



Co-funded by the
Erasmus+ Programme
of the European Union

NR: 2020-1DE02-KA202-007578
Duration: 1.09.2020 - 31.08.2023
Financed by European Union



CEMIVET

ERASMUS+ Programme Key Action2: Strategic Partnerships
'Circular Economy in Metal Industries VET'
2020-1-DE02-KA202-007578

IO2 DEFINITION OF CIRCULAR ECONOMY COMPETENCES
AT THE WORKPLACE



INTRODUCTION

Application of the principles of circular economy in the work processes and related re-design of work processes are important factors which define development of circular economy in the different sectors, especially in the industry.

The main goal of this document is to prepare a description of the competencies required to implement the principles of the circular economy.

Document was prepared by:

- Christine Schmidt, Vereinigung Für Betriebliche Bildungsforschung E.V. IBBF, DE
- Volha Zinouyeva, Vereinigung Für Betriebliche Bildungsforschung E.V. IBBF, DE
- Prof. PhD. Vidmantas Tūtlys, Vytautas Magnus University, LT
- Algimanta Ščiglinskienė, Alytus Business Advisory Center, LT
- Rolandas Urbanavičius, Alytus Business Advisory Center, LT
- Janusz Poulakowski, Centrum Promocji Innowacji I Rozwoju, PL
- Martyna Przedlacka, Centrum Promocji Innowacji I Rozwoju, PL
- Ilaria Massari, REI - Reindustria Innovazione - S.Cons.r.l., IT
- Rita Longari, REI - Reindustria Innovazione - S.Cons.r.l., IT
- Jose Ramón Natal, Metaindustry4 Cluster De Fabricacion Avanzada De La Industria Del Metal De Asturias, ES
- Silvia Jiménez García, Metaindustry4 Cluster De Fabricacion Avanzada De La Industria Del Metal De Asturias, ES

COMPETENCE PROFILE OF THE SUSTAINABLE EXECUTION OF WORK PROCESSES IN THE FIELD OF /AND RELATED TO WELDING

This competence profile is developed on the basis of the above provided findings of the work and learning station analysis of welding in the project partner countries. It describes the main competence areas and competence development steps related to sustainable, environment friendly and ‘circular’ execution of the work processes of welding. It can serve as a reference for development of the new and updating of the existing training modules in the initial and continuing VET. Each competence development step can be regarded as separate training module.

Provided competence profile “aggregates” the competence development steps of the whole technological and work processes of welding defined below. These competence steps cover different qualifications of the welding specialists: welders and welding operators (EQF levels

2-4), welding supervisors and technicians (EQF level 5), welding process engineers and product designers (EQF levels 6-7).

1. Competence area: Following the design and maintenance of sustainable work process and products.

Competence development steps	Qualifications
1.1.To read the drawings and understand the symbols and technological information in order to avoid mistakes and non-conformities.	Welders and welding operators (EQF 3-4)
1.2.To clarify the technological requirements and possible practices of sustainable technological work regimes (using of materials, applying welding regimes, preparation of materials) with designers and engineers. To discuss possible, from the welder's and his shop's point of view, sustainable resource use practices by arguing one's proposals properly.	
1.3.To apply the instructions and suggestions of sustainable usage of materials and consumables in the welding practice.	

2. Competence area: Sustainable and circular preparation, maintenance and design of the workplaces in welding

Competence development steps	Qualifications
2.1.To keep the workplace tidy (e.g. putting scrap metal in the designated place).	Welders and welding operators (EQF 2 - 4)
2.2.To verify the parameters of the dust extraction system (the condition of the welding station) and the performance of the welding source (and its changes) by following internal regulations and rules of the enterprise, using control sheets of filtering systems.	Welders and welding operators (EQF 3 - 4)
2.3.To sort and dispose the rests of materials at the workplace according to defined rests management procedures and systems (ISO etc.), internal rules of management of rests, environmental guides.	

2.4.To evaluate each rest of materials produced at the workplace and its suitability for further use.	
2.5.To execute and ensure the traceability of the used materials in ensuring economic usage of the main materials (metal sheets) by moving the remaining materials to the warehouse and using them in further production (when it is a part of work delegated to welder/welding operator).	
2.6.To evaluate the welding position and to apply the possible countermeasures, evaluating the risk of failures or poor welding regimes.	

3. Competence area: Sustainable and circular execution of the technological operations in the field of welding.

Competence development steps	Qualifications
3.1. To develop practical skills of welding by using simulator before executing the real operations, practicing; to use test equipment of the alternative methods, e.g. safety-relevant bolting, tightening torques and bolted connections by hand.	Welders, welding operators (EQF 3-4)
3.2. To execute quality control of the materials and executed welds: reading and checking the markings of the material to be welded and welding consumables, visual control of the metal sheets and workpieces before the welding in order to spot and remove dirt, slags, rust and other deficiencies potentially having harmful effect on quality and volume of used materials; to execute the self-inspection of weld by using inspection gauges, as prevention of non-conformities.	

<p>3.3. To apply savvy procedures of the preparation of raw materials for welding permitting to save on the surface treatment operations after welding (metal and sand blasting); to follow the technological requirements and guidelines for selecting and fine-tuning of the composition of welding consumables : shielding gases, welding wire, electrodes etc.; to execute the preparation of the surface and edges of their workpieces and sheets before welding by using cutters, grinding plates instead of abrasive materials (where possible); to execute the edge preparation in the ways which help to optimize the volume and intensiveness of the welding /joining and to minimize the zones of weld area.</p>	
<p>3.4. To follow strictly quality management procedures, requirements of the WPS and welding instructions; visually assess the quality of weld; to evaluate the effect of changing welding parameters on the quality of weld.</p>	
<p>3.5. To ensure proper quality of cleaning of surface after welding (remaining slags before pickling requires additional pickling operations with negative environmental implications); to follow strictly the requirements of the need of the volume of paint and other surface surface treatment materials by referring to the corrosiveness of the environment of product usage.</p>	
<p>3.6. To apply higher pace in executing welding operation in seeking to use fewer materials and save emissions (only for highly experienced welders, not compromising the quality).</p>	<p>Welders, welding operators (EQF 4)</p>
<p>3.7. To apply possible changes in the welding process parameters to optimize the welding process; to apply technological solutions of welding regimes that allow for the reduction of subsequent work expenditure on cleaning the connection; while executing welds to keep within the limits of thermal impact defined in the welding procedure; to execute welds in applying savvy regimes, such as pulse regime helping to control the thermal input and to regulate the volume of energy, using of synergetic regimes of welding which help to control and optimise the energy consumption; to apply submerged-arc welding or combination of welding regimes with submerged arc welding for the welding of high thickness metal sheets, what permits to reduce the number of welding passes; to</p>	<p>Welders, welding operators (EQF 4)</p>

<p>apply contact welding (point welding) instead of full joint welding, where possible; to use the CNC machines (plasma cutters, lasers) in seeking to limit the harmful impact of welding processes on the operation of other stations (machining in a closed machine space).</p>	
--	--

4. Competence area: Sustainable and circular organization of work in welding

Competence development steps	Qualifications
<p>4.1.To control issuing of the materials and welding consumables for welders by disciplining the welders and signalling / discussing of the cases of excessive consumption of materials and consumables of welding; to organize proper quality control of the metal sheets, to select and use less „contaminating” welding consumables, like, for example, solid welding wires which produce much less emissions that when using „powder” based welding wire.</p>	<p>Welding supervisors and technicians (EQF 5)</p>
<p>4.2.To ensure the proper division of tasks amongst the welders by considering their qualifications and their fit to the quality requirements related to he complexity of welding processes individual workplaces; to ensure the right following of the sequence of welding operations defined by the technological specifications; to plan all the working operations in the holistic way by taking into consideration their interdependencies.</p>	
<p>4.3.To define clear goals and clear work plan of welding process; to support transparent and constant cooperation between welding engineers, technologists, experienced welders and welding operators regarding requirements and environmental preferences; to plan the work and control of work by methods and times to avoid unnecessary tasks.</p>	
<p>4.4.To organise the teamworking of welders with different levels of qualifications, including the organisation of work of experience welders and beginners operators; to execute the mentoring of welders by providing suggestions and recommendations on how to apply more sustainable and economic ways of working in executing different welding operations; to exchange practical and theoretical know-how on the sustainable and circular approaches and ways of</p>	

welding between welders, welding operators and engineering staff; to collect and evaluate the suggestions from the welders on the improvement of sustainability of the welding processes.	
4.5.To establish and maintain tense collaboration between production preparation and programming units in the field of sustainable optimisation of the welding processes.	

5. Competence area: Sustainable and circular digitalization of the work processes in the field of welding.

Competence development steps	Qualifications
5.1.To apply the automated welding processes (welding robots, CNC laser cutters used in repeatable processes leading to the reduction of defects).	Welders, welding operators (EQF 4)
5.2.To monitor and mitigate the consumption of the materials and energy in operating welding robots at the initial stages of their implementation by seeking to deal with possible increases in this consumption by following and analysing information about the status and progress of the welding process.	Welding supervisors and technicians (EQF 5)
5.3.To optimise accessibility and communication of the production data between the welding robot, operator and design specialist in seeking to reduce the volume of welding seams and to reduce the volume of emissions.	Welding engineers and designers (EQF 6-7)

6. Competence area: Sustainable and circular design of welding processes and products (welding technicians, engineers and designers, EQF 5-7).

Competence development steps	Qualifications
6.1.To apply know-how of the welding quality requirements for the different constructions and products when deciding about sufficiency (not excessive) of these requirements for welding process; to evaluate possibilities to optimise of yield strengths of the steels in the welding process; to minimise the volume of welded joints in the design of products, taking into consideration	Welding engineers and designers (EQF 6-7)

<p>the volume of rests of materials and it's management options resulting from the design; to optimise the weld joint design.</p>	
<p>6.2.To select the most economic and environmently friendly welding processes, regimes and procedures for the each case by taking into consideration technological and product requirements (avoiding excessive welding regimes, e.g. very often use of submerged arc welding for thick sheets helps to economise on the preparatory edge cutting of sheets and to reduce emissions from this process); to control the selection of welding regimes in order to avoid applying excessive regimes in terms of thermal impact.</p>	
<p>6.3.To combine the theoretical know-how and engineering expertise with the practical (tacit) know-how of welding processes possessed by welders and welding operators, especially when making decisions about optimal technological processes, procedures, regimes and design; to engage in consultations with welders when preparing technical documents and procedures, collecting of their feedback and practical recommendations on the optimisation of welding processes.</p>	
<p>6.4.To design clear and transparent order in the field of collecting, sorting and processing of rests of materials and prevention of emissions of the welding processes; to develop the transparent and clear technical documentation for welding (drawings and technical specifications) leaving a minimal room for interpretation of data by the welder.</p>	
<p>6.5.To evaluate the possibilities for applying alternative procedures of welding; to consider and foresee partial replacement welding with other technological processes having lower impact on environment (e.g. screwing and riveting), where possible.</p>	
<p>6.6.To design the customer-oriented and environmentally friendly welded products, leading to CO₂ savings; to consider the increasing of repairability of products in the design process (USP special vehicle construction, vertical range of manufacturing, applying lightweight design and modular construction of products (vehicle units).</p>	

REFERENCES

Erasmus+ Project “Learning through experience is one of the fundamental rules of sustained learning.” <http://icsas-project.eu/>

Raworth, K. (2017). Doughnut Economics: Seven Ways to Think Like a 21st-Century Economist. London: Penguin Random House

Saniter, A., Lopez, A.E., Carballo-Cruz, F. (2015). DualTrain: Building A Sustainable Approach To The Dual Vocational Training System In the Shoe Sector In Portugal, Spain And Germany. <https://eera-ecer.de/ecer-programmes/conference/20/contribution/36510/>



Co-funded by the
Erasmus+ Programme
of the European Union



CEMIVET

The European Commission's support for the production of this publication does not constitute an endorsement of the contents, which reflect the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein