TRANSFER OF INNOVATION, MULTILATERAL PROJECTS, LEONARDO DA VINCI - LIFELONG LEARNING PROGRAMME (2007-2013)
AGREEMENT n° 2013-1-IT1-LEO05-04065 cod. CUP: G63D13000380006

ECVET system for no borders in the Green Economy sector

supporting Employability, Adaptability and European Mobility in VET systems and Labour Market

PROFESSIONAL PROFILE - RO
R.3.3

Project title	ECVET system for no borders in the Green Economy sector supporting Employability, Adaptability and European Mobility in VET systems and Labour Market
Project Acronym	ECOVET
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UNIUNEA EUROPEANĂ | GUVERNUL ROMANIEI MINISTERUL MUNCII, FAMILIEI ŞI PROTECŢIEI SOCIALE AMPOSDRU | Fondul Social European POSDRU 2007-2013 | Instrumente Structurale 2007-2013 | OIPOSDRU | Centrul Naţional de Dezvoltare a Învăţământului Profesional şi Tehnic

Investeşte in oameni !
FONDUL SOCIAL EUROPEAN
Programul Operaţional Sectorial Dezvoltarea Resurselor Umane 2007 – 2013
Axa prioritară:1 "Educaţia şi formarea profesională in sprijinul creşterii economice şi dezvoltării societăţii bazate pe cunoaştere"
Domeniul major de intervenţie 1.1 "Accesul la educaţie şi formare profesională iniţială de calitate"
Titlul proiectului: **"Curriculum Revizuit in Învăţământul Profesional şi Tehnic (CRIPT)"**
Numărul de identificare al contractului: POSDRU/85/1.1/S/58832

MINISTRY OF EDUCATION, RESEARCH, YOUTH AND SPORTS

NATIONAL CENTRE FOR DEVELOPMENT OF TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING

VOCATIONAL TRAINING STANDARD

Qualification:
Technician operator of renewable power systems

Level 3

Vocational training area:
Electric

2012

AUTHORS:

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ASISTENŢĂ C.N.D.I.P.T.
ANGELA POPESCU – specialist inspector, C.N.D.I.P.T.

Description of the Qualification
This qualification develops the skills and attitudes that permit the graduate to install and commission electrical equipment and plant used in *wind or photovoltaic power stations*, to operate, maintain and repair such electrical plant and equipment, in compliance with the health and safety and fire fighting laws and regulations, assuming the responsibilities and roles in the team, developing his/her workplace decision making and problem solving capacity, and building attitudes such as correctness, respect, self-confidence and job satisfaction.

ROF occupations:

- 313113-Operator of renewable power systems
- 313101-Operator of electrical power plant

Qualification units:

- **GENERAL TECHNICAL UNITS**

1. Using automation systems in processes.
2. Constructing electrical drive systems.
3. Production planning.

- **SPECIALIST TECHNICAL UNITS**

4. Operating photovoltaic power systems
5. Operating wind power systems

The qualification „Technician operator of renewable power systems" integrates the following key skills areas:
1. communication in Romanian and mother tongue;
2. communication in foreign languages;
3. mathematics, science and technology skills;
4. IT skills;
5. learning to learn;
6. citizenship and social skills;
7. initiative and entrepreneurship;
8. sensitivity to culture and cultural expression.

These skills are to be:
- developed and diversified in the vocational training process;
- assessed in the continuous (current) and summative evaluation process;
- mentioned in the qualification of the graduates.

The qualification level in Romania and the corresponding EQF level, as per the National Qualifications Framework and the European Qualifications Framework:
- qualification level in Romania – 3
- qualification level EQF – 5.

Final aim of qualification:
- employment in one of the occupations listed above;

- further education towards a different qualification / level 4 or 5 qualifications of the National Qualifications Framework, namely: master of trade, post-high school programme or higher education.

➢ The qualification is NOT included in the *Register of Vocational Qualifications* HG Nr. 866/ 2008 amending *H G nr. 844/2002* ANNEX 3.

Integrating table of the Units with the specific skills for the potential occupations

Unit Qualification in TVET	**Skills proposed by employers in the TVET qualification**
1. Using automation systems in processes. 2. Constructing electrical drive systems 3. Production planning	➢ Apply with H&S, fire fighting and environmental protection regulations ➢ Interactive communication at the workplace ➢ Team coordination ➢ Quality procedures ➢ Planning and organising work stages ➢ Pegg-out and install components in the field ➢ Correlate operations, measurements and checks with the technical documentation ➢ Apply basic design elements ➢ Comply with the relevant laws and regulations
4. Operating photovoltaic power systems	➢ Measuring solar radiation ➢ Determine the optimal system configuration depending on the application ➢ Measuring the operating parameters of the photovoltaic generator ➢ Apply specific standardization systems ➢ Coordinate installation of photovoltaic panels and protection devices of the photovoltaic generator. ➢ Apply troubleshooting procedures in photovoltaic cells
5. Operating wind power systems	➢ Determine the optimal configuration of the wind power system ➢ Apply specific standardization systems ➢ Coordinate installation of wind turbines ➢ Coordinate installation of the electric generator and related electrical equipment ➢ Apply troubleshooting procedures in wind power systems ➢ Coordinate the maintenance of wind turbines equipment

Unit 1:

USING AUTOMATION SYSTEMS IN PROCESSES

Credits:

Learning outcomes:

Knowledge	Skills	Attitudes
1.1.1. Automation systems: - applications, - types of processes, - types of automation.	**1.2.1.** Selecting the type of automation depending on the application and process	***1.3.1.*** *Assuming a team role and team working.*
1.1.2. Automatic control system (ACS): - Components: regulator, actuator, transducer (classification, functional role, operating principle), - System measurable variables; - Information flow (direct, reverse) - Monitoring the variation of controlled variables (outputs, electrical and non-electrical).	**1.2.2.** Selecting the ACS components depending on the process: - Automated regulator, - Actuator, - Transducer. **1.2.3.** Interpreting the variations of the controlled variables in the information flow. ***1.2.4.*** *Monitoring automated parameters.*	***1.3.2.*** *Proactive performance of a given work task.* ***1.3.3.*** *Complying with process flows and deadlines.* ***1.3.4.*** *Efficient use of working time.* ***1.3.5.*** *Proactive solving of a work task*
1.1.3. Automated control systems of process parameter (components, use): - Temperature control, - Flow control, - Speed/rotation control, - Pressure control, - Fluid level control.	**1.2.5.** Using automated control systems of process parameter: - Temperature, - Flow, - Speed/rotation, - Pressure, - Fluid level..	**1.3.5.** Responsibility for the quality of work. **1.3.6.** Supporting decisions taken in the work performed. **1.3.7.** Complying with workplace procedures.
1.1.4. Sources of information and learning for automated control systems and components.	***1.2.6.*** *Learning about automated regulation and components, including in a foreign language.*	
1.1.5. PLC's: - structure - elements of programming language - use	**1.2.7.** Using PLC's in automated systems ***1.2.8.*** *Using educational software* ***1.2.9.*** *Learning about PLC's*	
1.1.6. Educational software for PLC's **1.1.7.** Sources of information and learning for PLC's	***1.2.10.*** *Correct use of specialist language in workplace communication.* ***1.2.11.*** *Communicating the outcomes of work performed.*	

The general technical unit **„Using automation systems in processes"** integrates the following key skills areas:

- **Communication in Romanian and the mother language:**
  Correct use of specialist language in workplace communication.
  Communicating the outcomes of work performed.
- **Mathematics, science and technology skills:**

Monitoring automated parameters (outputs, electrical and non-electrical).

- **Citizenship and social skills**:
  Assuming a team role and team working.
  Complying with process flows and deadlines.
- **Initiative and entrepreneurship**
  Proactive solving of a work task.
  Efficient use of working time.
- **IT skills**
  Using educational software.
- **Communication in a foreign language**
  Learning about automated regulation and components, including in a foreign language.
  Learning about PLC's.

Minimum equipment for ensuring quality of training (required at school or employer):

1. **Components of automated control systems**: transducers, regulators, amplifiers, actuators.
2. **Laboratory equipment (teaching test stand)** for determining the characteristic parameters of automated systems
3. **Automated control systems** for process parameters
4. **Educational software**
5. Electrician's tools kit, multi-meter
6. Personal protective equipment

Evaluation standard for the Unit:

1. Required materials and equipment:

a. **Components of automated control systems**: transducers, regulators, amplifiers, actuators.
b. **Laboratory equipment (teaching test stand)** for determining the specific parameters of automated systems.
c. **Automated control systems** for process parameters.
d. Electrician's tools kit, multi-meter.
e. Personal protective equipment.

2. Performance criteria and indicators and their weight

No.	Performance criteria and their weight		Performance indicators and their weight	
1.	Receiving and planning the task	35%	Review task and formulate solution	30%
			Learning about automated control systems and components	30%
			Selecting ACS components depending on the process	40%
2.	Carrying out the task	50%	Monitoring automated parameters	30%
			Interpreting the variation of variables in ACS	30%
			Using automated control systems if parameters	40%
3.	Presenting and promoting the achieved task	15%	Supporting decisions taken in the work performed	50%
			Correct use of specialist language for communicating the outcomes of work performed	50%

Unit 2:

CONSTRUCTING ELECTRICAL DRIVE SYSTEMS

Credits:

Learning outcomes:

Knowledge	Skills	Attitudes
2.1.1. Electrical drive systems: structure	**2.2.1.** Representation of de electrical drive systems.	***2.3.1.*** *Assuming a team role and team working.*
2.1.2. Electrical devices in drive systems – automated switchgear, electromagnetic relays, signalling devices: - classification, - rated parameters, - construction, - operation, - usage	**2.2.2.** Selecting electrical devices for building a drive depending on the rated parameters, , construction etc.	***2.3.2.*** Responsibility for the quality of work; ***2.3.3.*** Supporting decisions made on work performed. ***2.3.4.*** Ownership of individual work plan.
2.1.3. Electrical drive motors: - classification, - rated parameters,, - construction, - operating principle, - (electro) mechanical characteristics, - selection criteria for use in drive systems, - heat and electrical stress.	**2.2.3.** Analysing the (electro)mechanical characteristics of the drive system rotation variation at constant torque **2.2.4.** Determining the characteristics of the drive motor for a given machine **2.2.5.** *Determining the rated parameters of the drive motor depending on the machine* **2.2.6.** Selecting the electrical motor for building a drive system for a machine depending on given criteria. **2.2.7.** *Heat and electrical checks on the drive motor*.	***2.3.5.*** Efficient use of working time. ***2.3.6.*** Quality assurance of work performed. ***2.3.7.*** *Complying with process flows and deadlines.* ***2.3.8.*** *Complying with H&S standards.* ***2.3.9.*** *Proactive performance of a given work task.*
2.1.4. Catalogues of electrical parts made in Romania or abroad (electrical apparatuses, electrical motors, wires and conductors)	**2.2.8.** *Reading electrical parts catalogues, including in a foreign language.*	
2.1.5. Documents for electrical drive systems: - Drawings of electrical drive systems with AC and DC motors (start-up, rev control, breaking), - Electrical installation drawings, - Connection drawings, - Cable list, - List of equipment.	**2.2.9.** *Reading electrical drive drawings.* **2.2.10.** Producing electrical installation drawings for a given electrical drive blueprint **2.2.11.** *Assessing the technical and operational characteristics of the components of a drive system in reference to the specs in the electrical parts catalogue.* **2.2.12.** *Producing the documentation for a drive system using IT&C.*	

2.1.6. Drive system building technology in accordance with the documentation: - Fitting components of drive systems, - Wiring components of the drive systems, - Materials, - TDV and measurement and control equipment, - H&S/operation.	**2.2.13.** Selecting TDV and measurement and control equipment. **2.2.14.** Installing the components of a drive system. **2.2.15.** Wiring the components of a drive system.	
2.1.7. Procedures for checking the operation of electrical drive systems: - measurement and control equipment, - H&S.	**2.2.16.** Checking the operation of electrical drive systems using a measurement and control equipment. **2.2.17.** *Correct use of specialist language in workplace communication.* **2.2.18.** *Waste collection to minimise environmental impact.* **2.2.19.** *Recovery and use of electrical materials.*	

General technical unit **„Constructing electrical drive systems"** integrates the following key skills areas:

- **Communication in Romanian and the mother language:**
  Correct use of specialist language.
  Preparing technical documentation for submission to the supervisor.
- **Communication in a foreign language**
  Reading electrical parts catalogues, including in a foreign language.
- **Mathematics, science and technology skills:**
  Assessing the technical and operational characteristics of the components of a drive system in reference to the specs in the electrical parts catalogue.
  Reading circuit drawings of drive systems.
  Determining the rated parameters of the drive motor for a given machine
- **IT skills:**
  Producing the documentation for a drive system using IT&C.
- **Citizenship and social skills:**
  Complying with process flows and deadlines.
  Assuming a team role and team working.
  Complying with H&S standards
  Waste collection to minimise environmental impact.
  Recovery and reuse of electro-technical materials.
- **Initiative and entrepreneurship:**
  Proactive performance of a given work task.

Minimum equipment for ensuring quality of training (available at school or employer):

1. **Electrical devices**: switching, control, adjustment, signalling, protection, automation, low power transformers.
2. **Electrical motors**: asynchronous, synchronous, continuous current, linear, stepper.
3. **Laboratory equipment (teaching test stand)** for determining the (electro)mechanical parameters of electrical drive motors.
4. Electrician's tools kit, portable drill, multi-meter.
5. Computer/ network.
6. **Materials and accessories** for practical work (cables, conductors, connectors, cable sockets, labels etc.)

Evaluation standard for the Unit:

1. **Required materials and equipment:**
   a. **Electrical devices**: switching, control, adjustment, signalling, protection, automation, low power transformers.
   b. **Electrical motors**: asynchronous, synchronous, continuous current, linear, stepper.
   c. **Laboratory equipment (teaching test stand)** for determining the (electro)mechanical parameters of electrical drive motors.
   d. Electrician's tools kit, portable drill, multi-meter.
   e. Computer/network.
   f. **Materials and accessories** for practical work (cables, conductors, connectors, cable sockets, labels etc.)

2. **Performance criteria and indicators and their weight:**

No..	Performance criteria and their weight		Performance indicators and their weight	
1.	Receiving and planning the task	35%	Review task and formulate solution	50%
			Selecting the components of the electrical drive system	40%
			Determining the characteristics of the drive motor for a given machine	10%
2.	Carrying out the task	50%	Selecting tools and devices required for building a drive system	10%
			Constructing electrical drive systems	40%
			Checking the operation of electrical drive systems using a measurement and control equipment	20%
			Compliance with environmental protection and health and safety regulations	10%
			Complying with process flows and deadlines	20%
3.	Presenting and promoting the achieved task	15%	Producing the documentation for a drive system using IT&C.	60%
			Correct use of specialist language in the communication process	40%

Unit 3:

PRODUCTION PLANNING

Credits:

Learning outcomes:

Knowledge	Skills	Attitudes
3.1.1. Production process: - production process characteristics; - classification of production processes; - components of the production process; - correlations between the components of the production processes.	**3.2.1.** Analysing a typical production process from the perspective of: - Process characteristics; - Manner of production; - Nature of activities; - Time scheduling. **3.2.2.** identifying the elements of a typical electrical production process. **3.2.3.** Correlating inputs/resources in a production process and manufacturing stages with outputs/expected outcomes. **3.2.4.** *Correct use of specialist language to describe the structure of a production process or production planning methods.*	***3.3.1.*** *Taking responsibility in selecting and planning a production process.* ***3.3.2.*** Critical thinking in determining the inputs to a production process and the process stages, in correlation with the required outputs. ***3.3.3.*** *Taking responsibility for the assigned work task.*
3.1.2. Types of production (features, strengths, weaknesses) - individual production; - series production; - mass production.	**3.2.5.** Identification of types of production in depending on the variety of products, production volume, specialisation of operations, layout of workstations and internal transportation methods. **3.2.6.** Assessing the strengths and weaknesses of various types of production for a given context. **3.2.7.** Comparison of production organisation methods.	***3.3.4.*** Decision making in selecting a particular type of production in a given situation. ***3.3.5.*** Creative problem solving in organising production. ***3.3.6.*** Using automation as a method for production organisation.
3.1.3. Methods for organising the main production: - in flow; - by homogenous groups of machines and plant; - manufacturing cells; - automated.	**3.2.8.** *Applying production organisation methods for a given context.* **3.2.9.** Determining the stages of production planning and organisation.	***3.3.7.*** *Taking responsibility for completing/using production planning, launching and monitoring documents.* ***3.3.8.*** *Proactive problem solving in organising production.*
3.1.4. Production planning/scheduling - scheduling, preparing, launching and monitoring production; - planning materials and personnel; - documents used in planning workplace activities	**3.2.10.** *Determining the required materials and personnel for a given context.* **3.2.11.** Drawing operations planning graphs. **3.2.12.** *Using dedicated software for production planning.* **3.2.13.** *Using and/or completing documents for planning, launching and monitoring production in a given context (materials orders, work orders by operation or part, bills of work; bills of*	***3.3.9.*** *Teamwork to launch and monitor production.* ***3.3.10.*** *Responsibility for the outcomes of the assessment of the production processes.*

(documents for production launch, production sheet, graphs, diagrams etc.). **3.1.5.** Productivity indicators **3.1.6.** Methods for increasing production efficiency	*materials; part or product sheet, product movement schedules, operations sheets, diagrams etc.) using IT&C.* **3.2.14.** *Calculating the work productivity indicators.* **3.2.15.** Assessing a production process based on the work productivity indicators in view of increasing production efficiency. **3.2.16.** Analysing the methods of increasing production efficiency and selecting the optimal solution. **3.2.17.** *Communicating the outcomes of work performed.*	***3.3.11.*** Applying solutions for increasing production efficiency. ***3.3.12.*** *Compliance with rules, assuming team roles and teamwork*

The general technical unit **„Production planning"** integrates the following key skills areas:

- **Communication in Romanian and the mother language:**
  Correct use of specialist language to describe the structure of a production process or production planning methods;
  Communicating the outcomes of work performed;
- **Mathematics, science and technology skills:**
  Determining the required materials and personnel for a given context.
  Calculating the work productivity indicators.
- **IT skills:**
  Using dedicated software for production scheduling;
  Using and/or completing documents for planning, launching and monitoring production in a given context (materials orders, work orders by operation or part, bills of work; bills of materials; part or product sheet, product movement schedules, operations sheets, diagrams etc.) using IT&C
- **Citizenship and social skills:**
  Taking responsibility in selecting and planning a production process.
  Taking responsibility for the assigned work task.
  Teamwork to launch and monitor production.
  Taking responsibility for completing/using production planning, launching and monitoring documents.
  Compliance with rules, assuming team roles and teamwork
- **Initiative and entrepreneurship:**
  Responsibility for the outcomes of the assessment of the production processes.
  Proactive solving of production planning specific problems.

Minimum equipment for ensuring quality of training (available at school or employer):

1. computer/network, video projector;
2. field-specific production process films;
3. dedicated software for production organisation and planning

Evaluation standard for the Unit:

1. **Required materials and equipment**
   1. course support materials, worksheets and video-audio materials with field specific production processes;
   2. computer/network, video projector;
   3. dedicated software for production organisation and planning
   4. standard documents and forms used in production organisation and planning (process sheets, product sheets, graphs, diagrams, plans)

2. **Performance criteria and indicators and their weight:**

No..	Performance criteria and their weight		Performance indicators and their weight	
1.	Receiving and planning the task	50%	Reviewing the situation for carrying out the task	30%
			Determining the production process inputs depending on the expected outcomes	40%
			Determining the production organisation method for a given situation	30%
2.	Carrying out the task	35%	Determining the stages in the organisation of production activities	20%
			Determining the required materials and personnel for a specific production process	20%
			Applying the selected production organisation method	40%
			Completing the documents required for planning, launching and monitoring production	20%
3.	Presenting and promoting the achieved task	15%	Supporting the choice of production organisation method	30%
			Evaluating the productivity indicators and proposing solutions increasing efficiency	30%
			Adequate use of specialist vocabulary for describing the production process and method of organisation used	40%

Unit 4:

OPERATING PHOTOVOLTAIC POWER SYSTEMS

Credits:

Learning outcomes:

Knowledge	Skills	Attitudes
4.1.1. Global policies in renewable energy sources. **4.1.2.** Romania's policy in renewable energy sources **4.1.3.** Solar energy. - Solar constant; - Flux density at ground level; - Flux density on variable gradient areas; - Solar radiation measuring equipment; **4.1.4.** Solar panels - operating principle; - equivalent circuit diagrams; - parameters of the photovoltaic cell; - influences of illumination and temperature; **4.1.5.** Types of applications in solar power generation - Specific components - Design elements - Sources of information on the types of solar applications **4.1.6.** Requirements for the layout of solar plant - criteria for maximising solar power generation; - solar panel tilt and alignment; **4.1.7.** Internal electrical network in solar plant: **4.1.8.** Symbols used in continuous or alternative current diagrams of	***4.2.1.*** *Reviewing global and national policies on non-polluting power sources* **4.2.2.** Using the national law opportunities for building solar power plants ***4.2.3.*** *Measuring solar radiation for deciding the location of solar power plants.* ***4.2.4.*** *Determining the parameters of a solar cell* **4.2.5.** Connecting solar components circuitry (series, parallel) ***4.2.6.*** *Using primary design elements for designing a solar power plant:* - *Distance between arrays,* - *Sizing the plant* - *Calculating currents and voltages* - *Determining the optimal system configuration depending on the application.* ***4.2.7.*** *Learning about various types of photovoltaic applications* **4.2.8.** Determining the optimal system configuration depending on the application and the location. ***4.2.9.*** *Correct use of specialist language in workplace communication.* **4.2.10.** Reading / preparing circuitry schemes for solar cell plant	**4.3.1.** *Proactive problem solving* **4.3.2.** Identifying solutions for dealing with team problems; **4.3.3.** Complying with the working times as per the established work schedule; **4.3.4.** *Taking responsibility for the work task assigned as part of the team.* **4.3.5.** *Compliance with process discipline* **4.3.6.** *Team working in view of carrying out the workplace tasks*

solar panel plant; - diagrams of AC and DC solar panel plant. - components of solar plant (cables, power conditioners, protection systems, invertors) **4.1.9.** Fitting / installation / verification and alignment technologies for solar panels and solar generator protections: - TDV used, - materials, - measurement and control equipment - quality standards for work on solar plant. **4.1.10.** Maintenance and checks in solar plants: - Required operations - materials, - TDV, - measurement and control equipment. **4.1.11.** Troubleshooting by specific measurements in solar plants. - Types , - Causes. **4.1.12.** Specific health and safety regulations.	**4.2.11.** *Applying specific standardisation systems* **4.2.12.** Selecting the components of solar plant. **4.2.13.** Applying specific internal work instructions for power generation; **4.2.14.** Coordinating installation work (solar panels, cabling, power conditioners, protections, invertors). **4.2.15.** Checking operating parameters. **4.2.16.** *Communicating / reporting outcomes of work performed* **4.2.17.** *Quality assurance of work performed.* **4.2.18.** Drafting the bill of materials for maintenance work **4.2.19.** Coordinating maintenance work in solar power plants. ***4.2.20.*** *Interpreting the readings of measurements of solar plant parameters.* **4.2.21.** Applying H&S regulations	**4.3.7.** Complying with workplace procedures **4.3.8.** Compliance with quality requirements for work performed; **4.3.9.** *Active communication in the team, irrespective of the ethnic background of members* **4.3.10.** Compliance with H&S and fire fighting standards

The unit **Operating photovoltaic power systems** integrates the following key skills areas:

- **Communication in Romanian and mother language**
  Correct use of specialist language in workplace communication.
  Communicating / reporting outcomes of work performed.
- **Mathematics, science and technology skills**
  Measuring solar radiation for deciding the location of solar power plants.
  Using primary design elements for designing a solar power plant:
  - Distance between arrays,
  - Sizing the plant
  - Calculating currents and voltages
  - Determining the optimal system configuration depending on the application.

  Determining the parameters of a solar cell
- **Citizenship and social skills**
  Taking responsibility for the work task assigned as part of the team

Compliance with process discipline
Team working in view of carrying out the workplace tasks

- **Learning to learn**
  Learning about various types of photovoltaic applications
- **Initiative and entrepreneurship**
  Proactive problem solving
- **Awareness of culture and cultural expression**
  Active communication in the team, irrespective of the ethnic background of members

Minimum equipment for ensuring quality of training (available at school or employer):

1. Solar panels: detached, integrated
2. Electrical components: cables, invertors, switchboard, surge and over-voltage protection, junction box, battery bank;
3. TDV for checking and maintaining solar plant components.

Evaluation standard for the Unit:

1. Required materials and equipment

- Solar panels: detached, integrated
- Electrical components: cables, invertors, switchboard, surge and over-voltage protection, junction box, battery bank;
- TDV for checking and maintaining solar plant components.

2. Performance criteria and indicators and their weight

No..	Performance criteria and their weight		Performance indicators and their weight	
1.	Receiving and planning the task	35%	Review task and formulate solution	50%
			Selecting the photovoltaic system components	40%
			Determining the location / layout characteristics	10%
2.	Carrying out the task	50%	Selecting the tools and devices required for building a solar system	10%
			Applying the specific technology for building solar systems	40%
			Checking the operation of solar systems using measurement and control equipment	20%
			Compliance with environmental protection and health and safety regulations	10%
			Complying with process flows and deadlines	20%
3.	Presenting and promoting the achieved task	15%	Preparing documentation using IT&C	60%
			Correct use of specialist language in the communication process	40%

Unit 5:

OPERATING WIND POWER SYSTEMS

Credits:
Learning outcomes:

Knowledge	Skills	Attitudes
1.1.1. Assessing wind potential: - Assessing average power; - Selecting the location; - Reviewing layout plans, installed power, types of turbines, foundations etc.	**5.2.1.** Determining the optimal configuration of wind power conversion plant **5.2.2.** Applying field –specific standardisation systems	***5.3.1.*** *Proactive decision making;* **5.3.2.** using working time in compliance with the work schedule
1.1.2. Sources of information on wind farms	**5.2.3.** *Finding information about wind plants from various sources* **5.2.4.** Selecting the components of a wind farm	**5.3.3.** Keeping technical documentation, measurement equipment and toolkits in standard conditions;
1.1.3. Wind power plant / farms: - Components; - Operation regimes.	**5.2.5.** *Correct use of specialist language* **5.2.6.** Coordinating the installation of wind turbines **5.2.7.** Coordinating the installation of the generator and related electrical equipment	***5.3.4.*** *Taking responsibility for the work task assigned as part of the team*
1.1.4. Fitting / installation / verification processes for wind turbines and related electrical equipment: - Switchgear, - Protection and signalling devices, - Measurement equipment	**5.2.8.** Connecting wind farms to the SEN ***5.2.8.*** *Communicating the outcomes of work performed* **5.2.9.** Correct filling-in of technical records	**5.3.5.** Compliance with process discipline ***5.3.6.*** *Team working in view of carrying out the workplace tasks*
	5.2.10. Applying troubleshooting procedures in wind power conversion plants **5.2.11.** Coordinating maintenance of wind turbines and equipment	***5.3.7.*** *Proactive problem solving* **5.3.8.** Identifying solutions for dealing with team problems;
1.1.5. Maintenance and checks on wind plant / farms: - Required operations, - Materials, - TDV, - measurement and control equipment	**5.2.12.** *Interpreting the readings if measurements on wind plant.* **5.2.13.** Applying the quality standards for work carried out; **5.2.14.** Applying H&S and fire fighting regulations	**5.3.9.** Complying with working times as per the established work schedule; ***5.3.10.*** *Compliance with process discipline* **5.3.11.** Complying with workplace procedures
1.1.6. Troubleshooting by specific measurements in wind plants / farms. - Types,		**5.3.12.** Compliance with H&S and fire fighting standards

- Causes. **1.1.7.** Specific H&S and fire fighting regulations.		

The unit **Operating wind power systems** integrates the following key skills areas:

- **Communication in Romanian and mother language**
  Correct use of specialist language
  Communicating / reporting outcomes of work performed.
- **Citizenship and social skills**
  Taking responsibility for the work task assigned as part of the team
  Compliance with process discipline
  Team working in view of carrying out the workplace tasks
- **Learning to learn**
  Finding information about wind plants from various sources
- **Initiative and entrepreneurship**
  Proactive decision making
  Proactive problem solving

Minimum equipment for ensuring quality of training (available at school or employer):

1. Installed wind generators (in operation);
2. Measurement equipment: ampere-meters, volt-meters, watt-meters, power factor meter, meters (active and reactive power) phase meters, chronometers, gradient-metre, Schering bridge, recorders (power, energy);
3. Measuring devices: power, energy, current intensity and voltage in three-phase systems;
4. Protection and signalling devices: short-circuit, overload, over-voltage and related signalling;
5. Records: verification reports, registers;
6. Apparatuses, kits, prophylactic measurement and test equipment as per the energy generation standards;

Evaluation standard for the Unit:

1. Required materials and equipment

Installed wind generators (in operation); Measurement equipment: ampere-meters, volt-meters, watt-meters, power factor meter, meters (active and reactive power) phase meters, chronometers, gradient-metre, Schering bridge, recorders (power, energy); Protection and signalling devices: short-circuit, overload, over-voltage and related signalling; Records: verification reports, registers;

2. Performance criteria and indicators and their weight

No..	Performance criteria and their weight		Performance indicators and their weight	
1.	Receiving and planning the task	35%	Review task and formulate solution	50%
			Selecting the components of the wind system	40%

			Determining the characteristics of the wind system	10%
2.	Carrying out the task	50%	Selecting the tools and devices required for building a wind system	10%
			Applying the technology for building wind power electricity generation systems	40%
			Checking the operation of electrical drives using measuring and control equipment	20%
			Compliance with environmental protection and health and safety regulations	10%
			Complying with process flows and deadlines	20%
3.	Presenting and promoting the achieved task	15%	Preparing the documentation for a drive system using IT&C	60%
			Correct use of specialist language in communication	40%

The learning outcomes specific for mathematics and communication required for achieving the Level 3 qualification ***Technician operator of renewable power systems*** are:

Subject matter	**Learning outcomes**
Romanian language and literature	Efficient communication in Romanian
	Understanding written text / reading
Foreign language	Efficient communication in foreign language
	Understanding written text / reading
Mathematics	Basic arithmetical operations for simple algebraic calculations using rational numbers (addition, subtraction, multiplication, division, use of parentheses, simple algebraic fractions, powers, radicals, linear equations, graphic representation of linear and quadratic function).
	Basic trigonometry (defining the elementary trigonometric functions in right angle triangles and their values for 0°, 30°, 45°, 60°, 90°, 180°).
	Basic plane geometry (surface area of plane figures – triangle, parallelogram, circle area).
	Basic spatial geometry (identifying various bodies and the shapes resulting from their cross sections)
Physics	Physical parameters and measurement units
	Physical phenomena in electricity (electrostatics – electrification of bodies, voltage, electro-kinetics – electrical current) and electromagnetism (electromagnetic force, electrical motor, electromagnetic induction, alternator).
	Ohm law, Joule law.
Chemistry	Symbols of chemicals
	Microscopic structure of substances
Civic culture	Respect for rules and regulations
	Autonomy
	Initiative

	Team work
	Accountability
Technology education	Specific physical – chemical characteristics of conductive and non-conductive materials (copper, aluminium, silver, wolfram, paper, cotton, silk, glass, mica, asbestos, lacquers, enamels, resins)
	Applying technical drawing standards and rules
	Electrical household consumers

GLOSSARY OF ABBREVIATIONS

ROF	ROF	Romanian occupation framework
EQF	EQF	European Qualifications Framework
TVET	TVET	Technical and vocational education and training
NTSM	H&SS	Health and safety standards
NSSM	H&SS	Health and safety standards
Ing. prof.	Ing. prof.	Engineer, Professor
PSI	Fire fighting	Fire fighting
OS	OS	Occupational standard
SSM	H&S	Health and safety
WS	WS	Work safety
TDV	TDV	Tools, devices and verifiers
CC	CC	Continuous current
AC	AC	Alternative current
LV	LV	Low voltage
CT	CT	Current transformer
VT	VT	Voltage transformer
Unit	Unit	Unit

TRANSFER OF INNOVATION, MULTILATERAL PROJECTS, LEONARDO DA VINCI - LIFELONG LEARNING PROGRAMME (2007-2013)
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MINISTRY OF EDUCATION, RESEARCH, YOUTH AND SPORTS

NATIONAL CENTRE FOR DEVELOPMENT OF TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING

VOCATIONAL TRAINING STANDARD

Qualification:
Fitter of electrical operation systems for renewable power sources

Level 2

Vocational training area:
Electric

2012

Authors:

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C.N.D.I.P.T. SUPPORT:
ANGELA POPESCU – specialist inspector, curriculum expert

Description of the Qualification:

Fitter of electrical operation systems for renewable power sources is competent to fit plant and equipment for the conversion of renewable power sources (sun and wind) into electricity, to maintain them and fix defects that may occur in their operation, in compliance with the health and safety rules and regulations, fire prevention and fighting, taking up responsibility and roles in the team, developing his/her decision making and problem solving skills at the workplace.

Renewable power sources (sun, wind, geothermal, water, biomass, waves, biogas) are becoming the main power sources and require the development of new skills for new jobs.

ROF occupations:
-741103 Fitter for photovoltaic sun systems
-741105 Fitter of sun power plant

Qualification units:

- **GENERAL TECHNICAL UNITS**

1. Building mechanical components of electrical plant
2. Measuring electrical values in plant
3. Installing electrical wiring
4. Fitting, maintaining and repairing Fitting, maintaining and repairing low voltage electrical equipment

- **SPECIALIST TECHNICAL UNITS**

1. Fitting and maintaining photovoltaic plant.
2. Fitting and maintaining wind power plant.

The qualification *Fitter of electrical operation systems for renewable power sources* integrates the following key skills areas:

9. communication in Romanian and mother tongue;
10. communication in foreign languages;
11. mathematics, science and technology skills;
12. IT skills;
13. learning to learn;
14. citizenship and social skills;
15. initiative and entrepreneurship;
16. sensitivity to culture and cultural expression.

These skills are to be:

- developed and diversified in the vocational training process;
- assessed in the continuous (current) and summative evaluation process;
- mentioned in the qualification of the graduates.

The qualification level in Romania and the corresponding EQF level, as per the National Qualifications Framework and the European Qualifications Framework

- qualification level in Romania – 2
- qualification level EQF – 3.

Final aim of qualification:

- employment in one of the occupations listed above;
- further education towards a different qualification / level 3 qualifications of the National Qualifications Framework (e.g.: power generation technician, electrical ălant technician, electrical technician, metrology technician).

- The qualification is NOT included in the *Register of Vocational Qualifications* HG Nr. 866/ 2008 amending *H G nr. 844/2002* ANNEX 3, for which training is provided in pre-university education system for 2 years.

Integrating table of the Units with the specific skills for the potential occupations:

Unit **Qualification in TVET**	**Skills proposed by employers in the TVET qualification**
1. Building mechanical components of electrical plant	➢ Apply H&S and fire fighting standards ➢ Communication at the workplace ➢ Team work ➢ Adaptability
2. Measuring electrical values	➢ Apply H&S and fire fighting standards ➢ Communication at the workplace ➢ Team work ➢ Apply quality procedures
3. Installing electrical wiring	➢ Apply H&S and fire fighting standards ➢ Communication at the workplace ➢ Team work ➢ Adaptability ➢ Apply quality procedures ➢ Making electrical connections to the power gird (independent, national) and the user wiring (for buildings) ➢ Wiring electrical connections in the electrical plant of the low power wind generators
4. Fitting, maintaining and repairing low voltage electrical equipment	➢ Apply H&S and fire fighting standards ➢ Communication at the workplace ➢ Team work ➢ Adaptability ➢ Apply quality procedures ➢ Fitting D.C. cables ➢ Fitting power conditioning equipment ➢ Fitting over-voltage protection systems (thunder rods, arresters, grounding devices);

	➢ Making electrical connections to the power gird (independent, national) and the user wiring (for buildings) ➢ Maintaining photovoltaic cell plant ➢ Repairing sun plant defects ➢ Maintaining wind turbine plant ➢ Repairing wind plant defects
5. Fitting and maintaining photovoltaic plant.	➢ Apply H&S and fire fighting standards standards ➢ Communication at the workplace ➢ Team work ➢ Adaptability ➢ Apply quality procedures ➢ Installing photovoltaic panels ➢ Fitting D.C. cables ➢ Fitting power conditioning equipment ➢ Fitting over-voltage protection systems (thunder rods, arresters, groundings); ➢ Making electrical connections to the power gird (independent, national) and the user wiring (for buildings) ➢ Maintaining photovoltaic cell plant ➢ Repairing sun plant defects
6. Fitting and maintaining wind power plant.	➢ Apply H&S and fire fighting standards ➢ Communication at the workplace ➢ Team work ➢ Adaptability ➢ Apply quality procedures (understand and comply with blueprints) ➢ Fitting wind turbines ➢ Fitting wind generators ➢ Wiring the electrical equipment of low power wind generators ➢ Connecting over-voltage protection systems ➢ Maintaining wind turbine plant ➢ Repairing wind plant defects

Unit 1:
BUILDING MECHANICAL COMPONENTS OF ELECTRICAL PLANT

Credits:

Learning Outcomes:

Knowledge	Skills	Attitudes
1.1.1. Ergonomic requirements at the workplace. **1.1.2.** Materials required for making parts by fitters: - Physical-chemical properties, - Mechanical properties - Technological properties, - Standard symbols, - Scope of usage. **1.1.3.** Drawing standards (sketches and scale drawings) for process specifications: **1.1.4.** General fitting operations (cleaning, straightening, setting out, cutting, bending, boring, punching out, threading, dismountable and fixed assemblies): - operations, - tools, devices, verifiers (TDV), - measuring devices, - H&S/operation. **1.1.5.** Workplace hazard warning means (warning signs). **1.1.6.** Environmental protection and waste management rules	**1.2.1.** Ergonnomical organisation of te workplace **1.2.2.** Selecting the materials required for making parts by fitter operations, depending on their respective physical chemical and technological properties. **1.2.3.** Understanding standard symbols of materials used in making parts. **1.2.4.** Making drawings for simple parts, items, subassemblies. ***1.2.5.*** *Interpreting graphic representations in the process specifications.* **1.2.6.** Selecting the TDV's required for each fitting operation to be carried out. **1.2.7.** Supplying the materials required for each operation. **1.2.8.** Carrying out operations: - cleaning, - straightening, - setting out, - cutting, - bending, in compliance with the process requirements. **1.2.9.** Making dismountable and fixed assemblies in compliance with the process requirements. **1.2.10.** Interpreting workplace warnings. **1.2.11.** Waste management for	***1.3.1.*** *Teamwork to carry out tasks at the workplace.* ***1.3.2.*** *Taking responsibility for the task as part of the team at the workplace.* ***1.3.3.*** *Using work and protective equipment specific to the workplace.* ***1.3.4.*** Compliance with H&S regulations. ***1.3.5.*** *Compliance with electrocution protection standards.* ***1.3.6.*** Compliance with workplace ergonomic standards. ***1.3.7.*** Compliance with workplace hazard warnings. ***1.3.8.*** *Compliance with the rules for environmental protection and selective collection of waste.* ***1.3.9.*** *Proactive problem solving.*

	environmental protection **1.2.12.** Materials recovery and reuse. ***1.2.13.*** *Correct use of specialist language in workplace communication* **1.2.14.** *Communicating the outcomes of work performed*	

The general technical unit „**Building mechanical components of electrical plant"** integrates the following key skills areas:

- **Communication in Romanian and the mother language:**
  Correct use of specialist language in workplace communication.
  Communicating the outcomes of work performed.
- **Mathematics, science and technology skills**
  Interpreting graphics in the technical specifications
- **Learning to learn**
  Compliance with the rules for environmental protection and selective collection of waste
  Using work and protective equipment specific to the workplace
  Compliance with electrocution protection standards
- **Citizenship and social skills**
  Taking responsibility for the task as part of the team at the workplace
  Team working to carry out workplace tasks
- **Initiative and entrepreneurship**
  Proactive problem solving

Minimum equipment for ensuring quality of training (required at school or employer):

1. wire brushes, sand paper for manually cleaning parts;
2. TDV's for manual straightening operations: straightening block, hammers, anvils;
3. TDV's used for setting out: setting out table, marking point, punch, compass, parallel marker, distance meter, hammer, ruler, sliding callipers;
4. TDV's used for manual cutting: manual scissors, cutting pliers, manual saws, chisels, rulers, sliding callipers, set squares;
5. TDV's used for manual bending: vice, anvil, pipe bending devices, bending block with lever, sliding callipers, rulers, protractors, gauges;
6. drilling machines: fixed and portable;
7. tools and verifying devices used for boring: helical bits, bit holding devices, devices for fixing parts to the machining table, sliding callipers, micrometers;
8. Punches, punching machines
9. TDV's used for manual threading: taps, threading dies, tap wrenches, die holders, sliding callipers, micrometers, boring templates, ring gauges;
10. tools for making soldered un-dismantable assemblies (soldering iron, soldering lamp) and riveted (hammer, riveting die, bucking bar, rivet setter).
11. parts required for making a dismantable assembly: bolts, nuts, washers, wedges, springs, pegs, grooved axles and hubs.
12. measuring and control equipment, measuring devices
13. fire fighting equipment and tools, warning devices (sound, visual, smoke etc)
14. sets of samples of various materials (metallic, non-metallic)

EVALUATION STANDARD for the Unit:

1. Required materials and equipment

a. *Semi-finished materials*: sheet metal, strip steel, bars, profiled steel, pipes, wire;

b. *Materials*: ferrous (steel, cast iron), soldering alloys.

c. *TDV's for fitter operations:* cleaning (wire brushes, sand paper for manually cleaning materials), straightening (straightening block, hammers, anvils), setting out (setting out table, marking point, punch, compass, parallel marker, distance meter, hammer, ruler, sliding callipers), cutting (manual scissors, cutting pliers, manual saws, chisels, rulers, sliding callipers, set squares), bending (vice, anvil, pipe bending devices, bending block with lever, sliding callipers, rulers, protractors, gauges), threading (taps, threading dies, tap wrenches, die holders, sliding callipers, micrometers, boring templates, ring gauges), boring (helical bits, bit holding devices, devices for fixing parts to the machining table, sliding callipers, micrometers), tools and verifying devices for reaming, bevelling, widening (reamers, bevellers), punching out (dieing machines), riveting (hammer, riveting die, bucking bar, rivet setter), soldering (soldering iron, soldering lamp).

d. *Assembling parts*: rivets, bolts, nuts, springs, wedges, pins

e. *Equipment:* presses, bending machines, drills, grinders.

2. Performance criteria and indicators and their weight:

Item	Performance criteria and their weight		Performance indicators and their weight	
1.	Receiving and planning the task	25%	Interpreting graphics in process standards to make parts by fitters operations/preparing operations	20%
			Reviewing the requirements for each task and identifying possible methods for carrying it out	10%
			Selecting the materials, TDV's/tools required for making the part by fitter's operations/preparing operations	40%
			Compliance with health and safety and environmental protection standards	30%
2.	Carrying out the task	60%	Checking the part/item drawing in the technical specifications sheet	20%
			Suitable use of TDV's/tools for making the part by fitter's operations/preparing operations.	20%
			Making the part by fitter's operations/preparing operations, in compliance wit the process requirements.	60%
3.	Presenting and promoting the achieved task	15%	Providing rationale for chosen materials and construction solution.	50%
			Using specialist language in describing the operations and control methods used for making the part by fitter's operations/preparing operations.	50%

Unit 2:

MEASURING ELECTRICAL VALUES

Credits:

Learning Outcomes:

Knowledge	Skills	Attitudes
2.1.1. Electrical values in electrical plant (definitions, measurement units, mathematical relations) .	***2.2.1****. Calculating the numeric value of electrical measurements using mathematical formulas.* ***2.2.2.*** *Transforming measurement units.*	***2.3.1****. Teamwork to carry out tasks at the workplace.* ***2.3.2****. Taking responsibility for the task as part of the team at the workplace.*
2.1.2. Laws and theorems for measuring electrical values in circuits.	***2.2.3.*** *Determining electrical values in circuits by applying electricity laws.*	***2.3.3.*** *Compliance with workplace H&S and fire prevention and fighting regulations.*
2.1.3. Simple electrical circuits (principle electrical drawing, calculation relations in serial/parallel circuits, typical values, educational software):	**2.2.4.** Drawing the electrical diagram for the use of simple circuits. **2.2.5.** Determining the resistance /equivalent capacity of serial/parallel circuits **2.2.6.** Determining the typical values for voltage divider circuits. **2.2.7.** *Using educational software for simple electrical circuits*	***2.3.4****. Permanently and responsibly wearing protective equipment to prevent workplace accidents and professional illness* **2.3.5.** Compliance with workplace ergonomic standards
2.1.4. Analogical and digital electricity measurement devices for measuring electrical values in D.C. and A.C. circuits (constructive types, symbols used for marking, technical and metrological features, measuring scope, assembly drawings, educational software).	**2.2.8.** Decoding the symbols used to mark measuring devices. **2.2.9** Selecting measuring devices for each of the electrical values typical for an electric circuit. **2.2.10.** Making measuring assemblies. **2.2.11.** Measuring electrical values of an electrical circuit: − Measuring current intensity, − Measuring voltage, − Measuring resistance, − Measuring power, − Measuring energy. **2.2.12.** *Using educational software to measure electrical values using analogical and digital devices* ***2.2.13.*** *Determining errors in the measurement and percentage calculation process.* ***2.2.14.*** *Mathematical processing of measured values.*	**2.3.6.** Compliance with environmental protection and selective waste collection standards ***2.3.7.*** *Proactive problem solving*

2.1.5. Measurement errors: types, causes, mathematical relations **2.1.6.** Extending the measurement scope of analogical devices (devices, assembly drawings, calculation relations, educational software) - shunt - additional resistance - measurement transducers (current -CT, voltage-VT)	***2.2.15.*** *Calculating shunt value required for a given measurement.* **2.2.16.** Drawing the assembly schematics for using the shunt. **2.2.17.** Measuring electrical current intensity using shunts. **2.2.18** Measuring electrical current intensity using CT. ***2.2.19.*** *Calculating the additional resistance for a given measurement.* **2.2.20.** Drawing the assembly schematics for using additional resistance. **2.2.21.** Measuring voltage using additional resistors. **2.2.22.** Measuring voltage using VT. ***2.2.23.*** *Using educational software to measure electrical values using analogical devices with extended measuring scope* ***2.2.24.*** *Correct use of specialist language in workplace communication.* ***2.2.25.*** *Communicating the outcomes of work performed*	

The general technical unit „**Measuring electrical values"** integrates the following key skills areas

- **Communication in Romanian and the mother language**
  Correct use of specialist language in workplace communication.
  Communicating the outcomes of work performed.
- **Mathematics, science and technology skills**
  Calculating the numeric value of electrical measurements using mathematical formulas.
  Transforming measurement units.
  Determining errors in the measurement and percentage calculation process.
  Mathematical processing of measured values.
  Determining electrical values in circuits by applying electricity laws.
  Calculating shunt value required for a given measurement.
  Calculating the additional resistance for a given measurement.
- **Learning to learn**
  Compliance with workplace H&S and fire prevention and fighting regulations.
  Permanently and responsibly wearing protective equipment to prevent workplace accidents and professional illness.
- **Citizenship and social skills**
  Taking responsibility for the task as part of the team at the workplace.
  Team working in view of carrying out the workplace tasks.
- **Initiative and entrepreneurship**
  Proactive problem solving.
- **IT skills**

Using educational software for simple electrical circuits
Using educational software to measure electrical values using analogical and digital devices
Using educational software to measure electrical values using analogical devices with extended measuring scope

Minimum equipment for ensuring quality of training (required at school or employer):

1. Electricity measurement equipment: ampere-meters, voltmeters, wattmeter, counters, multi-meters.
2. Shunt, additional resistor, measuring transformers (current-CT, voltage-VT)
3. Sources, resistors, bobbins, capacitors,
4. Educational software.
5. Consumables

EVALUATION STANDARD for the Unit de Learning outcomes:

1. Required materials and equipment:

a. Electricity measurement equipment: ampere-meters, voltmeters, wattmeter, counters, multi-meters.
b. Shunt, additional resistor, measuring transformers (current-CT, voltage-VT)
c. Sources, resistors, bobbins, capacitors
d. Educational software
e. Consumables

2. Performance criteria and indicators and their weight:

Item	Performance criteria and their weight		Performance indicators and their weight	
1.	Receiving and planning the task	35%	Calculating the numeric value of electrical measurements using mathematical formulas	40%
			Transforming measurement units	30%
			Decoding the symbols used to mark measuring devices	30%
2.	Carrying out the task	50%	Selecting measuring devices for each of the electrical values typical for an electric circuit	30%
			Making measuring assemblies	30%
			Measuring electrical values of an electrical circuit	30%
			Correct use of work equipment	10%
3.	Presenting and promoting the achieved task	15%	Determining errors in the measurement and percentage calculation process	40%
			Mathematical processing of measured values	40%
			Communicating the outcomes of work performed	20%

Unit 3:

INSTALLING ELECTRICAL WIRING

Credits:

Learning Outcomes:

Knowledge	Skills	Attitudes
3.1.1. Specific materials for electricity (conductive, isolating materials): - Physical-chemical properties, - Mechanical properties - Technological properties, - Standard symbols, - Scope of usage.	**3.2.1.** Selecting specific materials for electrical work depending on their physical chemical, technological properties and scope of usage.	**3.3.1.** Complying with the standards for symbolising the components in electric circuits. ***3.3.2.*** *Teamwork to carry out tasks at the workplace* ***3.3.3.*** *Taking responsibility for the task as part of the team at the workplace.*
3.1.2. Preparation operations in electrical fitting (measuring, stripping, cleaning, pickling): - Operations, - Specific TDV's, - H&S/operation.	**3.2.2.** Selecting the TDV's required for each preparing operation to be carried out. **3.2.3.** Supplying the materials required for each job to be carried out. **3.2.4.** Carrying out preparation operations for making connexions: - Measuring conductors, - Stripping conductors - Cleaning conductors, - Pickling conductors.	***3.3.4.*** *Using work and protective equipment specific to the workplace* ***3.3.5.*** *Compliance with H&S regulations.* *3.3.6. Compliance with electrocution protection standards.*
3.1.3. Electric and electronic components in electrical circuits: sources, resistors, bobbins, capacitors, diodes, transistors: - Operating function, - Marking.	**3.2.5.** Selecting electrical components for making electrical circuits. **3.2.6.** Selecting electronic components for making electronic circuits. **3.2.7.** Fitting/replacing electronic blocks.	*3.3.7. Compliance with workplace ergonomic standards* ***3.3.8.*** *Compliance with workplace hazard warnings*
3.1.4. Simple electronic blocks (electronic schematics, assembly drawing s): - Double wave and half wave rectifiers, - One stage amplifiers.	**3.2.8.** *Using information sources on simple electronic components and blocks, including those in an international language.*	***3.3.9.*** *Compliance with the rules for environmental protection and selective collection of waste* ***3.3.10.*** *Proactive problem solving*
3.1.5. Information sources for simple electronic components and blocks.	**3.2.9.** Selecting electrical conductors and cables depending on the circuit to be built.	
3.1.6. Electrical conductors and cables, accessories for low voltage	**3.2.10.** Using specific TDV's for connecting	

electrical wiring **3.1.7.** Simple electrical installation technology (in compliance with the technical standards sheets): - operations, - specific TDV's and measurement and control devices, - H&S/operation - Quality standards for electricity work. **3.1.8.** Methods and means for protection against electrocution: possible electrocution situations (types), prevention. **3.1.9.** Means for workplace hazard warning (warnings: sound, visual, written warnings, indicators, security colours) **3.1.10.** Environmental protection and waste management standards	electrical and electronic components in circuits. **3.2.11.** Installing simple electrical wiring (as per technical specifications sheets). **3.2.12.** Checking the work performed using measurement and control devices, in compliance with the specific technologies. **3.2.13.** Compliance with specific H&S for each operation carried out. **3.2.14.** Applying electrocution protection rules for the individual and for work mates throughout the duration of the operations. **3.2.15.** Interpreting workplace warnings **3.2.16.** Waste management for environmental protection. **3.2.17.** Recovering and reusing materials. ***3.2.18.*** *Correct use of specialist language in workplace communication* ***3.2.19.*** *Communicating the outcomes of work performed*	

The general technical unit „**Installing electrical wiring"** integrates the following key skills areas**:**

- **Communication in Romanian and the mother language**
  Correct use of specialist language in workplace communication.
  Communicating the outcomes of work performed.
- **Learning to learn**
  Compliance with H&S regulations.
  Compliance with electrocution protection standards.
  Compliance with workplace ergonomic standards
  Compliance with workplace hazard warnings
  Compliance with environmental protection and selective waste collection standards
- **Citizenship and social skills**
  Teamwork to carry out tasks at the workplace
  Taking responsibility for the task as part of the team at the workplace.
- **Initiative and entrepreneurship**
  Proactive problem solving
- **Communication in a foreign language**
  Using information sources on simple electronic components and blocks, including those in an international language

Minimum equipment for ensuring quality of training (required at school or employer):

1. Tools and devices for making an electrical installation (electrician's toolkit - various types of pliers: multi-purpose, setting, press, knives).

2. Electricity measurement equipment: ampere-meters, voltmeters, wattmeter, multi-meters.
3. Sources, resistors, bobbins, capacitors, diodes, transistors, rectifiers
4. Sets / samples of conductive and isolating materials.
5. Cables and conductors, cable shoes, bolts and nuts, various clips and connectors, soldering iron, solder.
6. Consumers (e.g. light bulbs)
7. Workbenches.
8. Personal protective equipment
9. Consumables

EVALUATION STANDARD for the Unit:

1. Required materials and equipment:

a. *semi-finished materials*: conductors, cables, insulators;
b. *Materials*: copper and copper alloys, aluminium and aluminium alloys;
c. Tools and devices for making an electrical installation (electrician's toolkit - various types of pliers: multi-purpose, setting, press; knives);
d. Electricity measuring equipment: ampere-meters, voltmeters, wattmeter, multi-meters;
e. Sources, resistors, bobbins, capacitors, diodes, transistors, rectifiers;
f. Cables and conductors, cable shoes, bolts and nuts, various clips and connectors, soldering iron, solder;
g. Consumers (e.g. light bulbs);
h. Workbenches;
i. Personal protective equipment;
j. Consumables

2. Performance criteria and indicators and their weight:

Item	Performance criteria and their weight		Performance indicators and their weight	
1.	Receiving and planning the task	35%	Compliance with the planning of the operation, as per the process standards sheets.	40%
			Selecting the TDV's required for each preparing operation to be carried out	50%
			Compliance with environmental protection, quality and H&S standards as per the technology.	10%
2.	Carrying out the task	50%	Compliance with process standards in carrying out the task.	30%
			Making simple electrical circuits, in compliance with the process standards sheets	50%
			Correct use of TDV's, materials and devices required for making simple electrical circuits; correct use of personal protective equipment.	20%
3.	Presenting and promoting the achieved task	15%	Ensuring the quality of work performed.	50%
			Correct use of specialist language in presenting the work task.	50%

Unit 4:

FITTING, MAINTAINING AND REPAIRING LOW VOLTAGE ELECTRICAL EQUIPMENT (L.V.)

Credits:

Learning outcomes:

Knowledge	Skills	Attitudes
4.1.1. Low voltage electrical machines and devices (electric transformer, rotating electrical machines, manual switching gear, fusible plugs, thermal cut-outs): - Conventional markings; - Functional role; - Constructive sub-assemblies; - Usages.	***4.2.1.*** *Decoding conventional markings of electrical machines and devices from electrical plant.*	***4.3.1.*** *Taking responsibility for the task as part of the team at the workplace.* ***4.3.2.*** *Teamwork to carry out tasks at the workplace* ***4.3.3.*** *Compliance with workplace hazard warnings.*
4.1.2. Information sources for low voltage electrical machines and devices.	***4.2.2.*** *Using the information sources for low voltage electrical machines and devices, including in an international foreign language.*	***4.3.4.*** *Compliance with process discipline.* **4.3.5.** Meeting the time standards allocated for each operation.
4.1.3. Fitting and connecting l..v. electrical equipment, as per the process standards sheets: - Fitting and connecting operations - Materials, - TDV's, measurement and control devices, - H&S/operation.	***4.2.3.*** *Interpreting the requirements stated in process sheets.* **4.2.4.** Assembling manual switch gear. **4.2.5.** Selecting TDV's and control devices when carrying out fitting operations. **4.2.6.** Selecting the materials required for installing/fitting l..v. electrical machines and devices. **4.2.7.** Fitting low voltage electrical devices in installations, as per the process sheets. **4.2.8.** Making connections of low voltage electrical devices. **4.2.9.** Installing electrical machines in electrical plant, as per the process sheets. **4.2.10.** Connecting electrical machines. **4.2.11.** Interpreting workplace warnings. **4.2.12.** Applying measures for limiting the stress on l.v. electrical equipment.	**4.3.6.** *Proactive problem solving.* ***4.3.7.*** *Compliance with workplace H&S and fire prevention and fighting regulations* **4.3.8.** Permanently and responsibly wearing protective equipment to prevent workplace accidents and professional illness.
4.1.4. Stresses on l.v. electrical equipment and limiting methods/measures. **4.1.5.** Maintenance, repair and	***4.2.13.*** *Interpreting the requirements stated in process sheets.* **4.2.14.** Selecting the TDV's and measurement and control equipment for l.v. electrical devices maintenance and repair	

verification work on low voltage electrical devices (as per process sheets): - Assembling/disassembling low voltage electrical devices, - materials, - TDV's and measurement and control devices, - H&S/operation. **4.1.6.** Environmental protection and waste management standards.	work. **4.2.15.** Selecting materials for maintenance and repair of l.v. electrical devices. **4.2.16.** Carrying out maintenance work on l.v electrical devices. **4.2.17.** Carrying out repair work on l.v electrical devices. **4.2.18.** Using work and protective equipment specific to the workplace. **4.2.19.** Checking the operation of low voltage electrical devices subject to maintenance and repair work. **4.2.20.** Waste management for environmental protection. **4.2.21.** Recovery and reuse of materials in fitting / maintenance / repair work of electrical equipment. ***4.2.22.*** *Correct use of specialised language.* ***4.2.23.*** *Communicating the outcomes of work performed.*	

The general technical unit **„Fitting, maintaining and repairing low voltage electrical equipment (l.v.)"** integrates the following key skills areas:

- **Communication in Romanian and the mother language**
  Correct use of specialised language.
  Communicating the outcomes of work performed.
- **Mathematics, science and technology skills**
  Interpreting the requirements stated in process sheets.
  Decoding conventional markings of electrical machines and devices from electrical plant.
- **Learning to learn**
  Compliance with workplace H&S and fire prevention and fighting regulations.
  Compliance with workplace hazard warnings.
- **Citizenship and social skills**
  Taking responsibility for the task as part of the team at the workplace.
  Compliance with process discipline.
  Teamwork to carry out tasks at the workplace.
- **Initiative and entrepreneurship**
  Proactive problem solving.
- **Communication in a foreign language**
  Using the information sources for low voltage electrical machines and devices, including in an international foreign language.

Minimum equipment for ensuring quality of training (available at school or employer):

1. Tools and devices for fitting, maintaining and repairing l.v. electrical equipment (electrician's toolkit – various types of pliers: multi-purpose, setting, press, knives).
2. Electricity measurement equipment: ampere-meters, voltmeters, wattmeter, multi-meters.
3. Cables and conductors, cable shoes, bolts and nuts, various clips and connectors, soldering iron, solder.
4. Low voltage electrical devices (fusible/automated plugs, circuit breakers, switches, time relays, temperature relays, on/off buttons, warning lamps etc).
5. DC and AC motors, single and three phase electrical transformers.
6. Workbenches.
7. Personal protective equipment.

EVALUATION STANDARD for the Unit:

1. Required materials and equipment:

a. Tools and devices for fitting, maintaining and repairing l.v. electrical equipment (electrician's toolkit – various types of pliers: multi-purpose, setting, press, knives).
b. Electricity measurement equipment: ampere-meters, voltmeters, wattmeter, multi-meters.
c. Cables and conductors, cable shoes, bolts and nuts, various clips and connectors, soldering iron, solder.
d. Low voltage electrical devices (fusible/automated plugs, circuit breakers, switches, time relays, temperature relays, on/off buttons, warning lamps etc).
e. DC and AC motors, single and three phase electrical transformers.
f. Workbenches.
g. Personal protective equipment.

2. Performance criteria and indicators and their weight:

Item	Performance criteria and their weight		Performance indicators and their weight	
1.	Receiving and planning the task	35%	Interpreting the requirements stated in process sheets	50%
			Selecting electrical machines and devices, as per the process sheets.	40%
			Compliance with environmental protection, quality and H&S standards, as per process standards	10%
2.	Carrying out the task	50%	Compliance with process standards in carrying out the task.	25%
			Fitting, maintenance and repair work on low voltage electrical equipment, in compliance with process sheets.	50%
			Correct use of TDV's and measurement and control equipment, as well as protective equipment.	25%
3.	Presenting and promoting the achieved task	15%	Compliance with quality requirements for work /tasks carried out.	50%
			Correct use of specialist language in presenting the work performed	50%

Unit 5:

FITTING AND MAINTAINING PHOTOVOLTAIC PLANT

Credits:

Learning Outcomes:

Knowledge	Skills	Attitudes
5.1.1. Photovoltaic cell - Principle of solar energy conversion into electricity. - Classification of cells by process.	**5.2.1.** *Correct use of specialist language* **5.2.2.** Analysing various types of photovoltaic cells	**5.3.1.** *Taking responsibility for the task as part of the team at the workplace*
5.1.2. Photovoltaic cell Electrical schematics of photovoltaic plant - Symbols of components - Classification of photovoltaic applications. - electrical schematics of photovoltaic plant.	**5.2.3.** *Decoding symbols used in photovoltaic plant schematics* **5.2.4.** Representing electrical schematics of photovoltaic plant **5.2.5.** *Applying standardisation systems specific to the field*	**5.3.2.** *Proactive problem solving* **5.3.3.** Complying with the working times as per the established work schedule.
5.1.3. Electrical components of photovoltaic plant: - electrical cables. - power conditioning equipment - photovoltaic panel protection systems:	**5.2.6.** Selecting the electrical components for a particular application **5.2.7.** Analysing protection systems for a photovoltaic plant	**5.3.4.** *Team working in view of carrying out the workplace tasks*
5.1.4. Information sources on photovoltaic plant.	**5.2.8.** *Using sources of information on photovoltaic plant, including in an international language.*	**5.3.5.** *Compliance with process discipline*
5.1.5. Installing photovoltaic plant (as per process documentation). - methods for inter-connecting photovoltaic elements - operations for fitting electrical components -TDV's and measuring and control devices - specific H&S and fire fighting standards - Quality standards for photovoltaic plant works.	**5.2.9.** *Using the process documentation for fitting electrical equipment.* **5.2.10.** Installing photovoltaic panels **5.2.11.** Installing electrical cables **5.2.12.** Fitting power conditioning equipment **5.2.13.** Fitting over-voltage protection systems **5.2.14.** Making electrical connections to the power gird **5.2.15.** Applying internal work instructions specific to power generation	**5.3.6.** *Taking responsibility for the quality of work performed* **5.3.7.** Compliance with H&S and fire fighting standards specific to t he work performed. **5.3.8.** Compliance with quality standards of work performed;
5.1.6. Types of maintenance work on photovoltaic plant (as per process sheets). - Required operations - Materials - TDV's, measuring and control devices - H&S and fire fighting standards/job	**5.2.16.** *Interpreting the requirements stated in the process sheets* **5.2.17.** Selecting TDV's and materials for maintenance work on photovoltaic plant **5.2.18.** Carrying out maintenance work on components of photovoltaic plant	**5.3.9.** Using work and protective equipment specific to the workplace **5.3.10.** *Active communication*

5.1.7. Defects of photovoltaic plant. - Procedures for measuring electrical values. - Types of defects (causes, remedial work)	**5.2.19.** *Interpreting the measurements of electrical values in photovoltaic plant* **5.2.20.** Fixing simple defects in photovoltaic plant. **5.2.21.** *Communicating the outcomes of work performed*	*in the team, irrespective of the ethnic background of members*

The specialist technical Unit „**Fitting and maintaining photovoltaic plant**" integrates the following key skills areas:

- **Communication in Romanian and the mother language**
  Correct use of specialist language;
  Communicating the outcomes of work performed
- **Communication in a foreign language**
  Using sources of information on photovoltaic plant, including in an international language.
- **Mathematics, science and technology skills**
  Decoding symbols used in photovoltaic plant schematics
  Interpreting the measurements of electrical values in photovoltaic plant.
  Applying standardisation systems specific to the field
- **Learning to learn**
  Using process documentation for fitting electrical equipment.
- **Citizenship and social skills**
  Team working to carry out workplace tasks
  Taking responsibility for the task as part of the team at the workplace
  Compliance with process discipline
- **Initiative and entrepreneurship**
  Proactive problem solving
  Taking responsibility for the quality of work performed
- **Sensitivity to culture and cultural expression**
  Active communication in the team, irrespective of the ethnic background of members

Minimum equipment for ensuring quality of training (required at school or employer):

4. Photovoltaic conversion elements: cells, modules;
5. Schematics, photographs of various types of photovoltaic systems: autonomous, residential, industrial, photovoltaic farms;
6. Electrical equipment: cables, invertors, switchboard, overload and over charge protection devices, junction boxes, batteries of accumulators, battery charging regulators, capacitors, invertors;
7. Protection systems (varistors, diode by-pass, arresters, grounding equipment);
8. Catalogues of photovoltaic plant components: solar panels, cables, invertors, batteries of accumulators, charging regulators, capacitors etc.
9. TDV's and electrical measuring equipment for fitting, verifying, maintaining and repairing photovoltaic cells equipment.
10. Personal protective equipment

EVALUATION STANDARD for the Unit:

1. **Required materials and equipment**

- Photovoltaic conversion elements: cells, modules;
- Electrical equipment: cables, invertors, switchboard, overload and over charge protection devices, junction boxes, batteries of accumulators, battery charging regulators, capacitors, invertors;
- Protection systems (varistors, diode by-pass, arresters, grounding equipment);
- TDV's and electrical measuring equipment for fitting, verifying, maintaining and repairing photovoltaic cells equipment.
- Personal protective equipment
- Consumables

2. Performance criteria and indicators and their weight:

Item	Performance criteria and their weight		Performance indicators and their weight	
1.	Receiving and planning the task	35%	Analysing the work task and formulating the solution	40%
			Selecting the components required for the photovoltaic plant, as per process documentation	40%
			Compliance with H&S, fire fighting and quality standards	20%
2.	Carrying out the task	50%	Compliance with process standards in carrying out the task.	25%
			Carrying out fitting / maintenance / repair work on photovoltaic plant, in compliance with process sheets.	50%
			Correct use of TDV's and measurement and control equipment, as well as protective equipment.	25%
3.	Presenting and promoting the achieved task	15%	Compliance with quality requirements ofr work / tasks carried out	60%
			Correct use of specialised language for presenting the work performed.	40%

Unit 6:

FITTING AND MAINTAINING WIND POWER PLANT

Credits:

Learning Outcomes:

Knowledge	Skills	Attitudes
6.1.1. Components of wind power plant/farms: - Wind turbines: - Wind power generators: constructive and operating characteristics - Electrical equipment for fitting: cables, electrical switch boards, power conditioning equipment, protection systems, automation **6.1.2.** Information sources for wind power plant. **6.1.3.** Installing wind power plant / farms (as per process documentation): - Process operations for installing wind power plant components - TDV's, measuring and control devices used - materials - specific H&S and fire fighting standards - quality standards for specific wind power plant work. **6.1.4.** Wind power plant maintenance and repair work (as per process sheets): - Required operations - materials - defects: mechanical, electrical - TDV's, measuring and control devices - Job specific H&S and fire fighting standards	**6.2.1.** Comparing various types of wind turbines. **6.2.2.** Analysing the characteristics of wind power generators **6.2.3.** Selecting electrical equipment for building a wind power plant **6.2.4.** *Correct use of specialist language;* **6.2.5.** *Using information sources on wind power plant, including in a international foreign language.* **6.2.6.** *Using the process documentation for installing electrical equipment.* **6.2.7.** Fitting wind generators. **6.2.8.** Wiring the electrical equipment of low power wind generators **6.2.9.** Connecting over-voltage protection systems **6.2.10.** Checking operating parameters. **6.2.11.** *Communicating the outcomes of work performed.* **6.2.12.** *Interpreting the requirements stated in process sheets.* **6.2.13.** Selecting TDV's and materials for wind power plant maintenance work **6.2.14.** *Interpreting the readings of electrical values measurements in wind power plant* **6.2.15.** Carrying out maintenance work on wind power plant. **6.2.16.** fixing simple defects of wind power plant.	**6.3.1.** *Proactive problem solving* **6.3.2.** Complying with the working times as per the established work schedule; **6.3.3.** Keeping technical documentation, measurement equipment and toolkits in standard conditions **6.3.4.** *Taking responsibility for the quality of work performed* **6.3.5.** Compliance with H&S and fire fighting standards **6.3.7.** *Team working in view of carrying out the workplace tasks* **6.3.8.** Compliance with quality requirements for work performed. **6.3.9.** Using work and protective equipment specific to the workplace

The specialist technical Unit „**Fitting and maintaining wind power plant**" integrates the following key skills areas:

- **Communication in Romanian and the mother language**

Formattati: Elenchi puntati e numerati

Correct use of specialist language;
Communicating the outcomes of work performed

- **Communication in foreign languages**
  Using information sources on wind power plant, including in a international foreign language.
- **Mathematics, science and technology skills**
  Interpreting the readings of electrical values measurements in wind power plant
- **Learning to learn**
  Using the process documentation for installing electrical equipment.
- **Citizenship and social skills**
  Team working in view of carrying out the workplace tasks
- **Initiative and entrepreneurship**
  Proactive problem solving
  Taking responsibility for the quality of work performed

Formattati: Elenchi puntati e numerati
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Minimum equipment for ensuring quality of training (required at school or employer):

1. Wind turbines (high/low rotation, high/low power)
2. Wind power generators.
3. Electrical equipment: cables, invertors, switchboard, overload and over charge protection devices, junction boxes, batteries of accumulators, battery charging regulators, capacitors, invertors;
4. Over-voltage protection systems (varistors, diode by-pass, arresters, grounding equipment);
5. Catalogues of photovoltaic plant components: solar panels, cables, invertors, batteries of accumulators, charging regulators, capacitors etc.
6. TDV's and measuring equipment for fitting, verifying, maintaining and repairing wind power plant.
7. Personal protective equipment
8. Consumables

EVALUATION STANDARD for the Unit:

1. Required materials and equipment

- Various types of wind turbines (high/low rotation, high/low power)
- Wind power generators.
- Electrical equipment: cables, invertors, switchboard, overload and over charge protection devices, junction boxes, batteries of accumulators, battery charging regulators, capacitors, invertors;
- Over-voltage protection systems (varistors, diode by-pass, arresters, grounding equipment);
- TDV's, measuring equipment for fitting, verifying, maintaining and repairing wind power plant;
- Personal protective equipment
- Consumables

2. Performance indicators and their weight:

Item	Performance criteria and their weight		Performance indicators and their weight	
1.	Receiving and planning	35%	Interpreting requirements of process sheets	40%

	the task		Selecting TDV's and components required for installing the wind power plant, as per the work task	40%
			Compliance with H&S, fire fighting and quality standards	20%
2.	Carrying out the task	50%	Compliance with process requirements in carrying out the task.	25%
			Carrying out fitting / maintenance / repair work on wind power plant, in compliance with process sheets.	50%
			Correct use of TDV's and measurement and control equipment, as well as protective equipment.	25%
3.	Presenting and promoting the achieved task	15%	Compliance with quality requirements for work / tasks performed	50%
			Correct use of specialist language for communicating the performed task.	50%

Learning outcomes specific to mathematics and communication required for achieving the level 2 vocational qualification *Fitter of electrical operation systems for renewable power sources*:

Discipline	**Required learning outcomes**
Romanian language and literature	Efficient communication in Romanian
	Understanding written/ read text
Foreign language	Efficient communication in foreign language
	Understanding written/ read text
Mathematics	Basic arithmetic operations to make simple algebraic calculations with rational numbers (addition, subtraction, multiplication, division, using brackets, simple algebraic functions, powers, radicals, Ist degree equations).
	Basic trigonometry (defining basic triangle trigonometric functions and their values for 0°, 30°, 45°, 60°, 90°, 180°).
	Basic plane geometry (plane areas – triangle, parallelogram, circle area).
	Basic notions of spatial geometry (identification of various geometric solids and shapes resulting from their sectioning)
Physics	Physical values and units of measurement
	Electricity physical phenomena (electrostatics – electrisation of solids, voltage; electro kinetics – current); and electromagnetism (electromagnetic force. Electric motor, electromagnetic induction, synchronous generator).
	Ohm, Joule laws.
Chemistry	Chemical elements symbols
	Microscopic structure of substances
Civic culture	Respect for regulations / standards
	Autonomy
	Initiative
	Teamwork
	Responsibility
Technological education	Physical-chemical characteristics of electrical and non-electrical materials (copper, aluminium, silver, wolfram, paper, cotton, silk, glass, mica, asbestos, varnishes, enamels, resins)

	Applying technical drawing standards and rules
	Domestic consumers of electricity

ABBREVIATIONS

COR	ROF	Romanian occupation framework
EQF	EQF	European Qualifications Framework
IPT	TVET	Technical and vocational education and training
NTSM	H&S	Health and safety standards
NSSM	H&S	Health and safety standards
Ing. prof.	Ing. prof.	Engineer, Professor
PSI	Fire fighting	Fire fighting
SO	OS	Occupational standard
SSM	H&S	Health and safety
PM	WS	Work safety
SDV	TDV	Tools, devices and verifiers
D.C.	DC	Direct current
A.C.	AC	Alternative current
j.t.	LV	Low voltage
CT	CT	Current transformer
VT	VT	Voltage transformer
Unit	Unit	Unit