

Creating knowLedge and skilLs in AddItive Manufacturing

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QUALIFYING THE WORLD OF ADDITIVE MANUFACTURING

THE 1ST INTERNATIONAL AM QUALIFICATION SYSTEM

www.cllaimprojectam.eu

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About 3D printing is the new trend in industry

By adding metallic layers upon layers this technology has revolutionized the industry allowing the manufacturing of parts with improved characteristics that cannot be done through traditional manufacturing processes. More and more industrial sectors are turning to AM as a path to raise competitiveness and innovation.

Being this technology quite recent, suddenly there was an increasing need in terms of qualified personnel for Metal Additive Manufacturing / 3D printing.

Therefore, CLLAIM project was born to tackle these needs and developed the first International Harmonized Qualification System directed to Additive Manufacturing.



This system allows building one of the pillars to sustain the Additive Manufacturing market by providing highly specific qualified personnel. Besides the development of the system, several International Harmonized Metal AM Qualifications were developed:

- Operator DED-Arc
- Operator DED-LB
- Operator PBF-LB
- Operator PBF-EB
- AM Supervisor
- AM Inspector
- Designer for DED processes
- Designer for PBF processes

CLLAIM project partnership is composed by VET Training Centres (to ensure the implementation of the system), Certification Bodies (to ensure alignment of the Qualifications and Industrial Standards) and an Umbrella Organization (to ensure the exploitation and sustainability of the system). Furthermore, CLLAIM was funded by European Commission under the scope of ERASMUS+ project.

International AM Qualification System

CLLAIM developed the first European, "actually the first International", Qualification System for Additive Manufacturing. The project has defined the rules and operational procedures to guarantee the harmonised implementation of the Qualification System across Europe, inspired by the EWF Quality Assurance System.

The Qualification System is composed by the following Bodies*:



AM Council

The AM Council is one of the entities that administrates the AM Qualification System. It is responsible for supervising the entire activity ensuring the rules, operating procedures and quality of the System.



European Organisation Management

Responsible for all decisions required by this activity, through its General Assembly, and for certifying all AM ANBs in the AM System.



Authorised Nominated Body (ANB)

An organisation that has been assessed and authorised by the European Organisation Management in accordance with its rules, guidelines, requirements and business plan and is responsible to ensure the quality of the education from the organizations under its scope.



Approved Training Body (ATB) for Additive Manufacturing

An organisation that has been assessed and approved by an ANB in accordance with the AM Qualification System rules for training organisations. After being approved, the ATB can deliver courses based on the Qualification System Guidelines and award International diplomas for the Qualifications and Competence Units delivered.

Applying for

International AM Qualification System

Any organisation that wishes to deliver the courses of this International Harmonised Qualification System is free to apply to become an ATB.

The following figure illustrates the process to uptake.

TRAINING CENTER'S APPLICATION

The Training Centre presents its application to an Authorised Organisation from EWF Network.

AM ATB O4

After the assessment and approval the training centre fulfils all the requirements for delivering training in accordance with AM Guidelines

02

PROCEDURES FOR APPROVING AM ATB

The Authorized Organization assesses the application based on a defined set of conditions.

O3 ASSESSM CONDITION

Documental Review:

- Scope Evaluation;
- Conformity with AM syllabus;
- Quality;
- Health & Safety;

Audit to verify the compliance with AM Qualification System rules.

For more information on how to apply to the International AM Qualification System please contact: ewf@ewf.be

Recognise your prior

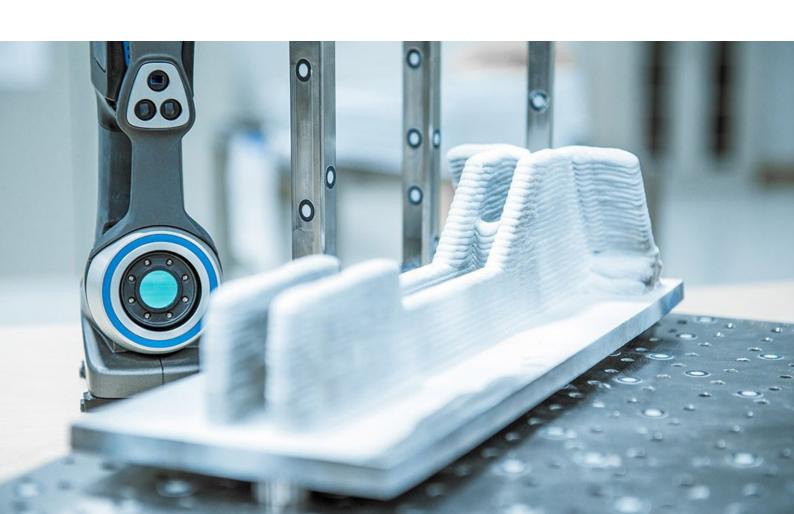
Knowledge and Experience in AM

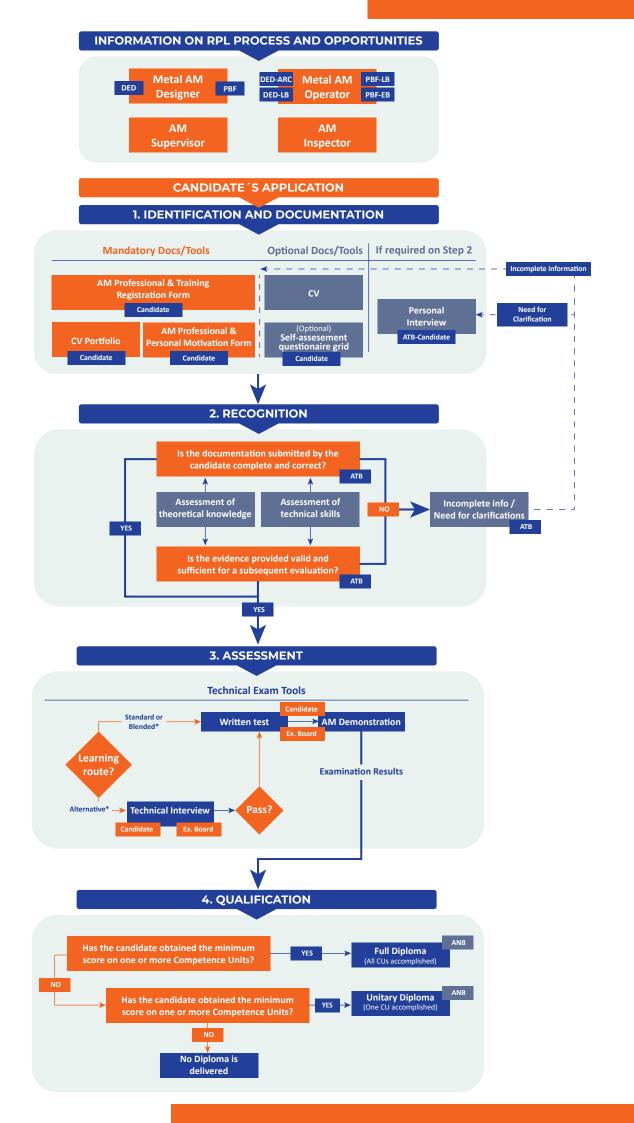
An innovative feature of the AM Qualification System is the process of Recognition of Prior Learning (RPL). The RPL process allows professionals to recognise and validate their prior knowlegde and skills in AM. In a nutshell, this means that a professional that already has experience in Metal Additive Manufacturing / 3D printing or related technologies can apply to an RPL process and acquire a Diploma/Record of Achievements without having to attend the mandatory classes.

This innovative process can also be used as a benchmark for Qualification Systems in different sectors and other Qualifications and Competence Units/ Modules developed under the scope of the AM Qualification System.

The following scheme illustrates the full process that an applicant must go through to have their competences and knowledge recognized.

The RPL scheme and stages are illustrated in the following flowchart:





CLLAIM Guidelines

CLLAIM project developed Guidelines for the profiles of Operator, Supervisor, Inspector and Designer.

The CLLAIM project developed several Guidelines that are fully aligned with European tools, namely in order to promote the integration of CLLAIM Qualifications in National Qualifications Framework. The International AM Qualification System* uses a modular structure composed by smaller units - the Competence Units (CU).

SUPERVISOR for all processes EETY AND ENVIORMENT EIT & SET-UP OF AM MACHINER PROCESS OVERVIEW OFSIGN PRINCIPALS DEDIPER OESICN METAL AM PARTS FOR DEDIPER

DESIGNER

for a specific process category

To have a full overview please check CLLAIM website at **cllaimproject.eu**In the following pages is an overview of the content of each **Guideline developed for CLLAIM Qualifications**.

INTERNATIONAL METAL AM OPERATOR

DED-Arc

International Metal AM Operator DED-Arc are the professionals with the specific knowledge, skills, autonomy and responsibility to operate metal AM machines using the DED-Arc Process.

His/her main tasks are to:

• Operate arc based DED machines for AM, including fitting and setting up, maintenance and repair.

- Verify arc related parameters and positioning in DED-Arc machines for AM;
- Self-manage the handling of feedstock (approval, storage, contamination, traceability);
- Develop solutions on basic and specific problems related with DED-Arc machines and processes for AM.

| COMPETENCE UNITS | Recommended Contact Hours | Expected Workload |
|--|------------------------------|-------------------|
| CU 00: Additive manufacturing Process Overview | 3.5 | 7 |
| CU 01: DED-Arc Process | 14 | 28 |
| CU 02: Quality Assurance (QA) in DED-Arc | 7 | 14 |
| CU 03: Health, Safety and Environment (HSE) in DED-Arc | 7 | 14 |
| CU 04: Fit and set-up of DED-Arc systems | 21 | 42 |
| CU 05: Manufacturing of DED-Arc parts | 7 | 14 |
| CU 06: Post processing of DED-Arc parts | 7 | 14 |
| CU 07: Maintenance of DED-Arc systems | 14 | 28 |
| TOTAL | 80.5 | 161 |

INTERNATIONAL METAL AM OPERATOR **DED-LB**

International Metal AM Operator DED-LB are the professionals with the specific knowledge, skills, autonomy and responsibility to operate metal AM machines using the DED-LB Process.

His/her main tasks are to:

• Operate Laser based DED machines for AM, including fitting and setting up, basic maintenance and repair.

- Verify Laser beam measurement and positioning in DED-LB machines for AM;
- Self-manage the handling of feedstock (approval, storage, contamination, traceability);
- Develop solutions on basic and specific problems related with Laser based DED machines and processes for AM.

| COMPETENCE UNITS | Recommended Contact Hours | Expected Workload |
|---|------------------------------|-------------------|
| CU 00: Additive manufacturing Process Overview | 3.5 | 7 |
| CU 08: DED-LB Process | 14 | 28 |
| CU 09: Quality Assurance (QA) in DED-LB | 14 | 28 |
| CU 10: Health, Safety and Environment (HSE) in DED-LB | 7 | 14 |
| CU 11: Fit and set-up of DED-LB systems | 21 | 42 |
| CU 12: Manufacturing of DED-LB parts | 7 | 14 |
| CU 13: Post processing of DED-LB parts | 7 | 14 |
| CU 14: Maintenance of DED-LB systems | 14 | 28 |
| Subtotal (without optional CUs) | 87.5 | 175 |
| CU 48: Powder Handling | 14 | 28 |
| CU 49: Laser Beam Characterisation | 7 | 14 |
| TOTAL | 108.5 | 217 |

INTERNATIONAL METAL AM OPERATOR

PBF-LB

International Metal AM Operator PBF-LB is the professional with the specific knowledge, skills, autonomy and responsibility to operate metal AM machines using the PBF-LB Process.

His/her main tasks are to:

• Operate powder bed-based laser beam machines for AM, including fitting and setting up, maintenance and repair.

- Remove parts and prepare them for post-processing steps;
- Verify Laser beam measurement and positioning in laser powder-bed machines for AM;
- Self-manage the handling of powder (approval, storage, contamination, traceability);
- Develop solutions on basic and specific problems related with laser powder-bed fusion machines

| COMPETENCE UNITS | Recommended Contact Hours | Expected Workload |
|---|------------------------------|-------------------|
| CU 00: Additive manufacturing Process Overview | 3.5 | 7 |
| CU 08: DED-LB Process | 14 | 28 |
| CU 09: Quality Assurance (QA) in DED-LB | 7 | 14 |
| CU 10: Health, Safety and Environment (HSE) in DED-LB | 3,5 | 7 |
| CU 11: Fit and set-up of DED-LB systems | 14 | 28 |
| CU 12: Manufacturing of DED-LB parts | 3,5 | 7 |
| CU 13: Post processing of DED-LB parts | 7 | 14 |
| CU 14: Maintenance of DED-LB systems | 7 | 14 |
| Subtotal (without optional CUs) | 59.5 | 119 |
| CU 48: Powder Handling | 14 | 28 |
| CU 49: Laser Beam Characterisation | 7 | 14 |
| TOTAL | 80.5 | 161 |

INTERNATIONAL METAL AM OPERATOR PBF-EB

International Metal AM Operator PBF-EB is the professional with the specific knowledge, skills, autonomy and responsibility to operate metal AM machines using the PBF-EB Process.

His/her main tasks are to:

 Operate electron beam powder bed fusion machines for AM, including fitting and setting up, maintenance and repair.

- Remove parts and prepare them for post-processing steps;
- Self-manage the handling of powder (approval, storage, contamination, traceability);
- · Develop solutions on basic and specific problems related with electron beam powder-bed fusion machines

| COMPETENCE UNITS | Recommended Contact Hours | Expected Workload |
|--|------------------------------|-------------------|
| CU 00: Additive manufacturing Process Overview | 3.5 | 7 |
| CU 22: PBF-EB Process | 14 | 28 |
| CU 23: Quality Assurance (QA) in PBF-EB | 7 | 14 |
| CU 24: Health, Safety and Environment (HSE) in PBF-EB | 3,5 | 7 |
| CU 50: Hardware, software and build file set-up for PBF- EB | 14 | 28 |
| CU 51: Monitoring and managing the manufacturing of PBF-EB parts | 3,5 | 7 |
| CU 52: Post-processing of PBF-EB parts | 7 | 14 |
| CU 53: Maintenance of PBF-EB systems | 7 | 14 |
| Subtotal (without optional CUs) | 59.5 | 119 |
| CU 48: Powder Handling | 14 | 28 |
| TOTAL | 73.5 | 147 |

INTERNATIONAL METAL AM Supervisor

International Metal AM Supervisors are the professionals with the specific knowledge, skills, autonomy and responsibility to supervise AM production on shop floor, being its main tasks to:

- Ensure quality procedures
- Ensure Health & Safety Environment procedures
- Record the essential information during the AM manufacturing process

| COMPETENCE UNITS | Recommended Contact Hours | Expected Workload |
|---|------------------------------|-------------------|
| CU 00: Additive manufacturing Process Overview | 3.5 | 7 |
| CU 01: DED-Arc Process | 14 | 28 |
| CU 08: DED-LB Process | 14 | 28 |
| CU 15: PBF-LB Process | 14 | 28 |
| CU 46: Quality Assurance for Metal AM Processes | 14 | 28 |
| CU 47: HSE for Metal AM Processes | 14 | 28 |
| CU 48: Powder Handling | 14 | 28 |
| TOTAL | 87.5 | 175 |

INTERNATIONAL METAL AM Inspector

International Metal AM Inspectors are the professionals with the specific knowledge, skills, autonomy and responsibility to conduct inspections to Metal Additive Manufacturing parts production.

Their main tasks are:

- Carry out quality assessments of the AM process at various critical stages;
- Perform inspection of all equipment ensuring adequate and controlled use;
- Conduct visual inspection to identify and evaluate imperfections in Metal AM parts and assess against agreed acceptance criteria;
- Verify all Metal AM related activities in production, including (but not limited to) the following points:
 - 1. Verify data and adequacy of material certificates (base and filler materials);
 - 2. Verify identification and traceability of the materials used during the manufacturing process;
 - 3. Verify the compliance of feedstock against applicable regulations, standards, codes and/or specifications
- Compile and verify completeness of the final inspection document package.

| COMPETENCE UNITS | Recommended Contact Hours | Expected Workload |
|--|------------------------------|-------------------|
| CU 00: Additive manufacturing Process Overview | 3.5 | 7 |
| CU 01: DED-Arc Process | 14 | 28 |
| CU 08: DED-LB Process | 14 | 28 |
| CU 15: PBF-LB Process | 14 | 28 |
| CU 22: PBF-EB Process | 14 | 28 |
| CU 63: Quality Assurance for Inspection | 28 | 56 |
| CU 64: Inspection-Examination and Testing | 38,5 | 77 |
| TOTAL | 126 | 252 |

INTERNATIONAL METAL AM DESIGNER

DED Processes

International Metal AM Designers for DED Processes are the professionals with the specific knowledge, skills, autonomy and responsibility to design metal AM solutions for DED Processes.

His/her's main tasks are to:

- Design Metal AM solutions for DED Processes ensuring and validating that parts can be made cost-effective and efficiently.
- Close DED Processes design projects by verifying requirements for production with engineer as well as process requirements, ensuring liaison with other technical areas to sign of drawings.
- Contribute to projects in a teaming environment cooperation with AM Team.

| COMPETENCE UNITS | Recommended Contact Hours | Expected Workload |
|--|------------------------------|-------------------|
| CU 00: Additive manufacturing Process Overview | 3.5 | 7 |
| CU 25: Post Processing | 14 | 28 |
| CU 57: Relevant principles of DED Processes for Design | 21 | 42 |
| CU 58: Design Metal AM parts for DED Processes | 35 | 70 |
| CU 61: Simulation Analysis | 21 | 42 |
| Subtotal (without optional CUs) | 94.5 | 189 |
| CU 62: Simulation Execution | 21 | 42 |
| TOTAL | 115.5 | 231 |

INTERNATIONAL METAL AM DESIGNER

PBF Processes

International Metal AM Designers for PBF Processes are the professionals with the specific knowledge, skills, autonomy and responsibility to design metal AM solutions for PBF Processes.

His/her's main tasks are to:

- Design Metal AM solutions for PBF Processes ensuring and validating that parts can be made cost-effective and efficiently.
- Close PBF Processes design projects by verifying requirements for production with engineer as well as process requirements, ensuring liaison with other technical areas to sign of drawings.
- Contribute to projects in a teaming environment cooperation with AM Team.

| COMPETENCE UNITS | Recommended Contact Hours | Expected Workload |
|--|------------------------------|-------------------|
| CU 00: Additive manufacturing Process Overview | 3.5 | 7 |
| CU 25: Post Processing | 14 | 28 |
| CU 59: Relevant principles of PBF Processes for Design | 21 | 42 |
| CU 60: Design Metal AM parts for PBF Processes | 28 | 56 |
| CU 61: Simulation Analysis | 21 | 42 |
| Subtotal (without optional CUs) | 87.5 | 175 |
| CU 62: Simulation Execution | 21 | 42 |
| TOTAL | 108.5 | 217 |



PROJECT Partners



CESOL

CESOL is an Association of Persons and Companies, independent and non-profit, in the service of welding and other joining techniques. The organization specializes in information, certification of people, products and processes, training, advice, and technical assistance to industries.

www.cesol.es



EWF

EWF, in conjunction with the relevant national welding institutes and organisations of European countries, has made great efforts in the updating and harmonisation of training and education in the field of welding technology. Manages the European Qualification Systems in the fields of Welding and Additive Manufacturing.

www.ewf.be



TWI

TWI is one of the world's foremost independent research and technology organisations, with expertise in solving problems in all aspects of manufacturing, fabrication and whole-life integrity management technologies.

www.twi-global.com



DVS

The DVS is a non-profit technical-scientific association, which is committed to all matters relating to the joining technology. With the numerous DVS state and DVS district associations, he is present throughout Germany. Seat of our main office is Dusseldorf.

www.die-verbindungs-spezialisten.de



PROJECT Partners



IDONIAL

IDONIAL is a technology centre specialized in industrial design and production. Our mission is to foster the competitiveness of industrial firms by applying technological advances both to their products and to their manufacturing and management processes.

www.idonial.com



LZH Laser Akademie GmbH

As a professional service provider LZH Laser Akademie GmbH offers a wide spectrum of training in the field of laser technology and laser based AM-technology. The company was the first DVS-certified supplier of training for experts in AM in Germany. A broad network of industrial partners ensures constant optimisation and actualisation in practical and valuable learning content.

www.lzh-laser-akademie.de



Fraunhofer IGCV

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Lloyd's

We started out in 1760 as a marine classification society. Today, we're one of the world's leading providers of professional services for engineering and technology – improving safety and increasing the performance of critical infrastructures for clients in over 75 countries worldwide.

www.lr.org



PROJECT Acknowledgement

CLLAIM Partners would like to thank the following organisations for assisting the development and validation of CLLAIM Qualifications.

























FUTURE Development



If you would like to be involved in **AM Qualifications** or be aware of the new **International AM Qualifications** being launched please contact us at **ewf@ewf.be** or follow the **SAM Project**.





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