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

SUMMARY

Kofinanziert durch das Programm Erasmus+ der Europäischen Union

ERASMUS+ KA2 STRAGETICAL PARTNERSHIP PROJECT
„CIRCULAR ECONOMY IN METAL INDUSTRIES VET“
Project No. 2020-1-DE02-KA202-007578

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INTRODUCTION

Application of the principles of circular economy in the work processes and related re-design of work processes are important factors which define dvelopment 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.

1. COMPETENCE MATRIX OF THE SUSTAINABLE EXECUTION OF WORK PROCESSES IN THE FIELD OF /AND RELATED TO WELDING

This competence matrix 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 matrix "aggregates" the competence development steps of the whole technological and work processes of welding defined in the Figure 1. In order to identify the competence steps applicable for the different qualifications of the welding specialists, they are marked with the different colours of the matrix „boxes":

Skilled 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)

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Competence areas	Competence development steps						
Following the design and maintenance of sustainable work process and products	To read the drawings and understand the symbols and technological information in order to avoid mistakes and non-conformities.		To discuss 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 apply the instructions and suggestions of sustainble usage of materials and consumables in the welding practice.		
Sustainable and circular preparation, maintenance and design of the workplaces in welding	To keep the workplace tidy (e.g. putting scrap metal in the designated place).	To execute periodic control of the aeration/ventillation systems of the welding areas by following internal regulations and rules of the enterprise, using control sheets of filtering systems .	To sort and dispose the waste at the workplace according to defined waste management procedures and systems (ISO etc.), internal rules of waste management, environmental guides. To evaluate each waste produced at the workplace and its suitability for further use.		To execute and ensure the traceability of the used materials in ensuring economic usage oft he main materials (metal sheets) by moving the remaining materials to the warehouse and using them in further production.	To execute the regular control and maintenance of the welding equipment in seeking to verify its efficiency, to control the temperature cycles and times.	
Sustainable and circular execution of the technological operations in the field of welding.	To execute quality control of the materials and executed welds: visual control of the metal sheets and workpieces before the welding in order	To follow strictly quality management procedures, requirements of the WPS and welding instructions.	To apply savy procedures of the preparation of raw materials for welding permitting to save on the surface	To apply technological solutions of welding regimes that allow for the reduction of subsequent work expenditure on	To apply higher pace in executing welding operation in seeking to use fewer materials and	To ensure proper quality of cleaning of surface after welding (remaining slags before pickling	To develop practical skills of welding by using simulator before executing the real operations, practicing; to

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	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.		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 ther workpieces and sheets before welding by using cutters, grinding plates instead of abrasive	cleaning the connection; while executing welds to keep within the limits of thermal impact defined in the welding procedure; to execute welds in applying savy 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	save emissions (only for highly experienced welders, not compromising the quality) .	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.	use test equipment of the alternative methods, e.g. safety-relevant bolting, tightening torques and bolted connections by hand.

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			materials (where possible); to execute the edge preparation in the ways which help to optimize the volume and instesiveness of the welding /joining and to minimize the zones of weld area.	welding regimes with submerged arc welding for the welding of high thickness metal sheets, what permits to reduce the number of welding passes; to 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).			
Sustainable and	To control issuing of the		To ensure the proper		To define clear goals and	To organise the		To establish and

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CEMIVET Circular Economy in Metal Industries Vocational Education and Training

circular organization of work in welding	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, avoiding the practices of economising on the quality of the metals by using cheap and low quality materials (rusted, contaminated, low-quality), what requires additional preparations and involves additional emissions; 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.	division of tasks amongst the welders in the workplaces by referring to the fit of their qualifications 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.	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.	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 welding between welders, welding operators and engineering staff; to collect and evaluate the suggestions from the welders on the	maintain tense collaboration between production preparation and programming units in the field of sustainable optimisation of the welding processes.

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CEMIVET Circular Economy in Metal Industries Vocational Education and Training

				improvement of sustainability of the welding processes.		
Sustainable and circular digitalization of the work processes in the field of welding.	To use welding robots and CNC laser cutters (especially fiber type), allowing a greater use of the starting material and reducing waste through optimized nesting (the robots perform welds in a repeatable manner, which, with the right choice of means and parameters of the technological process, leads to the reduction of defects).		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.		To optimise accessibililty and communication of the production data between the welding cobot, operator and design specialist in seeking to reduce the volume of welding seams and to reduce the volume of emissions.	
Sustainable and circular design of welding processes and products (welding technicians, engineers and designers, EQF 5-7)	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	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 (not compromising quality but avoiding excessive welding regimes,	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,	To design clear and transparent order in the field of collecting, sorting and processing of wastes and prevention of emissions of the welding processes; to develop the transparent and clear technical documentation for welding (drawings and technical specifications)	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.	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

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	steels in the welding process; to minimise the volume of welded joints in the design of products, taking into consideration the volume of waste and it's management options resulting from the design; to optimise the weld joint design.	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.	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	leaving a minimal room for interpretation of data by the welder.		design and modular construction of products (vehicle units).

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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/