



Euroopa Liit
Euroopa Sotsiaalfond



Eesti tuleviku heaks



ESF programm „Kutsete süsteemi arendamine“

OCCUPATIONAL STANDARD

Mechatronic-technician, level 5

The occupational standard is a document, that describes the job and competence requirements, i.e. a set of skills, knowledge and attitudes required for successful job performance in a particular occupation.

Occupational standard of mechatronic, level 5 is the basis for the continued vocational education curricula, adult in-service training curricula and assessment of professional competence of persons.

Occupational qualification title	Estonian qualifications framework (EstQF) level
<i>Mechatronic, level 5</i>	5

Part A JOB DESCRIPTION

A.1 Short description of job
<p>Mechatronics is the area of technology dealing with unidirectional interaction of mechanics, electronics and information technology systems.</p> <p>Mechatronic is a skilled worker who works in the mechatronics, automatics, instrument engineering or electronics area company. His/her main duty is assembly, use and testing of mechatronics equipment and systems to ensure their faultless functioning. He/she adjusts the mechatronics systems based on work instruction by using proper checking and measuring instruments. The mechatronic follows the prescribed work instruction, technical and normative documents and quality requirements when performing the tasks.</p> <p>Mechatronic, level 5 works independently or in a team by leading the performance of the mechatronics projects and being responsible for the results of the team's work. He/she selects and applies different technologies and methods for finding new solutions by also taking into account the energy efficiency, economy and environmental sustainability principles. Besides vocation-specific activities, the work of the mechatronic presumes supervising of a team, counselling of clients, division of resources and delegation of works and cooperation with electricians, automaticians, technologists, IT and other specialists of related fields of activity.</p>
A.2 Units
<p>A.2.1 Assembly and installation of mechatronic systems</p> <p>2.1.1 Assembly, installation and disassembly of mechatronic system components and switchings.</p> <p>2.1.2 Assembly, installation and disassembly of mechatronics systems.</p> <p>2.1.3 Documenting of works, preparation of user manuals and as-built drawings.</p> <p>2.1.4 Evaluation of the quality of work.</p> <p>A.2.2 Operation of mechatronics equipment and systems</p> <p>2.2.1 Measuring of electrical and nonelectrical quantities.</p> <p>2.2.2 Equipment monitoring.</p> <p>2.2.3 Maintenance and repair works of mechatronics equipment and systems.</p> <p>A.2.3 Installation, setup and operation of industrial and manufacturing mechatronics equipment and systems</p> <p>2.3.1 Installation and setup of industrial and manufacturing mechatronic equipment and systems</p> <p>2.3.2 Entering and adjusting of control programs of industrial and manufacturing mechatronic equipment and systems</p> <p>2.3.3 Monitoring and inspecting of technological processes of industrial and manufacturing mechatronics systems</p> <p>2.3.4 Maintenance of industrial and manufacturing mechatronics equipment and systems</p> <p>A.2.4 Installation and operation of integrated mechatronic systems</p> <p>2.4.1 Development of integrated mechatronics systems.</p> <p>2.4.2 Installation and setup of integrated mechatronic systems.</p> <p>2.4.3 Monitoring, inspection and setup of technological processes of integrated mechatronics systems</p> <p>2.4.4 Performance of maintenance and repair work of the integrated mechatronic systems.</p> <p>A.2.5 Management of mechatronics projects</p> <p>2.5.1 Selection and planning of technology of mechatronics projects</p>

2.5.2	Coordination of the activities and work of the team of mechatronics projects.
2.5.3	Analysis and documenting of mechatronics project activities.
2.5.4	Reporting, quality control and assessment of mechatronics projects
A.2.6	Organisation of works, team management and supervising
2.6.1	Organisation and delegation of works.
2.6.2	Preparation of a work plan and planning of activities
2.6.3	Resource control
2.6.4	Following of the production schedule
2.6.5	Direct supervision of workers, finding out the need for in-service training
2.6.6	Organisation of internal in-service training.
A.3	Working environment and specific aspects of work
Depending on the employer, mechatronic's working time may be in shifts or based on work schedule, covering also the night time, weekends and public holidays. The work pace may be fast and tense at times. The work may require performance of work operations in forced position. Working environment may be indoors as well as outdoors. Neglecting of the safety requirements of the working environment may involve accidents at work.	
A.4	Tools
Main tools of the mechatronic include computer with special software; electrical measurement instruments (multimeter, signal analyser, signal generator, oscilloscope, and other); hand measurement instruments (caliper, scale, measuring tape, different calibers, and other); hand tools (screwdriver, pliers, tweezers, wire cutter, special devices for assembly of cable connections; soldering iron, and other); electrical tools (electric screwdriver, drill, and other); special equipment (photo and video recording equipment, detectors, filler) but also office equipment. In some cases there may be need to deal with hydro- or pneumatic systems.	
A.5	Personal characteristics necessary for this job: abilities and personality traits
The work of the mechatronic presumes mathematical-logical capability and analysis skills, systematic thinking, concentration, manual activities and visual memory. Coping with work presumes logical thinking, communication and expression skill, good concentration, persistence, coordination ability, developed sense of responsibility and readiness to learn.	
A.6	Possible job titles
Mechatronic-technician.	
A.7	Occupational training
Generally the people working as mechatronics have professional vocational education, practical work experience and he/she has passed professional in-service trainings.	

Part B COMPETENCE REQUIREMENTS

B.1. The structure of the occupational qualification

To acquire the profession of mechatronics, level 5, the applicant must verify all obligatory (B.2.1-B.2.6) and transversal (B.2.7) competencies.

B.2 Competences

OBLIGATORY COMPETENCES

B.2.1 Assembly and installation of mechatronics equipment and systems	EstQF level 5
<p><u>Performance indicators:</u></p> <ol style="list-style-type: none"> 1. Installs, assembles and disassembles mechatronics systems containing different subsystems (e.g. mechanical, hydraulic, pneumatic, electro-mechanical, electronic, software systems, etc). Checks the performance of the whole system and ensures its reliability. 2. Installs and sets up the components (detectors, fillers, controllers) of mechatronics subsystems (e.g. metering systems, transportation mechanisms, sorting equipment) according to the work description and technical specification. 3. Documents performed installation and starting works and modifications, and prepares as-built drawings and user manuals of mechatronics systems. 4. Assesses and modifies the parameters of mechatronics process and product quality in cooperation with related specialists according to the requirements of the technology. 	
<p><u>Supporting knowledge:</u></p> <ol style="list-style-type: none"> a) installation methods of most common mechatronics equipment and systems; b) Tools used at installation; c) Knowledge about mechatronics installation works; d) Parameters of mechatronics systems; e) Operating principles of different mechatronics systems; 	
<p><u>Assessment method(s):</u></p> <p>Combined method containing verification of theoretical knowledge as well as practical skills.</p>	

B.2.2 Operation of mechatronics equipment and systems	EstQF level 5
<p><u>Performance indicators:</u></p> <ol style="list-style-type: none"> 1. Starts mechatronics equipment and systems according to the instruction and technical specification. Sets up and tests different equipment and systems based on prescribed tasks and technical documentation, documents modifications made in adjustment modes. 2. Measures the physical (length, width, height, pressure, temperature, humidity, speed, weight, etc) and electrical parameters (power consumption, impedance, frequency, voltage, etc) of the equipment and systems by using the prescribed tools and resources for it. 3. Performs scheduled maintenance to the systems and their assemblies and follows the maintenance plans of equipment to ensure faultless operation of equipment and system. 4. Monitors mechatronics equipment and systems regularly also in between the scheduled maintenances to prevent the errors which might occur during the operation of equipment and systems. If needed, repairs errors and eliminates the functional failures of mechatronics system 	

<p>components and equipment.</p> <p>5. Conducts the initial introductory user training of the equipment or system to the client, and, if needed, provides further technical support related to use of the equipment or system.</p>
<p><u>Supporting knowledge:</u></p> <p>a) Operating principles of mechatronics equipment and systems;</p> <p>b) Mechanics, electricity and information technology requirements set for mechatronics systems;</p> <p>c) Automatic adjustment, control and inspection equipment and means (including measuring instruments in their area of use);</p> <p>d) Technical solutions of local networks; principles for their development and used equipment;</p> <p>e) knowledge about documenting of operational works.</p>
<p><u>Assessment method(s):</u></p> <p>Combined method containing verification of theoretical knowledge as well as practical skills.</p>

<p>B.2.3 Installation and operation of industrial and manufacturing mechatronic systems and subsystems</p>	<p>EstQF level 5</p>
<p><u>Performance indicators:</u></p> <p>1. Installs industrial and manufacturing mechatronics equipment and systems by following the safety requirements. Regulates, controls and inspects the manufacturing equipment and robots related to certain manufacturing process (e.g. power producing, chemical industry) based on the nature of the manufacturing process.</p> <p>2. Prepares control programmes to different equipment by using the application software accompanying the equipment.</p> <p>3. Follows and inspects the operation of manufacturing mechatronics systems and subsystems.</p> <p>4. Performs tasks related to operation, maintenance and repair of the industrial and manufacturing mechatronics equipment by using the correct measuring methods.</p>	
<p><u>Supporting knowledge:</u></p> <p>a) Equipment and systems related to the technological processes of power production, district heating, timber, chemical, food and engineering industry;</p> <p>b) Operating principles and area of use of equipment /apparatus and power drive units related to the used process;</p> <p>c) Basic knowledge about pneumatics, hydraulics and power electronics equipment;</p> <p>d) Classification and area of use of mechatronics systems, components and equipment related to the processes.</p>	
<p><u>Assessment method(s):</u></p> <p>Combined method containing verification of theoretical knowledge as well as practical skills.</p>	

<p>B.2.4 Installation and operation of integrated mechatronics systems</p>	<p>EstQF level 5</p>
<p><u>Performance indicators:</u></p> <p>1. Develops simpler integrated mechatronics systems.</p> <p>2. Installs integrated mechatronics systems by following safety requirements. Adjusts, controls and inspects integrated mechatronics systems based on nature of processes.</p> <p>3. Prepares control programmes for different integrated mechatronics systems by using proper application software.</p> <p>4. Performs tasks related to operation, maintenance and repair of the integrated mechatronics systems by using the correct measuring and setup methods.</p>	
<p><u>Supporting knowledge:</u></p>	

- a) Operating principles of integrated mechatronics systems;
- b) Requirements established for integrated mechatronics systems and valid standards;
- c) Means of control and checking-equipment of mechatronics systems (including measuring and test instruments in their area of use);
- d) Technical solutions necessary for cooperation of mechatronics systems; principles for their development and used equipment;
- e) Principles for documenting of mechatronics systems.

Assessment method(s):

Combined method containing verification of theoretical knowledge as well as practical skills.

B.2.5 Management of mechatronics projects

**EstQF level
5**

Performance indicators:

1. Examines the initial task of the mechatronics project and existing documentation. Selects technology proper for performance of the project, determines the technical resources necessary for performance of the project. Prepares risk analysis of the project considering possible modifications during performance of the project. Negotiates with the employer, and, if needed, with the client.
2. Prepares action plan by determining there the time-related as well as phased progress of works. Delegates tasks and responsibility to team members. Coordinates the work of the team members during the whole project. Follows that the performed works conform to the schedule, budget and quality requirements of the project.
3. Analyses project related activities (e.g in the context of risk prevention, from standpoint of quality, more effective use of time and improvement of performance, etc). Manages project related documentation (instruments of delivery and receipt of performed works, product quality certifications, etc), organizes completion of necessary documentation or himself/herself completes the project-related documents.
4. Prepares project-related reporting. Assesses work quality continuously, between the phases as well as in final phase of the project based on valid norms and requirements provided by the contracts. Makes proposals for improvement of quality and activities.

Supporting knowledge:

- a) Project management phases of mechatronics projects;
- b) Principles of allocation of resources of mechatronics projects;
- c) Quality requirements established for mechatronics systems;
- d) Means of control and checking-equipment of mechatronics systems (including measuring and test instruments in their area of use);
- e) Technical solutions necessary for cooperation of mechatronics systems; principles for their development and used equipment;
- f) Principles for documenting of mechatronics systems;
- g) Quality assurance methods of mechatronics projects;
- h) Risk assessment methods of mechatronics projects.

Assessment method(s):

Combined method containing verification of theoretical knowledge as well as practical skills.

B.2.6 Organisation of works, team management and supervising

**EstQF level
5**

Performance indicators:

1. Organises work of the team and delegates tasks relevantly and fairly based on the work organization of the company.
2. Plans activities of own area of activity by being guided by the prescribed work plan and company's internal work procedure rules and taking into account possible changes.
3. Based on the company's work organization, plans, calculates and organizes resources (time, materials, working time of employees, tools, and other) for performance of tasks and reports on progress of works. Finds out which resources are needed, makes proposals for their provision.
4. Follows adherence to deadlines of the production schedule and uses own working time effectively.
5. Organises work of the supervised, supervises them at working and assesses their work. Makes proposals regarding the need of additional training. Makes proposals within the limits of own competence for improvement of work organization.
6. Performs installation and operation training of the equipment for the team (including technical indicators of automatics means).

Supporting knowledge:

- a) Basics of employment law;
- b) Principles of teamwork;
- c) Working environment and occupational safety requirements

Assessment method(s):

Theory questions, test work or interview or monitoring at working place.

TRANSFERSAL COMPETENCES

B.2.8 Mechatronic, level 5 transversal competence	EstQF level 5
<ol style="list-style-type: none"> 1. Uses working time effectively, works systematically and in organized manner and follows the prescribed instruction, procedures and safety requirements. 2. Uses area-specific knowledge and opportunities of the technology for reaching the work related goals. Shares his/her knowledge and specificity of the field also with colleagues and develops professional knowledge through continuous professional development. 3. Thinks fast and understands new information quickly. He/she has no difficulties in acquiring new tasks, methods and techniques. 4. While working, analyses own activities and presents ideas and innovation proposals, if needed, for improvement of work. 5. Mechatronic is a team worker. He/she has clear understanding about developed mechatronic system, he/she communicates with necessary people (colleagues and clients), expresses clearly his/her opinion and does not hide any information. If needed, copes also in conflict situations. Takes criticism reasonably, can make conclusions and learn from it. 6. Keeps track of technical problems in the mechatronics area. Knows how to behave in occurred danger situation and how to solve the problems with possibly little damage. When an error occurs, knows how to stop the system's operation so that the caused damage is possibly little. Uses existing knowledge and experience for fixing the errors. 7. Understands the need for archiving the technical repairs from the standpoint of further work, can fill in prescribed documents. 8. A person working as a mechatronic regards the ethical beliefs and values important. 	
<p><u>Supporting knowledge:</u></p> <ol style="list-style-type: none"> a) General knowledge about physics, mathematics and chemistry; b) General knowledge about mechanics, electronics, electrical engineering, computer technology and 	

software engineering;

- c) Professional terminology: Vocabulary used in instructions, user manuals and work orders;
- d) Technical drawings: Content and symbols;
- e) Mechatronics equipment and installations: Classification, purpose and building and assembly requirements;
- f) Parameters of mechatronics systems;
- g) Functioning principles of mechatronics systems;
- h) Structure of mechatronics equipment control systems;
- i) Principles of information processing and transmission and signal conversion;
- j) Most common mechatronics components (detectors, fillers, PLC-controllers, etc), their functions and operating principles;
- k) Product markings of most common mechatronics components;
- l) different installation works of mechatronics, materials used at installation (structural, electro-technical, etc) and their properties;
- m) Tools and measuring instruments used at installation of mechatronics equipment and systems;
- n) Operating principles of components related to hydraulics and pneumatics;
- o) Occupational health and safety requirements valid at main construction works;
- p) Technical requirements of installation and operation of mechatronics equipment and systems in potentially explosive environment;
- q) Technical requirements of installation and operation of mechatronics equipment and systems in potentially chemically aggressive environment;
- r) Technical requirements of installation and operation of mechatronics equipment and systems in environment with increased sterility;
- s) Occupational health and safety requirements, security measures and personal protective equipment related to mechatronics works;
- t) Requirements established for treatment of environmentally hazardous materials and materials that require disposal;
- u) Documents used in mechatronics works (installation, user and maintenance manuals, diagrams, etc).

Assessment method(s):

Transfersal competencies are appraised in an integrated manner together with appraisal of all other competencies presented in the occupational standard.

Part C GENERAL INFORMATION AND ANNEXES

C.1 Information on the preparation and approval of the occupational standard, on the body awarding occupational qualifications, and reference to the location of the occupational standard in classifications	
Designation of the occupational standard in the register of occupational qualifications	10-18122014-1.2/6k
The occupational standard is compiled by: names of people and organisations	Eduard Brindfeldt – Tallinna Tööstushariduskeskus Raivo Sell – Tallinna Tehnikaülikool Jüri Riives – IMECC OÜ Tõnu Vaher – Eli OÜ Anu Tuuksam – SA Innove
The occupational standard is approved by	Engineering industry, Metallurgical industry and Instrument engineering Sectoral Council
No. of the decision of the Sectoral Council	10
Date of the decision of the Sectoral Council	18.12.2014
The occupational standard is valid until (date)	17.12.2019
Occupational standard version No	6
Reference to the Classification of Occupations (ISCO 08)	7421 Electronics mechanics and servicers
Reference to the level in the European Qualifications Framework (EQF)	5
C.2 Title of occupational qualification in foreign languages	
In English - Mechatronic	
C.3 Annexes	
Annex 1. Units and tasks	

Units and tasks

UNITS AND TASKS		MECHATRONIC, LEVEL 4	MECHATRONIC, LEVEL 5
1	Assembly and installation of mechatronics equipment and subsystems		
1.1	Assembly, installation and disassembly of mechatronics equipment and subsystem components	X	
1.2	Assembly, installation and disassembly of mechatronics subsystems	X	
1.3	Installation and setup of mechatronics subsystem components	X	
1.4	Documenting of works, preparation of user manuals and as-built drawings	X	
2	Assembly and installation of mechatronics systems		
2.1	Assembly, installation and disassembly of mechatronic system components and switchings		X
2.2	Assembly, installation and disassembly of mechatronics systems		X
2.3	Documenting of works, preparation of user manuals and as-built drawings		X
2.4	Evaluation of the quality of work		X
3	Operation of mechatronics equipment and subsystems		
3.1	Operation, setting up and testing of mechatronics equipment or subsystem	X	
3.2	Measuring of electrical and nonelectrical quantities	X	
3.3	Scheduled monitoring of the work of mechatronics equipment and subsystems	X	
3.4	Performance of maintenance and repair work of mechatronics equipment and subsystems	X	
3.5	Performing user training of the equipment for the client	X	
4	Operation of mechatronic equipment and systems		
4.1	Operation, setting up and testing of mechatronics equipment or system		X
4.2	Measuring of electrical and nonelectrical quantities		X
4.3	Scheduled monitoring of mechatronics systems and their assemblies		X
4.4	Maintenance and repair works of mechatronics equipment and systems		X
4.5	Performing user training of the equipment for the client		X
5	Installation, setup and operation of industrial and manufacturing mechatronics equipment and subsystems		
5.1	Installation and setup of industrial and manufacturing mechatronics equipment and subsystems	X	
5.2	Entering, adjusting and use of control programs of industrial and manufacturing mechatronics equipment and subsystems	X	
5.3	Monitoring and inspecting of technological processes of industrial and manufacturing mechatronics equipment and subsystems	X	
5.4	Maintenance of industrial and manufacturing mechatronics equipment and subsystems	X	

6	Installation, setup and operation of industrial and manufacturing mechatronics equipment and systems		
6.1	Installation and setup of industrial and manufacturing mechatronic equipment and systems		X
6.2	Entering and adjusting of control programs of industrial and manufacturing mechatronic equipment and systems		X
6.3	Monitoring and inspecting of technological processes of industrial and manufacturing mechatronics systems		X
6.4	Maintenance of industrial and manufacturing mechatronics equipment and systems		X
7	Installation and operation of integrated mechatronic systems		
7.1	Development of integrated mechatronics systems		X
7.2	Installation and setup of integrated mechatronics systems		X
7.3	Monitoring, inspection and setup of technological processes of integrated mechatronics systems		X
7.4	Performance of maintenance and repair work of the integrated mechatronic systems		X
8	Management of mechatronic projects		
8.1	Selection and planning of technology of mechatronics projects		X
8.2	Coordination of the activities and teamwork of mechatronics projects		X
8.3	Analysis and documenting of mechatronics project activities		X
8.4	Reporting, quality control and assessment of mechatronics projects		X
9	Organisation of works, team management and supervising		
9.1	Organisation and delegation of works		X
9.2	Preparation of a work plan and planning of activities		X
9.3	Resource control		X
9.4	Following of the production schedule		X
9.5	Direct supervision of workers, finding out the need for in-service training		X
9.6	Conducting of internal in-service training		X