in the below relation (1).

$$ORL=\frac{\sum_{i=1}^{37} r_i*R_i}{\sum_{i=1}^{37} r_i}=\frac{0(7x7)+1(6x6)+3(5x5)+2(4x4)+31(3x3)+0(2x2)+0(1x1)}{0x7+1x6+3x5+2x4+31x3+0x2+0x1}=\frac{\mathbf{422}}{\mathbf{122}}=3.46 \quad (1)$$

where ORL is the overall workplace risk level; ri is the rank of the risk factor "i", Ri is the risk level for risk the factor "i" and n is the number of risk factors identified at the workplace.

9. Conclusions.

A risk analysis was made for the welding station. A number of 37 risk factors were identified with partial risk levels between 3 and 6. The overall risk level calculated for welding works is equal to **3.46,** considered an acceptable risk level. Out of the total of 37 risk factors identified, only 6 exceed, as a partial level of risk, the value 3: 0 falling into the category of maximum risk factors, 1 falling into the category of *very high* risk factors, 3 falling into the category of high risk factors, and the other 2 falling into the category of medium risk factors.

Table 5 Measures to combat risk factors that are in the unacceptable field

No	Name of risk factor	Measures to combat
F2	Machine parts in motion-the abrasive bodies of mobile electric grinders, impactors	Equipping workers with individual protective equipment - helmet and protective gloves Training workers on the use of individual protective equipment
F6	Spraying of particles (splashes, chips) especially in position welding, grinding and cutting	Arrangement according to workplace safety procedures before practicing these types of operations Verifying the use of protective means against particles, splashes resulting from polishing or cutting operations with oxyacetylene flame (ORGANIZATIONAL MEASURE)
F21	Gases, toxic vapors specific to the welding process	Periodic medical check-up with the determination of the concentrations of toxic agents; Compliance with the sampling schedules and determination of the concentrations of vapors, toxic gases in the atmosphere of the workplace Equipping the contractors with a gas protection mask - ensuring an efficient ventilation system that ensures the elimination of fumes from the work rooms (ORGANIZATIONAL MEASURE)
F13	Electrocution by direct touch (making improvised connections), by indirect touch (by accidental damage to some insulation, faults in the welding generator, etc.)	Identification of the installations to be worked on - visual verification of the integrity of the earthing of the equipment housings, metal and concrete poles and supports in the work area and the immediate removal of all non-conformities The use, as the case may be, of gloves, electro-insulating shoes and tools with electro-insulating handles - ensuring by the members of the work group that there are no unrestricted live parts nearby (when working in a team) and if there are unrestricted parts of the live electrical installations, measures will be

		immediately taken to fence and signal them or to remove them from power where possible (ORGANIZATIONAL MEASURE; TECHNIQUE)
F37	Failure to use personal protective equipment and other means of protection provided	Training workers on the consequences of non-compliance with safety restrictions – non-use or incomplete use of protective means etc. Verification by permanent control, by the head of the band, and/or by survey, by the hierarchically superior bosses of the use of PPE and compliance with the legal and internal provisions of prevention and protection Equipping workers with PPE corresponding to the activity to be carried out and the identified risks (ORGANIZATIONAL MEASURE)
F12	Flames, flames during the welding process – thermal burn	Verifying the full use of personal protective equipment; insisting, during the training, on the non-dangerous way of handling the respective devices and on the behavior (mode of movement, stationary, maintaining a sober attitude, etc.) that must be adopted in such workplaces; (TECHNICAL MEASUREMENT) Training workers on the importance of complying with the Highway Code
F33	Travel, parking in dangerous areas (on car access roads, machinery, etc.)	Training of workers on the consequences of non-compliance with technological discipline and safety restrictions – inattention to the operations performed, entry, even with only portions of the body, inside danger areas, etc The prohibition, as well as the training of workers in this regard, of parking or moving on car access roads Fencing where possible and signaling the work areas, in accordance with the legal provisions and own instructions (ORGANIZATIONAL MEASURE)
F23	Nervous request. Sometimes high pace of work with the request at several places under limited time conditions	Enough breaks to restore the body
F24	Carrying out unforeseen operations in the work load	Worker training
F25	Improper positioning of the electrode	worker training
F26	Failure to ensure the stability of the parts to be welded during work	The provision of materials and parts both in the storage areas and in the temporary storage places (until assembly)
F27	Incorrect adjustment of the welding parameters	training workers with an emphasis on their own instructionsof work security, specific to the workplace
F28	Handling oxygen cylinders and air bags with greasy hands	Worker training Providing workplaces with sanitary materials, toilets, sinks, cold water, depending on the number of workers

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