

Ordinance on Vocational Education and Training
(for Training Companies)
and Skeleton Curriculum
(for Vocational Schools)

in the Occupation of

Electronics Technician for Industrial Engineering

(English Version)

Bundesinstitut für Berufsbildung (BIBB)
Der Präsident
Robert-Schuman-Platz 3, 53175 Bonn
<http://www.bibb.de>

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Note: The training regulations for the electronics technician for industrial engineering are part of the common training regulations for several electronics professions (see § 1). In this document, the numbering is taken from the original and is therefore discontinuous.

Publication of the revised Ordinance on vocational education and training in the industrial electrical occupations^{*)}

From 9 July 2018, in respect of training for the occupation of

Electronics technician for industrial engineering

Whereas by reason of § 25 para. 1 of the Vocational Training Act of 14 August 1969 (Federal Law Gazette, BGBl., I p. 1112) in conjunction with para. 2 clause 1 ibid (as amended by Article 212 No. 2 of the Ordinance dated 29 October 2001 (BGBl. I p. 2785), in conjunction with § 1 of the German Jurisdictional Harmonisation Act of 16 August 2002 (BGBl. I p. 3165) and in conjunction with the Organisational Ordinance of 22 October 2002 (BGBl. I p. 4206) and in agreement with the Federal Ministry of Education and Research, the Federal Ministry of Economics and Labour does decree:

Based on Article 2 of the ordinance of 7 June (BGBl. 1 S. 678), the wording of the ordinance on vocational education and training in the industrial electrical occupations of the version valid as of 1 August 2018 is publicised below. The revised ordinance takes into account:

1. The ordinance of 24 July 2007 (BGBl. 1 S. 1678) which entered into force on 1 August 2007,
2. article 1 of the ordinance of 15 February 2013 (BGBl. 1 S. 292) which entered into force on 1 August 2013,
3. article 2 of the ordinance of 28 June 2013 (BGBl. 1 S. 2201) which entered into force on 1 August 2013 and,
4. article 1 of the previously stated ordinance which came into force on 1 August 2018.

Part 1 Joint stipulations

§ 1

State recognition of the training occupations

The training occupations

1. Electronics technician for building and infrastructure systems,
 2. Electronics technician for industrial engineering,
 3. Electronics technician for automation,
 4. Electronics technician for devices and systems,
 5. Systems informatics technician,
 6. Electronics technician for aerospace systems
- are accorded state recognition pursuant to § 4 para. 1 of the Vocational Training Act.

§ 2

Duration of training

Training is of three and a half years' duration.

§ 3

Structure and objective of the vocational education and training

(1) The competences, knowledge and skills stated in the present Ordinance (occupational employability) are to be imparted in a process related manner. These qualifications are to be imparted in such a way so as to enable trainees to exercise a qualified occupational activity within the meaning of § 1 para. 3 of the Vocational Training Act, this particularly to encompass autonomous planning, execution and checking as well as activities within the overall business context. Evidence of the competence described in Clause 2 is also to be provided in the examinations pursuant to §§ 9 and 10, 13 and 14, 17 and 18, 21 and 22, 25 and 26 and 29 and 30.

(2) The imparting of the joint basic skills pursuant to § 7 para. 1 clauses 1 to 11, § 11 para. 1 clauses 1 to 11, § 15 para. 1 clauses 1 to 11, § 19 para. 1 clauses 1 to 11, § 23 para. 1 clauses 1 to 11 and § 27 para. 1 clauses 1 to 11 and the occupationally specific skills pursuant to § 7 para. 1 clauses 12 to 17, § 11 para. 1 clauses 12 to 17, § 15 para. 1 clauses 12 to 17, § 19 para. 1 clauses 12 to 17, § 23 para. 1 clauses 12 to 17 and § 27 para. 1 clauses 12 to 17 each extends over a period of 21 months and takes place in an integrated fashion distributed across the entire duration of training and according due consideration to the aspects of sustainability.

(4) Within the scope of the occupationally specific specialist skills, occupational competence is to be extended and deepened within a field of deployment via the imparting of skills which enabled holistic execution of complex tasks within the respective business process.

§ 4

Training plan

The general training plan is to constitute the basis by which those providing training are to draw up a training plan for trainees.

§ 5

Written record of training

Trainees are to keep a written record of training. They are to be afforded the opportunity of maintaining their report book during training time. Trainees are to review the report book on a regular basis.

^{*)} The present statutory Ordinance constitutes a training regulation within the meaning of § 4 of the Vocational Training Act. The training regulation has been published in the Federal Gazette. The training regulation is supplemented by the skeleton curriculum for theoretical vocational training, whereby the latter is not included in this transcription.

§ 6

Final examination

The final examination comprises Parts 1 and 2, which take place in a staggered fashion at different times. The function of the final examination is to ascertain whether the candidate has acquired occupational competence. In the final examination, candidates are to demonstrate that they have obtained the necessary skills for this purpose, are in possession of the required vocational knowledge and abilities and are familiar with the teaching material to be imparted during teaching at the vocational school. During the examination process, skills which have already formed an object of Part 1 of the final examination are only to be included in Part 2 of the final examination to the extent that such inclusion is necessary for the determination of employability pursuant to § 38 of the Vocational Training Act.

Part 3
Stipulations for the training occupation of
Electronics technician for industrial
engineering

§ 11
Training profile

(1) The following skills shall constitute the minimum object of the vocational education and training:

1. VET, employment and collective wage agreement law,
2. Structure and organisation of the company providing training,
3. Health and safety at work,
4. Environmental protection,
5. Digitalisation of work, data protection and information security,
6. Company and technical communication,
7. Planning and organisation of work, evaluation of work results,
8. Assembly and connection of operating equipment,
9. Measuring and analysis of electrical functions and systems,
10. Assessing the safety of electrical plants and equipment,
11. Installing and configuring IT systems,
12. Advising and assisting customers, provision of services,
13. Technical analysis of orders, developing solutions,
14. Installing and putting electrical plants into service,
15. Configuring and programming controls,
16. Maintenance of plants and systems,
17. Technical service & operation,
18. Business processes and quality management within the field of deployment.

(2) The skills pursuant to para. 1 are to be applied and deepened in one of the following areas of deployment:

1. Power distribution facilities/networks
2. Installations and networks in buildings
3. Factory facilities, factory equipment
4. Production and process engineering facilities
5. Switch and control gear
6. Electro technical equipment

The area of deployment is to be stipulated by the company providing training. Other areas of deployment are permissible, providing it is possible to impart the skills pursuant to para. 1.

§ 12
General training plan

The skills stated in § 10 para. 1 (training profile) are to be imparted in accordance with the instructions contained within Annex 1 and Annex 3 in respect of the content and time structure of the vocational education and training (general training plan). Content and time structure of training content which deviates from that contained within the general training plan is permitted in particular to the extent to which specific company practices necessitate such a deviation.

§ 13
Part 1 of the final examination

(1) Part 1 of the final examination is to take place before the end of the second year of training.

(2) Part 1 of the final examination encompasses such skills as are listed for the first year of training in Annex 3 and also includes teaching material to be imparted at vocational school in accordance with the skeleton curriculum insofar as such material is integral to the vocational education and training.

(3) Candidates are to demonstrate that they are able to

1. evaluate technical documentation, determine technical parameters, plan and coordinate work processes, obtain materials and tools;
2. assemble, disassemble, wire, connect and configure pieces of equipment according due consideration to safety rules, accident prevention regulations and environmental protection stipulations;
3. Assess the safety of electrical plants and operating equipment, check electrical safety measures;
4. analyse electrical systems and check functions, identify and eliminate errors, set and measure operating values;
5. put products into service, hand over and explain products, document the processing of the order, draw up technical documentation, including test protocols.

Candidates should use a functioning piece of electronic equipment to demonstrate these requirements.

(4) The examination comprises the execution of a complex work related task, the situational oral examination elements and written assignment of tasks. The examination is of a maximum duration of eight hours, whereby the situational oral examination elements are to take up a total of no more than ten minutes. The written assignment of tasks are to extend over a maximum period of 90 minutes.

§ 14

Part 2 of the final examination

(1) Part 2 of the final examination encompasses such skills as are listed for the first year of training in Annex 1 and Annex 3 and also includes teaching material to be imparted at vocational school insofar as such material is integral to the vocational education and training.

(2) Part 2 of the final examination comprises the examination areas of

1. a company order,
2. system design,
3. function and system analysis and
4. business and social studies.

Attention is also to be accorded to VET, employment and collective wage agreement law, structure and organisation of the company providing training, health and safety at work, environmental protection, digitalisation of work, data protection and information security, company and technical communication, planning and organisation of work, evaluation of results, quality management and assessing the safety of electrical plants and equipment.

(3) In the examination area of the company order, candidates are to demonstrate that they are able to

1. analyse company orders, obtain information, clarify technical and organisational interfaces, evaluate and select possible solutions according due attention to business administration and ecological aspects,
2. plan and agree order processes, stipulate partial tasks, draw up planning documentation, accord due attention to work processes and areas of responsibility in the area of deployment,
3. execute orders, check and document functionality and safety, comply with standards and specifications relating to the quality and safety of plants, and systematically troubleshoot and solve causes of errors and defects,
4. authorise and transfer products, provide specialist information, prepare acceptance protocols, document work results and services, charge for services and document plant data and paperwork.

In terms of certification of the above, particular regard will be accorded to the setting up, modification or maintenance of electrical plants or the production of electrical pieces of equipment.

(4) For the purposes of certification of the requirements in the examination area of the company order, candidates are to

1. execute a company order within 18 hours, documenting this in the form of practice related documentation, and conduct a specialist oral examination of a maximum of 30 minutes' duration in respect of the order. The specialist oral examination will take place on the basis of the practically related documentation for the order executed. The specialist

oral examination is to act as a vehicle for the evaluation of skills relevant to the process in respect of the execution of the order and the practically related documentation is to be accorded consideration. Before execution of the order, the task assignment including the planned processing time is to be submitted to the examination board for approval or

2. in not more than 14 hours prepare, execute, and follow up a work related task, documenting this with task specific paperwork and conducting an attendant specialist oral examination of not more than 20 minutes. The duration of the execution of the work related task is to be seven hours. Evaluation of skills relevant to the process in respect of the execution of the work related task is to take place via observations of the execution of the work related task and via the task specific documentation and the specialist oral examination.

(5) The company providing training is to select the examination mode in accordance with paragraph 4 and inform candidates and the competent body when registration for the examination is made.

(6) In the examination area of the system design, candidates are to draw up modifications to be made to a piece of technical equipment in accordance with requirements stipulated. During this process, candidates are to demonstrate that they are able to conduct technical problem analyses, develop concepts for solutions according due attention to regulations, technical rules, guidelines, economic profitability and company processes, stipulate plant specifications in a way appropriate to use, select electrical components, adapt circuit documentation and use standard software.

(7) In the function and system analysis examination area, candidates are to analyse an electrical plant in a maximum of 120 minutes. During this process, candidates are to demonstrate that they are able to evaluate circuit and plant documentation, analyse functional correlations in electrical plants, interpret and modify control programmes, select measurement and inspection procedures, allocate signals functionally to interfaces, determine the causes of errors and evaluate electrical protection measures.

(8) In the examination area of business and social studies, candidates are to process practically related and employment oriented tasks in a maximum of 60 minutes, demonstrating that they are able to present and judge general business and social contexts with the world of occupations and work.

1. The specialist oral examination is to act as a vehicle for the evaluation of skills relevant to the process in respect of the execution of the order and the practically related documentation is to be accorded consideration. Before execution of the order, the task assignment including the planned processing time is to be submitted to the examination board for approval or
2. in not more than 14 hours prepare, execute, and follow up a work related task, documenting this with task

specific paperwork and conducting an attendant specialist oral examination of not more than 20 minutes. The duration of the execution of the work related task is to be seven hours. Evaluation of skills relevant to the process in respect of the execution of the work related task is to take place via observations of the execution of the work related task and via the task specific documentation and the specialist oral examination.

(5) The company providing training is to select the examination mode in accordance with paragraph 4 and inform candidates and the competent body when registration for the examination is made.

(6) In the examination area of system design, candidates are to design appliances and circuits for the testing of technical aeronautical systems in accordance with requirements stipulated and in a maximum of 120 minutes. During this process, candidates are to demonstrate that they are able to conduct a technical problem analysis and select and deploy testing procedures and diagnostic systems whilst according due attention to regulations, technical rules, economic profitability and company processes, stipulate tests and inspection processes according due consideration to specifications and system stipulations, stipulate test processes in compliance with guidelines relating to quality and process assurance, evaluate circuit documentation and use standard software.

(7) In the examination area of function and system analysis, candidates are to analyse a technical aeronautical subsystem or system in a maximum of 120 minutes. During this process, candidates are to demonstrate that they are able to evaluate technical documentation, including English language documentation, analyse functional correlations in technical aviation systems, allocate signals functionally to interfaces, determine the causes of errors, evaluate electromagnetic compatibility and evaluate electrical protection measures.

(8) In the examination area of business and social studies, candidates are to process practically related and employment oriented tasks in a maximum of 60 minutes, demonstrating that they are able to present and judge general business and social contexts with the world of occupations and work.

Part 7

Joint pass regulations

§ 27

Pass regulation

(1) The pass regulations stated in the subsequent paragraphs apply in respect of the training occupations listed in the present regulation.

(2) For the purposes of determining the overall result, weighting of 40 percent is applied to Part 1 of the final examination and weighting of 60 percent is applied to Part 2 of the final examination.

(3) For the purposes of determining the result of Part 2, weighting of 50 percent will be applied to the examination area of the company order, 20 percent each to the examination areas of system design and function and system analysis and 10 percent to the area of business and social studies.

(4) The examination shall be deemed to have been passed if at least sufficient fulfilment of requirements has been achieved

1. in the overall result pursuant to para. 2 and
2. in the examination area of the company order and
3. for the overall result achieved in the examination areas of system design, function and system analysis and business and social studies.

At least sufficient fulfilment of requirements must be achieved in two of the examination areas in point 3. Fulfilment of requirements must not have been unsatisfactory in the third examination area under point 3n.

(5) On application of the candidate or by the judgement of the examination board within individual examination areas, the examination areas of system design, function and system analysis and business and social studies may be replaced by an oral examination if this can prove decisive for the passing of the examination. In calculating the result for this examination area, the previous result and the result of the supplementary oral examination shall be accorded weighting in the ratio of 2:1.

Part 8

Additional occupational competencies, knowledge and skills

§ 28

Additional qualification

Beyond the respective training occupation profile described in Section 7 Paragraph 1, Section 11 Paragraph 1, Section 15 Paragraph 1, Section 19 Paragraph 1 and Section 23 Paragraph 1, training in one or more of the following additional qualifications can be arranged:

1. Digital Networking
2. Programming
3. IT Security

§ 29

Subject of the additional qualifications

(1) The subject of the additional qualification Digital Networking is the competencies, knowledge and skills stated in Appendix 7 Part A.

(2) The subject of the additional qualification Programming is the competencies, knowledge and skills stated in Appendix 7 Part B.

(3) The subject of the additional qualification IT Security is the competencies, knowledge and skills stated in Appendix 7 Part C.

§ 30
Application for examination in
additional qualification, time

(1) An examination in the additional qualification can take place upon request by the trainee if the trainee has provided reasonable evidence that they have learnt the necessary competencies, knowledge and skills.

(2) The examination takes place in the form of a special examination in the scope of Part 2 of the final examination.

§ 31
Requirements for the examination in additional
qualification Digital Networking

(1) The examination in additional qualification Digital Networking covers the competencies, knowledge and skills stated in Annex 7.

(2) In the examination in the additional qualification, the candidate should demonstrate that they are able to

1. analyse systems, process procedures and technical conditions, establish network requirements, and develop, evaluate and select solution variants,
2. Select, install and configure network components and integrate these into existing infrastructure, document system information and documents, and
3. Assess error, malfunctions or bottlenecks, evaluate data throughput and error rates, rectify errors, test the system, and suggest optimisation possibilities.

§ 32
Requirements for the examination in
additional qualification Programming

(1) The examination in additional qualification Programming covers the competencies, knowledge and skills stated in Annex 7.

(9) In the examination in the additional qualification, the candidate should demonstrate that they are able to

1. analyse systems, process procedures and technical conditions, and establish software model requirements,
2. adjust software modules and integrate these into existing systems, document software, and
3. create test plans and test data, simulate environmental conditions, test the systems, and rectify errors.

§ 33
Requirements for the examination in additional
qualification IT Security

(1) The examination in additional qualification IT Security covers the competencies, knowledge and skills stated in Annex 7.

(2) In the examination in the additional qualification, the candidate should demonstrate that they are able to,

1. develop technical and organisational IT security measures based on legal and operational guidelines and reconcile these,
2. implement IT security measures, and
3. monitor the implemented IT security measures.

§ 34
Completing and passing
the examination in the additional qualification

(1) A case-specific oral discussion on the relevant imparted additional qualification is conducted during the examination.

(2) In preparation for the respective case-specific oral discussion, the candidate is to independently perform a practice-related task in the training company: The trainer must confirm the independence of the performance.

(3) The candidate is required to create a report on the practice-related task. In the report, they must describe the task definition, the objective, the planning, the approach and the result of the practice-related task, as well as reflect on the process which led to the result. The report must be no longer than three pages.

(4) The candidate must supplement the report with an annex. The annex consists of visualisations of the practice-related task. It must comprise no more than five pages.

(5) The candidate begins the case-related oral discussion with a presentation of the practice-related task and the solution process. Based on the practice-related task and the report created for it, the examination board develop the case-related oral discussion such that each requirement can be demonstrated.

(6) The case-related oral discussion lasts a maximum of 20 minutes.

(7) Only the candidate's performance in the case-related oral discussion is assessed.

(8) The examination in the additional qualification is passed if the examination performance has been assessed as at least "sufficient".

Part 9
Joint transitional provisions

§ 35
Grandfather clause

The ordinance on vocational education and training in the industrial electrical occupations of 24 July 2007 (BGBl. I S. 1678), last changed by means of Article 2 of the ordinance from 28 June 2013 (BGBl. I S. 2201) is to continue to be applied to vocational education and training relationships that already exist before 1 August 2018.

§ 36
Change to existing vocational education and training
relationships

Vocational education and training relationships that already exist before the 1 August 2018 can be continued according to the stipulations of this ordinance in its version valid as of 1 August 2018 by offsetting the already completed training time, if the contractual parties agree this and or the trainee has not yet completed part 1 of the final examination.

§ 37
Additional qualification for
existing vocational education and training
relationships

The regulations regarding the additional qualifications according to Part 8 can, as of 1 August 2018, be applied to vocational education and training relationships that already exist before 1 August 2018.

Berlin, 28 June 2018

The Federal Minister of Economic Affairs and Energy
per procuracionem
Nussbaum

General training plan for vocational education and training in the industrial electrical occupations

Joint basic skills

No.	Part of the training occupation profile	Basic skills to be imparted, incorporating autonomous planning, execution and checking and integrated with occupationally specific specialist skills
1	2	3
1	VET, employment and collective wage agreement law (§ 7 para. 1 No. 1, § 11 para. 1 No. 1, § 15 para. 1 No. 1, § 19 para. 1 No. 1, § 23 para. 1 No. 1)	a) Explain the significance of the training contract, in particular conclusion, duration and termination b) State mutual rights and responsibilities arising from the training contract c) State opportunities for advanced vocational training d) State essential parts of the training contract e) State essential provisions contained within the collective wage agreements applying to the company providing training
2	Structure and organisation of the company providing training (§ 7 para. 1 No. 2, § 11 para. 1 No. 2, § 15 para. 1 No. 2, § 19 para. 1 No. 2, § 23 para. 1 No. 2)	a) Explain structure and tasks of the company providing training b) Explain the basic functions of the company providing training, such as procurement, production, sales and administration c) State the relationships of the company providing training and its staff to organisations of trade and industry, professional bodies and trade unions d) Describe the basic principles, tasks and way of working of labour-management relations or staff representative organs within the company providing training
3	Health and safety at work (§ 7 para. 1 No. 3, § 11 para. 1 No. 3, § 15 para. 1 No. 3, § 19 para. 1 No. 3, § 23 para. 1 No. 3)	a) Ascertain health and safety risk in the workplace and adopt measures for the avoidance of this b) Deploy occupationally related health and safety and accident prevention measures c) Describe behaviours when accidents occur and institute initial measures d) Comply with provisions and safety regulations when working on electrical plants, appliances and equipment e) Deploy regulations for preventative fire protection; describe behaviours in the event of fire and initiate fire fighting measures
4	Environmental protection (§ 7 para. 1 No. 4, § 11 para. 1 No. 4, § 15 para. 1 No. 4, § 19 para. 1 No. 4, § 23 para. 1 No. 4)	Contribute to the avoidance of instances of environmental pollution caused by the company within the occupational sphere of influence, in particular a) Explain possible instances of environmental pollution caused by the company providing training and its contribution to environmental protection using examples b) Deploy environmental protection regulations as these apply to the company providing training c) Take opportunities to use energy and materials in an environmentally friendly manner d) Avoid waste; make substances and materials available for environmentally friendly disposal
5	Digitalisation of work, data protection and information security (§ 7 para. 1 No. 5, § 11 para. 1 No. 5, § 15 para. 1 No. 5, § 19 para. 1 No. 5, § 23 para. 1 No. 5)	a) Use standard software to prepare order-related and technical documentation b) Manage, replace, secure and archive data and documents c) Enter, process, transmit, receive and analyse data d) Apply regulations regarding data protection e) Deploy information technology systems (IT systems) to plan and execute orders and to track schedules f) Research information sources and information, procure information from digital networks and evaluate information g) Use digital learning media h) Take account of the information technology protective objectives of availability, integrity, confidentiality and authenticity i) Comply with company guidelines relating to mobile storage media, electronic mail, IT systems and Internet sites j) Recognise abnormalities and irregularities in IT systems and initiate measures to rectify these k) Use assistance, simulation, diagnosis or visualisation systems l) Communicate, plan and cooperate in interdisciplinary teams
6	Company and technical communication (§ 7 para. 1 No. 6,	a) Evaluate, use and draw up technical drawings and circuit documentation, prepare sketches b) Evaluate and use documents and technical regulations and occupationally related

No.	Part of the training occupation profile	Basic skills to be imparted, incorporating autonomous planning, execution and checking and integrated with occupationally specific specialist skills
1	2	3
	§ 11 para. 1 No. 6, § 15 para. 1 No. 6, § 19 para. 1 No. 6, § 23 para. 1 No. 6)	provisions, including in English c) Work together in the virtual environment, exchange product and process data, as well as instructions and function descriptions d) Conduct appropriate and target oriented discussions with line managers, employees and within the team e) Present facts and circumstances, prepare protocols, use German and English specialist terminology f) Compile and supplement documentation in German and English g) Organise and chair meetings, prepare decisions within the team, minute results of discussions h) Present data, facts and circumstances and possible solutions i) Resolve disputes within the team j) Conduct written communication in German and English
7	Planning and organisation of work, evaluation of work results (§ 7 para. 1 No. 7, § 11 para. 1 No. 7, § 15 para. 1 No. 7, § 19 para. 1 No. 7, § 23 para. 1 No. 7)	a) Set up workplace or assembly location according due consideration to operational stipulations b) Ascertain and select tools, devices, diagnosis systems and other materials for the work process, request, test, transport, store and make these available for use in a timely manner c) Plan work processes and partial tasks in compliance with statutory, economic and schedule stipulations, operational processes as well as up and downstream sectors, set priorities in the event of deviations from planning d) Plan and agree tasks within the team, accord consideration to cultural identities e) Conduct calculations in accordance with company stipulations, show solution variants, compare costs f) Set up computer workplace in accordance with ergonomic aspects, set up graphical user interfaces g) Check order documentation and technical feasibility of the order and coordinate with company capacities h) Record and evaluate data relevant to business administration i) Recognise and deploy influences with the work situation, the working environment and working behaviours within the team which lead to an increase in quality in work results j) Compare internal and external provision of services k) Ascertain skills gaps, use training opportunities and various learning techniques l) Monitor, evaluate and document work results
8	Assembly and connection of electrical operating equipment (§ 7 para. 1 No. 8, § 11 para. 1 No. 8, § 15 para. 1 No. 8, § 19 para. 1 No. 8, § 23 para. 1 No. 8)	a) Assembly and disassembly of sub-assemblies and modification of parts using mechanical processing b) Select and prepare cables and connect sub-assemblies and equipment with different connection technologies c) Stipulate cabling routes and locations for the assembly of equipment according due consideration to electromagnetic compatibility d) Select and assemble operating equipment and cabling routing systems e) Install cabling f) Produce electrical equipment or set up electrical plants, put equipment or plants into operation g) Comply with electro technical rules when setting up, modifying, maintaining and operating electrical plants and operating equipment h) Avoid waste, evaluate waste materials, unused operating materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal
9	Measurement and analysis of electrical functions and systems (§ 7 para. 1 No. 9, § 11 para. 1 No. 9, § 15 para. 1 No. 9, § 19 para. 1 No. 9, § 23 para. 1 No. 9)	a) Select measuring procedures and measuring equipment b) Measure, evaluate and calculate electrical values c) Check ratings and function of sub-assemblies d) Analyse control circuits e) Track signals and check these at interfaces f) Conduct systematic trouble shooting g) Check and set sensors and actuators h) Check and evaluate open and closed loop controls in respect of function i) Check functionality of systems and components, interpret data protocols

No.	Part of the training occupation profile	Basic skills to be imparted, incorporating autonomous planning, execution and checking and integrated with occupationally specific specialist skills
1	2	3
10	Assessment of the safety of electrical plants and operating equipment (§ 7 para. 1 No. 10, § 11 para. 1 No. 10, § 15 para. 1 No. 10, § 19 para. 1 No. 10, § 23 para. 1 No. 10)	a) Check and assess the function of protection and potential equalisers b) Measure and assess insulating resistances c) Assess basic protection measures against electrical shock d) Assess cables and other operating equipment and the protective measures applied to these, in particular in respect of ampacity e) Assess the types of protection applied to electrical devices or plants in respect of environmental conditions and additional stipulations for special types of premises f) Assess risks arising from the operation of electrical devices, operating equipment and plants and ensure safe use via instigation of protective measures g) Assess the effectiveness of measures to counter electrical shock when errors arise, in particular occasioned by the switching off of over current protection devices and residual current protection devices h) Assess the electrical safety of portable operating equipment i) Assess fire protection regulations when setting up and operating electrical equipment and plants
11	Installation and configuration of IT systems (§ 7 para. 1 No. 11, § 11 para. 1 No. 11, § 15 para. 1 No. 11, § 19 para. 1 No. 11, § 23 para. 1 No. 11)	a) Select hardware and software components b) Install and configure operating systems and applications c) Integrate IT systems into networks d) Deploy tools and test programmes
12	Customer advice and care, provision of services (§ 7 para. 1 No. 12, § 11 para. 1 No. 12, § 15 para. 1 No. 12, § 19 para. 1 No. 12, § 23 para. 1 No. 12)	a) Determine wishes and requirements of customers, develop possible solutions and alternative forms of implementation b) Indicate maintenance works and intervals c) Record fault reports d) Agree details of the processing of the order, in the event of faults in processing of the order indicate alternative solutions e) Explain performance characteristics, provide instruction in operation, indicate risks, safety rules and regulations f) Provide technical support g) Organise exchange of information with the customers

Annex 3
(to § 11)

General training plan for vocational education and training in the occupation of Electronics technician for industrial engineering

Part A: Content structure for the occupationally specific specialist skills

No.	Part of the training occupation profile	Specialist skills to be imparted, incorporating autonomous planning, execution and checking and integrated with basic skills
1	2	3
13	Technical analysis of orders, developing solutions (§ 11 para. 1 No. 13)	a) Analyse customer requirements b) Assess existing plants included in operating equipment c) Design modifications and extensions to plants, stipulate electrical circuits and protective measures, select components and cables d) Check order documentation and compare with local conditions, stipulate delineation of on-site services e) Select measuring, open and closed loop control systems, sensors, actuators, software and other components f) Plan modifications to plants according due consideration to company processes of the customer g) Document services to be provided, modify circuit documentation
14	Installing and putting electrical plants into operation (§ 11 para. 1 No. 14)	a) Select, assemble and disassemble ladders, scaffolding and installation platforms b) Select and deploy lifting equipment, fittings and transport, secure loading and execute transport c) Check suitability of the subsurface for mounting, prepare anchoring and load bearing constructions and fix consoles d) Adjust, fix and connect machines, equipment, drive systems and other operating equipment e) Assemble and erect plug-in modules, housings and control unit combinations f) Install, wire up and label control units g) Install, wire up and label operating equipment for open and closed loop control, measuring and checking h) Mount protective systems, cladding and insulation i) Assemble data links j) Adjust and connect energy technology links and cables k) Process communication technology cables using various connecting technologies l) Connect components using pipe and hose links m) Create earthing and potential equaliser, measure and assess earthing and loop impedance n) Put main and auxiliary current circuits into operation o) Install, check and put into operation signal and data transmission systems p) Parameterise and put drive systems into operation, adjust ratings q) Check non-electrical components of plants, in particular pneumatic sub-assemblies r) Mount and assemble lighting systems s) Adjust protective systems and check the effectiveness of these, ensure the effectiveness of safety measures t) Check emergency shut down and alarm systems and mechanical safety systems u) Check compliance with measures relating to electromagnetic compatibility v) Draw up test protocols, draw up and adapt documentation, hand over plants or system
15	Configuration and programming of controls (§ 11 para. 1 No. 15)	a) Adjust, modify and put into operation the hardware and software used for measurement and control technology sub-assemblies b) Install and configure applications software c) Analyse, adjust and modify control programmes d) Check functional processes and modify programme processes e) Adjust architectures, protocols and interfaces of automation devices to networks and bus systems f) Install storage media and programmes to secure data

No.	Part of the training occupation profile	Specialist skills to be imparted, incorporating autonomous planning, execution and checking and integrated with basic skills
1	2	3
16	Maintenance of plants and systems (§ 11 para. 1 No. 16)	a) Plan maintenance and inspection measures b) Inspect systems, check function of plants and safety systems and protocol checks c) Maintain systems in accordance with maintenance and repair plans, replace wearing parts as part of preventative maintenance d) Compare systems parameters with stipulated values and adjust e) Use diagnostic systems, check function of sub-assemblies, replace defective sub-assemblies f) Maintain and repair decentralised energy supply systems g) Assess, maintain and repair energy distribution systems h) Maintain and repair processing machines i) Maintain and repair communication plants j) When putting back into operation equipment or parts of plants which have been the object of maintenance, adjust protective measures and safety systems and check the effectiveness of these k) Document maintenance measures
17	Technical service and operation (§ 11 para. 1 No. 17)	a) Provide and execute service b) Comply with company stipulations when drawing up offers and estimates c) Make customers aware of guarantee claims and provide advice on technical and economic feasibility d) Hand over plants, provide customers with initial instructions on how to operate technical systems e) Document services provided f) Monitor technical plants g) Conduct remote diagnosis and maintenance h) Evaluate plant and diagnostic data and use this for purposes of optimisation i) Operate and adjust visualisation applications of technical plants j) Record consumption data of energy and operating equipment, establish reasons for deviations from reference value, optimise consumption
18	Business processes and quality management within the area of deployment (§ 11 para. 1 No. 18)	a) Make customers aware of and provide advice on specific offers, accept orders b) Obtain and evaluate information, use and process documentation, ascertain technological developments, accord due consideration to documentation relating to safety c) Analyse starting position, clarify technical and organisational interfaces, document interfaces, stipulate order objectives, define subtasks, draw up technical documentation and take part in cost planning d) Obtain, check and evaluate offers and estimates according due consideration to company stipulations e) Plan order processing and coordinate this with upstream and downstream areas, draw up planning documentation f) Arrange for, monitor and check services from third parties g) Process orders, in particular according consideration to health and safety and environmental protection, monitor observance of schedules h) Select checking methods and test equipment, ascertain utilisability of test equipment, use inspection plans and company testing procedures i) Comply with standards and specifications in respect of quality and safety of the products and safety of the order processing, use quality assurance systems, search for, resolve and document causes of errors and quality defects in a systematic manner j) Document the order process, charge for services, draw up charge data, conduct subsequent calculations k) Authorise technical systems for use, hand technical systems over, prepare acceptance protocols, explain products and services l) Conduct target-performance comparison with planning data, evaluate work results and implementation of work m) Make a contribution to continuous improvement of work processes both within company operations and within own work area n) Assess lifecycle data of projects, services, products and resources, and develop suggestions for optimising procedures and processes

Part B: Time structure

Occupational profile item	Part of the training occupation profile	Basic and specialist skills to be imparted in an integrated manner, incorporating autonomous planning, execution and checking	Time framework in months
1	2	3	4

Section 1:

1	VET, employment and collective wage agreement law (§ 11 para. 1 No. 1)	a) Explain the significance of the training contract, in particular conclusion, duration and termination b) State mutual rights and responsibilities arising from the training contract c) State opportunities for advanced vocational training d) State essential parts of the training contract e) State essential provisions contained within the collective wage agreements applying to the company providing training	to be imparted over the whole course of the training period
2	Structure and organisation of the company providing training (§ 11 para. 1 No. 2)	a) Explain structure and tasks of the company providing training b) Explain the basic functions of the company providing training, such as procurement, production, sales and administration c) State the relationships of the company providing training and its staff to organisations of trade and industry, professional bodies and trade unions d) Describe the basic principles, tasks and way of working of labour-management relations or staff representative organs within the company providing training	
3	Health and safety at work (§ 11 para. 1 No. 3)	a) Ascertain health and safety risk in the workplace and adopt measures for the avoidance of this b) Deploy occupationally related health and safety and accident prevention measures c) Describe behaviours when accidents occur and institute initial measures d) Comply with provisions and safety regulations when working on electrical plants, appliances and equipment e) Deploy regulations for preventative fire protection; describe behaviours in the event of fire and initiate fire fighting measures	
4	Environmental protection (§ 11 para. 1 No. 4)	Contribute to the avoidance of instances of environmental pollution caused by the company within the occupational sphere of influence, in particular a) Explain possible instances of environmental pollution caused by the company providing training and its contribution to environmental protection using examples b) Deploy environmental protection regulations as these apply to the company providing training c) Take opportunities to use energy and materials in an environmentally friendly manner d) Avoid waste; make substances and materials available for environmentally friendly disposal	

Occupational profile item	Part of the training occupation profile	Basic and specialist skills to be imparted in an integrated manner, incorporating autonomous planning, execution and checking	Time framework in months
1	2	3	4
5	Digitalisation of work, data protection and information security, (§11 Abs. 1 Nr. 5)	a) Use standard software to prepare order-related and technical documentation b) Manage, replace, secure and archive data and documents c) Enter, process, transmit, receive and analyse data d) Apply regulations regarding data protection e) Deploy information technology systems (IT systems) to plan and execute orders and to track schedules f) Research information sources and information, procure information from digital networks and evaluate information g) Use digital learning media h) take account of the information technology protective objectives of availability, integrity, confidentiality and authenticity i) Comply with company guidelines relating to mobile storage media, electronic mail, IT systems and Internet sites j) Recognise abnormalities and irregularities in IT systems and initiate measures to rectify these k) Use assistance, simulation, diagnosis or visualisation systems l) Communicate, plan and cooperate in interdisciplinary teams	

Section 2:

1st year of training

(Time framework 1)

6	Company and technical communication (§ 11 para. 1 No. 6)	a) Research and procure sources of information and information, conduct database enquiries, evaluate information b) Evaluate, use and draw up technical drawings and circuit documentation, prepare sketches	2 to 4
7	Planning and organisation of work, evaluation of work results (§ 11 para. 1 No. 7)	a) Set up workplace or assembly location according due consideration to operational stipulations b) Ascertain and select tools, devices, diagnosis systems and other materials for the work process, request, test, transport, store and make these available for use in a timely manner c) Monitor, evaluate and document work results	
8	Assembly and connection of electrical operating equipment (§ 11 para. 1 No. 8)	a) Assembly and disassembly of sub-assemblies and modification of parts using mechanical processing	
9	Measurement and analysis of electrical functions and systems (§ 11 para. 1 No. 9)	a) Select measuring procedures and measuring equipment b) Measure, evaluate and calculate electrical values	

(Time framework 2)

6	Company and technical communication (§ 11 para. 1 No. 6)	a) Evaluate, use and draw up technical drawings and circuit documentation, prepare sketches b) Evaluate and use documents and technical regulations and occupationally related provisions, including in English	3 to 5
7	Planning and organisation of work, evaluation of work results (§ 11 para. 1 No. 7)	a) Set up workplace or assembly location according due consideration to operational stipulations c) Plan work processes and partial tasks in compliance with statutory, economic and schedule stipulations, operational processes as well as up and downstream sectors set priorities in the event of deviations from planning	

Occupational profile item	Part of the training occupation profile	Basic and specialist skills to be imparted in an integrated manner, incorporating autonomous planning, execution and checking	Time framework in months
1	2	3	4
8	Assembly and connection of electrical operating equipment (§ 11 para. 1 No. 8)	b) Select and prepare cables and connect sub-assemblies and devices with different connection technologies c) Stipulate cabling routes and locations for the assembly of equipment according due consideration to environmental conditions d) Select and assemble company equipment and cabling routing systems e) Install cabling	4
10	Assessment of the safety of electrical plants and operating equipment (§ 11 para. 1 No. 10)	c) Assess basic protection measures against electrical shock d) Assess cables and other company equipment and the protective measures applied to these, in particular in respect of ampacity	
14	Installing and putting electrical plants into operation (§ 11 para. 1 No. 14)	a) Select, assemble and disassemble ladders, scaffolding and installation platforms c) Check suitability of the subsurface for mounting, prepare anchoring and load bearing constructions and fix consoles f) Install, wire up and label control units	

(Time framework 3)

6	Company and technical communication (§ 11 para. 1 No. 6)	b) Evaluate, use and draw up technical drawings and circuit documentation, prepare sketches	2 to 4
8	Assembly and connection of electrical operating equipment (§ 11 para. 1 No. 8)	b) Select and prepare cables and connect sub-assemblies and devices with different connection technologies f) Produce electrical equipment or set up electrical plants, put equipment or plants into operation	
9	Measurement and analysis of electrical functions and systems (§ 11 para. 1 No. 9)	c) Check ratings and function of sub-assemblies d) Analyse control circuits e) Track signals and check these at interfaces f) Conduct systematic trouble shooting	
13	Technical analysis of orders, developing solutions (§ 11 para. 1 No. 13)	e) Select measuring, open and closed loop control systems, sensors, actuators, software and other components	
14	Installing and putting electrical plants into operation (§ 11 para. 1 No. 14)	g) Install, wire up and label operating equipment for open and closed loop control, measuring and checking	

(Time framework 4)

7	Planning and organisation of work, evaluation of work results (§ 11 para. 1 No. 7)	h) Set up computer workplace in accordance with ergonomic aspects, set up graphical user interfaces	1 to 3
11	Installation and configuration of IT systems (§ 11 para. 1 No. 11)	a) Select hardware and software components, install and configure these b) Install and configure operating systems and applications c) Integrate IT systems into networks d) Deploy tools and test programmes	

Occupational profile item	Part of the training occupation profile	Basic and specialist skills to be imparted in an integrated manner, incorporating autonomous planning, execution and checking	Time framework in months
1	2	3	4

2nd year of training, 1st half year

(Time framework 5)

8	Assembly and connection of electrical operating equipment (§ 11 para. 1 No. 8)	g) Comply with electro technical rules when setting up, modifying, maintaining and operating electrical plants and company equipment	1 to 3
10	Assessment of the safety of electrical plants and operating equipment (§ 11 para. 1 No. 10)	a) Check and assess the function of protection and potential equalisers b) Measure and assess insulating resistances e) Assess the types of protection applied to electrical devices or plants in respect of environmental conditions and additional stipulations for special types of premises f) Assess risks arising from the operation of electrical devices, company equipment and plants and ensure safe use via instigation of protective measures g) Assess the effectiveness of measures to counter electrical shock when errors arise, in particular occasioned by the switching off of over current protection devices and residual current protection devices h) Assess the electrical safety of portable company equipment i) Assess fire protection regulations when setting up and operating electrical equipment and plants	
13	Technical analysis of orders, developing solutions (§ 11 para. 1 No. 13)	c) Stipulate modifications and extensions to plants, electrical circuits and protective measures, select components and cables d) Check order documentation and compare with local conditions, stipulate delineation of on-site services	
14	Installing and putting electrical plants into operation (§ 11 para. 1 No. 14)	e) Assemble and erect plug-in modules, housings and control unit combinations h) Mount protective systems, cladding and insulation j) Adjust and connect energy technology links and cables m) Create earthing and potential equaliser, measure and assess earthing and loop impedance n) Put main and auxiliary current circuits into operation	

(Time framework 6)

6	Company and technical communication (§ 11 para. 1 No. 6)	e) Present facts and circumstances, prepare reports, use German and English specialist terminology f) Compile and supplement documentation in German and English, use standard software	3 to 5
9	Measurement and analysis of electrical functions and systems (§ 11 para. 1 No. 9)	g) Check and set sensors and actuators h) Check and evaluate open and closed loop controls in respect of function	
12	Customer advice and care, provision of services (§ 11 para. 1 No. 12)	c) Record fault reports	
14	Installing and putting electrical plants into operation (§ 11 para. 1 No. 14)	s) Adjust protective systems and check the effectiveness of these, ensure the effectiveness of safety measures t) Check emergency shut down and alarm systems and mechanical safety systems	
16	Maintenance of plants and systems (§ 11 para. 1 No. 16)	a) Plan maintenance and inspection measures b) Inspect systems, check function of plants and safety systems and protocol checks c) Maintain systems in accordance with maintenance and repair plans, exchange wearing parts as part of preventative maintenance	

Occupational profile item	Part of the training occupation profile	Basic and specialist skills to be imparted in an integrated manner, incorporating autonomous planning, execution and checking	Time framework in months
1	2	3	4

2nd year of training, 2nd half year

(Time framework 7)

6	Company and technical communication (§ 11 para. 1 No. 6)	h) Present data, facts and circumstances and possible solutions	2 to 4
7	Planning and organisation of work, evaluation of work results (§ 11 para. 1 No. 7)	g) Check order documentation and technical feasibility of the order and coordinate with company capacities	
8	Assembly and connection of electrical operating equipment (§ 11 para. 1 No. 8)	h) Avoid waste, evaluate waste materials, unused operating materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal	
12	Customer advice and care, provision of services (§ 11 para. 1 No. 12)	a) Determine wishes and requirements of internal or external customers, develop possible solutions and alternative forms of implementation	
13	Technical analysis of orders, developing solutions (§ 11 para. 1 No. 13)	e) Select measuring, open and closed loop control systems, sensors, actuators, software and other components	
14	Installing and putting electrical plants into operation (§ 11 para. 1 No. 14)	g) Install, wire up and label operating equipment for open and closed loop control, measuring and checking n) Put main and auxiliary current circuits into operation	
15	Configuration and programming of controls (§ 11 para. 1 No. 15)	a) Adjust, modify and put into operation the hardware and software used for measurement and control technology sub-assemblies b) Install and configure applications software c) Analyse, adjust and modify control programmes d) Check functional processes and modify programme processes f) Install storage media and programmes to secure data	
16	Maintenance of plants and systems (§ 11 para. 1 No. 16)	d) Compare systems parameters with stipulated values and adjust	
17	Technical service and operation (§ 11 para. 1 No. 17)	i) Operate and adjust visualisation applications of technical plants	

(Time framework 8)

7	Planning and organisation of work, evaluation of work results (§ 11 para. 1 No. 7)	e) Conduct calculations in accordance with company stipulations show solution variants, compare costs h) Record and evaluate data relevant to business administration	2 to 4
14	Installing and putting electrical plants into operation (§ 11 para. 1 No. 14)	d) Adjust, fix and connect machines, equipment, drive systems and other operating equipment m) Connect components using pipe and hose links q) Parameterise and put drive systems into operation, adjust ratings r) Check non-electrical components of plants, in particular pneumatic sub-assemblies	
16	Maintenance of plants and systems (§ 11 para. 1 No. 16)	h) Maintain and repair processing machines j) When putting back into operation equipment or parts of plants which have been the object of maintenance, adjust protective measures and safety systems and check the effectiveness of these	

Occupational profile item	Part of the training occupation profile	Basic and specialist skills to be imparted in an integrated manner, incorporating autonomous planning, execution and checking	Time framework in months
1	2	3	4

3rd and 4th year of training

(Time framework 9)

6	Company and technical communication (§ 11 para. 1 No. 6)	b) Evaluate and use documents and technical regulations and occupationally related provisions, including in English c) work together in the virtual environment, exchange product and process data, as well as instructions and function descriptions d) Conduct appropriate and target oriented discussions with line managers, employees and within the team g) Organise and chair meetings, prepare decisions within the team, minute results of discussions i) Resolve disputes within the team	3 to 5
7	Planning and organisation of work, evaluation of work results (§ 11 para. 1 No. 7)	d) Plan and agree tasks within the team, accord consideration to cultural identities i) Recognise and deploy influences with the work situation, the working environment and working behaviours within the team which lead to an increase in quality in work results j) Compare internal and external provision of services	
9	Measurement and analysis of electrical functions and systems (§ 11 para. 1 No. 9)	i) Check functionality of systems and components, interpret data protocols	
12	Customer advice and care, provision of services (§ 11 para. 1 No. 12)	d) Agree details of the processing of the order, in the event of faults in processing of the order indicate alternative solutions	
13	Technical analysis of orders, developing solutions (§ 11 para. 1 No. 13)	a) Analyse customer requirements b) Assess existing plants included in company equipment f) Plan modifications to plants according due consideration to company processes of the customer g) Document services to be provided, modify circuit documentation	
14	Installing and putting electrical plants into operation (§ 11 para. 1 No. 14)	b) Select and deploy lifting equipment, fittings and transport, secure and execute transport i) Assemble data links k) Process communication technology cables using various connecting technologies o) Install, check and put into operation signal and data transmission systems r) Mount and assemble lighting systems u) Check compliance with measures relating to electromagnetic compatibility v) Draw up test protocols, draw up and adapt documentation, hand over plants or system	
15	Configuration and programming of controls (§ 11 para. 1 No. 15)	e) Adjust architectures, protocols and interfaces of automation devices to networks and bus systems	
16	Maintenance of plants and systems (§ 11 para. 1 No. 16)	g) Assess, maintain and repair energy distribution systems i) Maintain and repair communication plants	
17	Technical service and operation (§ 11 para. 1 No. 17)	d) Hand over plants, provide customers with initial instructions on how to operate technical systems	

Occupational profile item	Part of the training occupation profile	Basic and specialist skills to be imparted in an integrated manner, incorporating autonomous planning, execution and checking	Time framework in months
1	2	3	4

(Time framework 10)

6	Company and technical communication (§ 11 para. 1 No. 6)	j) Conduct written communication in German and English	2 to 4
7	Planning and organisation of work, evaluation of work results (§ 11 para. 1 No. 7)	k) Ascertain skills gaps, use training opportunities and various learning techniques	
12	Customer advice and care, provision of services (§ 11 para. 1 No. 12)	b) Indicate maintenance works and intervals e) Explain performance characteristics, provide instruction in operation, indicate risks, safety rules and regulations f) Provide technical support g) Organise exchange of information with the customers	
16	Maintenance of plants and systems (§ 11 para. 1 No. 16)	e) Use diagnostic systems, check function of sub-assemblies, replace defective sub-assemblies f) Maintain and repair decentralised energy supply systems k) Document maintenance measures	
17	Technical service and operation (§ 11 para. 1 No. 17)	a) Provide and execute service b) Comply with company stipulations when drawing up offers and estimates c) Make customers aware of guarantee claims and provide advice on technical and economic feasibility e) Document services provided f) Monitor technical plants g) Conduct remote diagnosis and maintenance h) Evaluate plant, diagnostic and process data and use this for purposes of optimisation j) Record consumption data of energy and operating equipment, establish reasons for deviations from reference value, optimise consumption	

(Time framework 11)

18	Business processes and quality management within the area of deployment (§ 11 para. 1 No. 18)	a) Make customers aware of and provide advice on specific offers, accept orders b) Obtain and evaluate information, use and process documentation, ascertain technological developments, accord due consideration to documentation relating to safety c) Analyse starting position, clarify technical and organisational interfaces, document interfaces, stipulate order objectives, define subtasks, draw up technical documentation and take part in cost planning d) Obtain, check and evaluate offers and estimates according due consideration to company stipulations e) Plan order processing and coordinate this with upstream and downstream areas, draw up planning documentation f) Arrange for, monitor and check services from third parties g) Process orders, in particular according consideration to health and safety and environmental protection, monitor observance of schedules h) Select checking methods and test equipment, ascertain utilisability of test equipment, use inspection plans and company testing procedures i) Comply with standards and specifications in respect of quality and safety of the products and safety of the order processing, use quality assurance systems, search for, resolve and document causes of errors and quality defects in a systematic manner j) Document the project process, charge for services, draw up charge data, conduct subsequent calculations k) Authorise technical systems for use, hand technical systems over, prepare acceptance protocols, explain products and services	10 to 12
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Occupational profile item	Part of the training occupation profile	Basic and specialist skills to be imparted in an integrated manner, incorporating autonomous planning, execution and checking	Time framework in months
1	2	3	4
		l) Conduct target-performance comparison with planning data, evaluate work results and implementation of work m) Make a contribution to continuous improvement of work processes both within company operations and within own work area n) Assess lifecycle data of projects, services, products and resources, and develop suggestions for optimising procedures and processes	

Annex 7 (on Sections 32 to 37)

General training plan for the additional qualifications

Part A: Additional qualification Digital Networking

No.	Part of the additional qualification	Competencies, knowledge and skills to be imparted	Suggested time allocations in weeks
1	2	3	4
1	Analysis of technical projects and development of solutions	a) Analyse customer requirements in regards to the desired function , and analyse the technical environment b) Analyse the original state of the system, in particular evaluate documentation as well as clarify and document network topologies, deployed software and technical interfaces c) Analyse technical processes and environmental conditions, establish network requirements d) Taking specifications into account, plan and work out technical requirements and legal guidelines, select network components, create technical documentation, calculate costs e) Coordinate the networking solution and changes to the system with the client	8
2	Installation, alteration, and checking networked systems	a) Install, adjust and configure network components and network operating systems, follow guidelines for a secure configuration b) Observe data exchange between IT and automation systems c) Set up access permissions d) Take into account security systems, in particular firewalls, encryption systems and data back-up systems e) Review functions, remedy errors, start up and handover systems, document changes	
3	Operation of networked systems	a) Record error messages, inspect systems, establish deviations from desired condition, assess data throughput and error rates, introduce immediate measures for upkeep of networked systems b) Analyse system malfunctions, deploy test software and diagnostic systems, introduce maintenance measures c) Evaluate system data, diagnostic data and process data and suggest possibilities for optimisation d) Evaluate maintenance protocol, analyse and log weak points	

Part B: Additional qualification Programming

No.	Part of the additional qualification	Competencies, knowledge and skills to be imparted	Suggested time allocations in weeks
1	2	3	4
1	Analysis of technical projects and development of solutions	a) Analyse client requirements in regards to the required b) Analyse processes, interfaces and environmental conditions as well as the original state of the system, establish and document requirements of software modules c) Plan and reconcile software solutions and changes to the system using design methods	8
2	Adaptation of software modules	a) Adapt and document software modules b) Integrate adapted software modules into the system	
3	Testing of software modules in the system	a) Draft a test plan corresponding to the operational test and release procedure, in particular establish procedures as well as standard and limit values of operational parameters, generate test data b) Simulate technical environmental conditions c) Test software modules d) Perform system tests, test components in the system with the operational parameters subject to environmental conditions e) Analyse malfunctions, perform systematic error searches in systems f) Document system configuration, quality controls and test runs g) Create documentation on changes	

Part C: Additional qualification IT Security

No.	Part of the additional qualification	Competencies, knowledge and skills to be imparted	Suggested time allocations in weeks
1	2		3
1	Development of security measures	a) Analyse security requirements and functionalities of industrial communication systems and controls b) Evaluate protection requirement in relation to confidentiality, integrity, availability and authenticity c) Assess dangers and risks d) Develop and coordinate security measures	8
2	Implementation of security measures	a) Integrate security measures into systems b) Inform IT users regarding work procedures and organisational guidelines c) Prepare documentation corresponding to operational and legal guidelines	
3	Monitoring of security measures	a) Check effectiveness and efficiency of the implemented security measures b) Deploy system monitoring tools c) Review and assess protocol files, in particular relating to access, actions and errors d) Report security-related incidents	

SKELETON CURRICULUM

for the training occupation of

Electronics technician for industrial engineering

(Resolution of the Standing Conference of the Ministers of Education and Cultural Affairs of 16 May 2003) ¹

Part I: Preliminary remarks

The present skeleton curriculum for occupationally related teaching at a vocational school has been passed by the Standing Conference of the Ministers of Education and Cultural Affairs of the Länder in the Federal Republic of Germany (KMK).

The present skeleton curriculum has been agreed in conjunction with the corresponding training regulations promulgated by the Federal Government (issued by the Federal Ministry of Labour and Economics or by the otherwise responsible ministry in agreement with the Federal Ministry for Education and Research). The process for such agreement is regulated via the "Joint Results Protocol of 30 May 1972". The present skeleton curriculum takes the lower secondary school leaving certificate as its basis and describes minimum requirements.

In the case of allocated occupations, the present skeleton curriculum is structured to include basic training extending across all occupational fields and specialist training for which such basic training forms the foundation.

The training regulations and the skeleton curriculum stipulating the objectives and content of vocational education and training form the basis for the imparting of final qualifications in a recognised training occupation and of the qualification issued by the vocational school in conjunction with teaching in further subjects. This enables the essential prerequisites for qualified employment and entry into school based and vocational advanced and continuing training courses to be put into place.

The skeleton curriculum does not contain any methodological stipulations in respect of teaching. Autonomous and responsible thoughts and actions constitute the overarching objective of training, and the preferred course of action is for delivery of these aims to take place via such forms of teaching in which they represent part of the overall methodological concept. In principle, any methodological approach adopted may contribute to the achievement of this objective. Methods which directly foster occupational competence are particularly suited to purpose and appropriate consideration should be accorded to these within the structuring of the teaching.

The federal states either adopt the skeleton curriculum directly or else implement it via their own curricula. In the latter case, the federal states ensure that coordination of the result stipulated in the skeleton curriculum in terms of structure of specialist content and time remains intact.

Part II: Educational remit of the vocational school

Within the dual system of vocational education and training, the vocational school and the company providing training fulfil a joint educational remit.

Within this process, the vocational school constitutes an independent learning venue. The vocational school cooperates with other VET participants as an equal partner. The task of the vocational school is to impart vocational and general educational content to pupils according particular consideration to VET requirements.

The aim of the vocational school is to provide basic and specialist vocational training and to extend general education previously acquired. Within this process, the vocational school pursues the objective of enabling pupils to carry out occupational tasks and be involved in shaping the world of work and of society whilst fulfilling their social and ecological responsibility. It is guided by the regulations contained within the educational laws of the federal states as these apply to such schools. Vocationally related teaching is also guided by the national vocational regulatory instruments in respect of each individual recognised training occupation:

- the skeleton curriculum issued by the Standing Conference of the Ministers of Education and Cultural Affairs (KMK);
- training regulations promulgated by the Federal Government in respect of in-company training;

Pursuant to the Framework Agreement on Vocational Schools (Resolution of the KMK of 15 March 1991), the aims of vocational schools are:

- "to impart employability encompassing a combination of specialist competence and general skills of a human and social nature;
- to develop occupational flexibility enabling the changing requirements within the world of work

¹ Based on the second ordinance on the revision of the ordinance on vocational education and training in the industrial electronics occupations of ... (BGBl. I S. ...), the general training plan has been adapted with regard to the topic of "digitalisation of work, data protection and information security" in 2018.

including in respect of the convergence of Europe to be met;

- to stimulate readiness to engage in advanced and continuing vocational training;
- to foster the ability and readiness to act in a responsible manner in the way in which pupils organise their own lives and act within public life.“

In order to achieve these aims, a vocational school must:

- structure teaching in such a way so that it is aligned to the specific educational purpose of the tasks it pursues and emphasises an employment oriented approach;
- impart vocational skills and skills which extend across occupational fields whilst according due consideration to necessary vocational specialisation;
- guarantee differentiated and flexible educational provision in order to accord full consideration to varying degrees of ability and talent whilst also fulfilling the needs of the world of work and of society;
- provide extensive support for and promotion of opportunities for the disabled and the disadvantaged insofar as possible;
- indicate environmental threats and accident risks in conjunction with the exercise of an occupation and in connection with pupils' private lives and highlight means by which such threats and risks may be avoided or reduced.

In addition to this, the vocational school should, within the general teaching it conducts and to the greatest possible extent within occupationally related teaching, address core contemporary problems such as:

- work and unemployment,
- the peaceful coexistence of people, peoples and cultures in the world whilst maintaining a sense of cultural identity,
- the preservation of the natural basis of life and
- The guarantee of human rights.

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The aims listed address the development of **employability skills**. Employability skills within this context are defined as the readiness and ability of an individual person to conduct himself or herself in an appropriate, considered and individually and socially responsible manner in social, occupational and private situations.

Employability skills are contained within the dimensions of specialist competence, personal competence and social competence.

Specialist competence describes the readiness and ability to use specialist knowledge and ability as a basis to solve tasks and problems in a target oriented, appropriate, methodologically suitable and autonomous manner and to assess results.

Personal competence describes the readiness and ability to act as an individual personality in clarifying, considering and assessing development

opportunities, requirements and restrictions within the family, within an occupation and within public life, to evolve individual talents and to make and further develop life plans. Personal competence encompasses such personal qualities as autonomy, critical ability, confidence, reliability and a sense of responsibility and duty. It also particularly includes the development of considered values and self-determined loyalty to values.

Social competence describes the readiness and ability to develop and live out social relationships, to detect and understand areas of affinity and conflict and to deal with and reach understanding with others in a rational and responsible manner. It also particularly includes the development of social responsibility and solidarity.

Methodological and learning competence arise from a balanced development of these three dimensions.

Competence describes successful learning in respect of the individual learner and the equipping of him or her with the ability to act autonomously in private, occupational and social situations. In contrast to this, **qualification** is defined as successful learning in respect of usefulness of competences within the context of the demand for such competences in private, occupational and social situations (cf. German Education Council, recommendations of the Educational Commission for the Reorganisation of Upper Secondary Education).

Part III: Didactic principles

The objectives of vocational education and training require teaching to be conducted in accordance with educational methods aligned to the tasks of the vocational school and to enable young people to plan, execute and evaluate work related tasks within the scope of their occupational activity.

Learning at vocational school essentially takes place with reference to specific occupational actions, a variety of mental operations and theoretical understanding of the actions of others. This learning is primarily linked to reflecting on the execution of actions (action plan, process, results). The fact that occupational work is pervaded by this thought process creates the preconditions for learning at and from work. As far as the skeleton curriculum is concerned, this means that the description of aims and the choice of content takes place in an occupationally related way.

Learning theory and didactic cognitions form the basis for the adoption of a pragmatic approach towards the structuring of employment oriented teaching in which the following points of reference apply.

- Situations which are usual for the execution of the occupation form the didactic points of reference (learning in order to be able to act).
- Actions which trainees can perform themselves wherever possible or understand in theory constitute the starting point for learning (learning via acting).
- Wherever possible, actions need to be autonomously planned, executed, checked, corrected where necessary and finally evaluated in writing by the learners themselves.
- Actions should foster a holistic understanding of occupational reality, incorporating technical, safety, economic, legal, ecological and social aspects amongst others.
- Actions need to be integrated into the experiences of the learners and be reflected upon with reference to their societal implications.

- Actions should also include social processes such as declaration of interest or conflict resolution.

Employment oriented teaching is a didactic concept bundling together specialist and action system structures and may be realised via a range of teaching methods.

Teaching provision at vocational schools is directed towards young people and adults who have different prior learning, cultural backgrounds and experiences gained from companies providing training. Vocational schools are only able to fulfil their educational remit if they accord due consideration to these differences and encourage pupils, including disadvantaged and particularly talented pupils, to develop in line with their individual potential.

Part IV Occupationally related preliminary remarks

The present skeleton curriculum for vocational education and training in the occupation of Electronics technician for industrial engineering has been harmonised with the Ordinance on Vocational Education and Training in the Industrial Electrical Occupations of 3 July 2003 (Federal Law Gazette, BGBl. I p. 1144).

The training occupation has been aligned to the occupational field of electro technology pursuant to the Basic Vocational Training Year Accreditation Directive issued by the Federal Ministry for Economics and Labour.

In respect of the first year of training, the skeleton curriculum corresponds to the vocationally related specialist theory area of the skeleton curriculum for the school based basic vocational training year. Insofar as the first year of training takes place within a school based basic vocational training year, the skeleton curriculum applies to the vocationally related learning area within such a basic vocational training year.

The skeleton curriculum for the training occupation of Energy electronics engineer (resolution of the KMK of 7 January 1987) is replaced by the present skeleton curriculum.

The principle vocational school curriculum content in the examination area of business and social studies is imparted on the basis of "Elements for teaching at vocational schools in the area of business and social studies for technical training occupations" (resolution of the KMK of 18 May 1984).

The aims and content of the skeleton curriculum relate to the vocational qualifications and the training occupation profile for the occupation of Electronics technician for industrial engineering.

Electronics technicians for industrial engineering assemble systems and plants for power supply, measurement and control, communications

technology, signalling technology, drive technology and lighting. They put these systems and plants into operation, maintain and operate them.

The skeleton curriculum takes the following objectives as its starting point.

Pupils

- work in a team and within the scope of their occupational activity, communicate, including in an interdisciplinary way, with others inside and outside the company, including with persons from other cultural circles. They also work in a team-oriented way and use the latest means of communication, including in the virtual environment,
- take data and information relating to the digitalisation of work into account,
- advise customers and provide customer service, analyse customer requirements in respect of the design of electrical systems and plants,
- accord due consideration to standards and regulations, use technical regulations and stipulations, technical bulletins and descriptions, operating instructions and other information typical to the occupation, including English language information, also in audiovisual or and virtual forms,
- use current information and communication systems to procure information, process orders and projects and document and present results,
- describe functionality, production and organisation processes, and the incorporation of cyber-physical systems, while also taking logistical process steps into account,
- design modifications and extensions to electrical systems and plants, including computer aided design,

- also conduct software aided technical calculations for the design of electrical systems and plants and cost calculations,
- plan and steer work processes when setting up and decommissioning workplaces/construction sites; organise and monitor the work of other trades and service providers, document and evaluate work results,
- accord due consideration to ergonomic, economic, ecological and societal aspects when planning and executing work. Minimise the negative impact of the work process on the environment by using appropriate materials, acting in a responsible manner and according due consideration to environmental regulations,
- programme and configure systems in compliance with standards, also with the aid of intelligent sensors and actuators,
- check functionality and safety systems.
- install/assemble wiring systems, information and energy cables including general supply lines.
- install automation systems, machines and drive systems, set these up and connect them to each other, taking into account the latest standards,
- upgrade partial systems to automation systems using suitable interfaces and protocols,
- take the information technology security goals of availability, integrity, confidentiality and authenticity into account,
- use standards, regulations and rules relating to securing product quality, ensure the smooth operation of plants and systems and Make a contribution to continuous improvement of work processes.
- develop approaches to be adopted for initial operation and optimisation of electrical systems and processors, including on the virtual level,
- check safety measures.
- take over and hand over plants, instruct users in their operation and provide services.
- deploy programmes and systems for collecting, processing, visualising and analysing process-related data and use these for troubleshooting, process optimisation and system simulation, and
- monitor and maintain systems with the aid of existing error and process data, conduct regular checks, analyse malfunctions, instigate immediate measures and repair plants.

The learning fields contained within the present skeleton curriculum are aligned to work and company operational processes. For this reason, customer oriented occupational actions and order processing are accorded particular significance and need to be given special consideration when implementing the learning fields within learning situations.

The imparting of competences and skills should take place using assignment of tasks typical to the occupation and should also be conducted in an order and project oriented manner involving cooperation with other learning venues.

Mathematical and scientific content, technical safety information and economic, business administration and ecological aspects should be imparted in an integrative manner within the learning fields.

The foreign language aims and content comprising 40 teaching hours are integrated into the learning fields.

Learning fields 1 to 4 in the first year of training correspond to learning fields 1 to 4 for the mechanical and industrial electronic occupations in terms of content. Joint teaching is possible in the first year of training.²

The main focus in the learning fields for the first year of training is on the acquisition of basic knowledge across the occupational field within the context of typical, cross-vocational occupational action processes. Consideration should be accorded to occupationally specific aspects via the selection of appropriate examples and tasks.

The objects of the interim examination or of Part 1 of the final examination have been accorded consideration in the aims and content of learning fields 1 to 6.

The new form of final examination also requires vocational schools to adopt a new concept for integrative preparation for the examination situation. The holistic and integrative approach of the final examination is particularly reflected in the expansions of competence in the seventh half year of training. The complex assignment of projects tasks in the learning fields of the seventh half year of training accord particular attention to occupational areas of deployment. These complex task assignments enable competences and skills which have already been imparted to be used and extended in a recapitulatory and project related manner as well as allowing additional aims and content specific to the area of deployment to be developed with the agreement of and in conjunction with the companies providing training.

The objective of all learning fields is the development of employability skills. In order to emphasise selected facts and circumstances relating to personal and social competence and methodological, learning and communication competence, such competences are expressly included as an integral part of some learning fields. In all other learning fields, these competences should be addressed situationally and individually according particular consideration to the typical main characteristics of the occupation and should be consolidated and extended.

² Due to the ordinances on credit transfer from the basic vocational training year being repealed by Article 8 of the Vocational Training Reform Act of 23.03.2005 (BGBl. I S. 931), the corresponding paragraph regarding the foundation training year in the electro technology occupational field has been deleted.

Part V Learning fields

Summary of the learning fields for the training occupation of Electronics technician for industrial engineering					
Learning fields		Suggested time allocation in hours			
		1st year	2nd year	3rd year	4th year
1	Analyse electrical systems and check functions	80			
2	Plan and execute electrical installations	80			
3	Analyse and adjust control systems	80			
4	Make information technology systems available for use	80			
5	Ensure electrical energy supply and the safety of operating equipment		80		
6	Analyse and check equipment and sub-assemblies in plants		60		
7	Programme and realise control systems for plants		80		
8	Select and integrate drive systems		60		
9	Execute technical building services plants and put these into operation			80	
10	Set up and maintain energy plants			100	
11	Put into operation and maintain automated plants			100	
12	Plan and realise electrical plants				80
13	Maintain and adjust electrical plants				60
	Total	320	280	280	140

Learning field 1	Analyse electrical systems and check functions
1st year of training	Suggested time allocation: 80 hours
Formulation of objectives: Pupils find out about the tasks, work requirements, activities and sample work processes within their occupation. Pupils analyse electrical systems at the plant, device, sub-assembly and component level and the correlative effects between the individual levels. During this process, they read and draw up technical documentation. They determine the functions and operational characteristics of selected components and sub-assemblies and their tasks within electrical systems. For these purposes, the pupils obtain information independently which they then evaluate. They evaluate English language technical documentation with the assistance of tools. For the purposes of analysing and checking basic circuits and recognising the general laws of electro technology, the pupils determine electrical values by measurement technology and calculation and document and evaluate these. The pupils check the function of electrical connections and operating equipment. They analyse and correct errors. The pupils realise tasks within a team and communicate using correct specialist language. They deploy work, time and learning planning methods. They act in a responsible manner according due consideration to technical safety aspects.	
Contents: Company structures, work organisation, company communication Products, services Circuit diagrams, circuit symbols Electrical operating equipment, basic circuits, basic electrical values Performance and ratings of sample components and functional units Risks posed by electrical current, safety rules, health and safety at work Measurement procedures, functional checks, trouble shooting Team work Methods of obtaining and processing information	

Learning field 2 1st year of training	Plan and execute electrical installations Suggested time allocation: 80 hours
Formulation of objectives: The pupils analyse orders for the installation of energy supply to plants and equipment. The pupils plan installations according due attention to typical network systems and the required protective measures. They draw up circuit and installation plans, including using computer aided means. They assess components and select these in accordance with functional, economic and ecological aspects. Pupils use specialist terminology from the field of electrical installation technology. They also evaluate English language information. Pupils plan the typical processes for the setting up of plants. They determine the approach to be adopted in respect of fulfilment of order, materials requirements and coordination with other parties involved, select equipment and coordinate the work process. They calculate the costs involved in setting up the plant, draw up offers and explain these to customers. The pupils set up plants according due consideration to safety rules and accident prevention stipulations relating to work in and on electrical plants. They recognise possible risks posed by electrical current and act in accordance with the relevant safety provisions and protective measures. The pupils put plants into operation, record ratings and draw up documentation. They check the functionality of plants, find and eliminate errors. They hand over plants to customers, demonstrate the functions of the plants and provide introductory guidance on use. The pupils evaluate their work results for the purposes of improving work organisation. They issue an invoice for the orders which have been processed.	
Contents: Order planning, execution of order Energy requirements of a plant or piece of equipment Safety regulations Installation technology Ratings of operational equipment Types of circuit diagram Dimensioning of cables Work organisation Calculation of costs, drawing up offers	
Learning field 3 1st year of training	Analyse and adjust control systems Suggested time allocation: 80 hours
Formulation of objectives: The pupils plan modifications and adjustments to control systems in accordance with stipulations. The pupils analyse plants and equipment and visualise structural composition and functional correlations. They determine control systems and differentiate between open and closed loop control systems. The pupils differentiate techniques for the realisation of control systems and evaluate the benefits and drawbacks of these in accordance with economic and technical safety aspects. The pupils alter control systems, selecting sub-assemblies and constituent components in accordance with requirements. The put systems to which control systems have been applied into operation, check functionality, record ratings using measurement technology and carry out necessary adjustments. They document technical changes using standard and bespoke software. The pupils organise their learning and work tasks autonomously and within the team. They analyse, reflect upon and evaluate the findings they have obtained within this process. They evaluate English language documentation with the assistance of tools and also use specialist English terminology for the written representation of facts and circumstances related to control technology.	
Contents: Block diagram, IPO model, sensors, actuators, interfaces Chain of effects, functional descriptions Connective and stored programme signal processing Logical basic interconnections, storage functions Standards, regulations and rules Technical documentation	

Learning field 4 1st year of training	Make information technology systems available for use Suggested time allocation: 80 hours
Formulation of objectives: The pupils plan the provision and expansion of information technology systems in accordance with functional specifications. They analyse systems, check the technical and economic feasibility of orders and offer solutions. They research German and English language media by using networks. The pupils select hardware and software components according due consideration to function, performance, area of deployment, compatibility, economic efficiency and environmental sustainability and procure these components. The pupils install and configure information technology systems and task related standard and bespoke software and use these. They integrate information technology systems into existing networks and carry out the necessary configurations for this purpose. The pupils accord due attention to statutory regulations in respect of data protection, copyright law and media law. They deploy selected data back-up and data protection measures. The pupils document and present the work processes and results relating to the provision of information technology systems. For this purpose, they use word processing, spreadsheet, graphical representation and presentation software.	
Contents: Function and structure of functional specifications Hardware, operating systems, standard and bespoke software Procurement process Installation and configuration processes for hardware and software components Ergonomic workplace design Tools and methods for diagnostics and trouble shooting Local and global networks, data transmission protocols Data back-up and data protection, copyright and media law Presentation technologies and methods	

Learning field 5 2nd year of training	Ensure electrical energy supply and the safety of operating equipment Suggested time allocation: 80 hours
Formulation of objectives: The pupils plan electrical energy supply for operating equipment and plants. They analyse and classify electrical energy supply possibilities in accordance with functional, economic and ecological aspects. The pupils dimension plants according due consideration to network systems and protective measures. For this purpose, they select and assess components from the plants and draw up circuit diagrams using specialist literature, technical bulletins and descriptions of equipment, including in the English language, and in audiovisual or virtual forms. The pupils check compliance with standards, regulations and rules relating to protection against electric shock, health and safety at work and prevention of accidents when setting up, putting into operation and maintaining electrical energy supply plants and when using operating equipment. The pupils check permanently sited and portable electric operating equipment and put such equipment into service. They record ratings and test results and classify these in document form. The pupils instruct users in how to operate the plants.	
Contents: Circuit and distribution systems Environmental sustainability Voltage levels Alternating and rotary current systems Network systems Protective systems Measurement and test equipment Test protocols Classes of protection, classes of insulation Types of protection User instructions	

Learning field 6 2nd year of training	Analyse and check equipment and sub-assemblies in plants Suggested time allocation: 60 hours
Formulation of objectives: The pupils plan and organise modification and repair orders to equipment and sub-assemblies in line with customer requirements and stipulate the stages for the execution of orders. The pupils analyse equipment, sub-assemblies and the correlative effects between the components constituting the plant. For this purpose, they use specialist literature and equipment descriptions, including in the English language, and in audiovisual or and virtual forms. They determine the function and operational characteristics of sub-assemblies constituting the plant. The pupils record measurement values and signal processes and evaluate these in the light of secure operational functioning of the equipment and sub-assemblies. The pupils systematically isolate errors and eliminate malfunctions within the components constituting the plant. They carry out modifications and repair work to equipment and sub-assemblies and monitor and check these. The pupils use standards, regulations and rules applying to the modification and repair of equipment and sub-assemblies and comply with regulations in respect of health and safety at work and environmental protection. The pupils use computer aided methods to draw up technical paperwork to document the modification or repair work. They substantiate, present and evaluate the work results.	
Contents: Operating instructions and instructions for use Connection analysis methods Analogue and digital sub-assemblies Standard connection solutions Error isolation methods Simulation software Measurement and test procedures Test regulations, test protocols Technical connection documentation Health and safety at work, health protection Electromagnetic compatibility Conducting discussions, taking minutes Latest communication means and forms	

Learning field 7 2nd year of training	Programme and realise control systems for plants Suggested time allocation: 80 hours
Formulation of objectives: The pupils plan control systems for plants. They analyse control systems in existing plants in order to adapt these to modified customer requirements. The pupils record and analyse control processes. They use programme development tools and configure and parameterise the necessary hardware and software components. During this process, they select forms of presentation in compliance with standards and regulations. The pupils put control systems into operation according due consideration to the functions of the plant. They undertake autonomous checks of the function of control systems, also including aspects relevant to safety, and use appropriate test and measurement procedures for the purposes of identifying errors. They eliminate errors in the control programmes they have developed. The pupils supplement or draw up technical documentation for control systems and present the results of their work. During the work process, the pupils use specialist language and terminology, including in English. The pupils work independently and assume responsibility, including in an interdisciplinary way, within the team. They evaluate the experiences and findings they have obtained.	
Contents: Catalogue of requirements Computer aided procurement of information Sensors, actuators Functional groups within a control system Programme documentation Functions, function modules Storage, time and counting functions Sequences Program tests on real and simulated processes Error search with the help of process-related data Test protocols, technical documentation and programme archiving Standards, regulations and rules Presentation techniques using standard software Lead presentation techniques	

Learning field 8 2nd year of training	Select and integrate drive systems Suggested time allocation: 60 hours
Formulation of objectives: The pupils plan the order processing of technical drive tasks in accordance with customer requirements. They analyse orders for drive systems and plan the technical realisation of the drive system. The pupils coordinate the procurement of order related information within the team, including English language information. For this purpose, they conduct specialist discussions and evaluate their findings. The pupils select the required equipment, sub-assemblies and protective systems according due consideration to functional, economic and ecological aspects and dimension these. The pupils set up electrical and pneumatic drive systems, check and put these into operation having parameterised the components. They measure and document ratings, draw up technical documentation and connection documentation using computer aided means, present these to users and instruct users. The pupils use standards, regulations and rules applying to the setting up and operation of electrical drive systems and comply with regulations in respect of health and safety at work and environmental protection. They check compliance with and document the above in a professional manner. The pupils conduct a holistic analysis of work results.	
Contents: Structure of drive systems Actuators Direct and alternating current machines Protective systems Construction forms, types of operation, types of protection and cooling of machines Equipment and sub-assemblies for switching and steering drive systems Starting and braking processes Revolution speed control Test procedures Specialist discussions Technical documentation	

Learning field 9 3rd year of training	Execute technical building services plants and put these into operation Suggested time allocation: 80 hours
Formulation of objectives: The pupils plan order processing for electrical building services plants in accordance with technical and time stipulations. They coordinate their time and work planning within the team and in agreement with other trades. The pupils check their decisions to ensure that they are feasible, economical and environmentally sustainable. The pupils analyse, expand, set up and configure technical building services systems including communication systems. While doing so, they accord due consideration to data and information security and integrate visualisation into the project planning process. The pupils check the technical building services plants when these have been completed, put them into operation and instruct users. The pupils monitor technical building services systems, systematically isolate error in the event of malfunctions and initiate measures to eliminate such errors. During this process, they deploy diagnostic systems and interpret function and error protocols. They use complaints to improve plants and services. The pupils comply with safety and fire prevention regulations and stipulate measures to ensure compliance with these. The pupils process and draw up the necessary service documentation for the operation of plants. They use software which is usually deployed within the branch for this purpose. The pupils use specialist literature, product databases and equipment and plant descriptions, including in English.	
Contents: Customer advice Materials management and calculation Light and lighting technology Risks and fire alarm systems Communication systems Information technology security goals of availability, integrity, confidentiality and authenticity Protection against lightning Building services systems technology and its constituent components Load management Visualisation software Standards, regulations and rules	

Learning field 10 3rd year of training	Set up and maintain energy plants Suggested time allocation: 100 hours
Formulation of objectives: The pupils analyse customer orders relating to the setting up of energy plants and plan the processing of orders in agreement with all of those involved in the process. The pupils obtain order related information on the structure and operational characteristics of low voltage switch gears and evaluate the combined effects of the components. They plan stages of the work and make decisions on work organisation in order to execute assembly and installation in a target oriented and time efficient manner. During this process, they accord particular consideration to compliance with safety rules, accident prevention regulations and environmental protection provisions. The pupils check and evaluate stages and results of work in accordance with economic, ecological and technical safety aspects. When setting up plants, they deploy measurement and test procedures and initiate the necessary adjustments and modifications. The pupils conduct regularly scheduled testing in a timely manner and localise and evaluate operational malfunctions. They discuss possible solutions for elimination of errors with involved parties and repair malfunctions in a targeted way. The pupils document all work processes and modifications made to the plants.	
Contents: Cables and cable networks Switch gears Protective systems for electrical networks Types of network Decentralised and intelligent energy supply systems Energy plants in buildings, in special premises and outside Compensation Collection, processing and evaluation of readings and data Recording, processing and evaluating metered values Types of error and methods of trouble shooting Recycling and disposal	
Learning field 11 3rd year of training	Put into operation and maintain automated plants Suggested time allocation: 100 hours
Formulation of objectives: The pupils plan control systems for complex automated plants. They analyse the control systems within existing plants and install automated plants. They use industrial communication systems to integrate components into superordinate automated systems. The pupils organise and optimise their work processes based on a system of division of labour. They use predictive analysis to prevent possible sources of error in the planning of plants. They record the effects of sources of error on the plants and services and initiate preventative measures. The pupils configure and parameterise automated plants and the drive systems integrated into these. During this process, they accord due consideration to the topology and structures of automated systems. They record and analyse the data exchange between these systems and deploy programme development and programme visualisation instruments. The pupils use standards, regulations and rules applying to the setting up and operation of automated plants, communication electric drive systems and health and safety at work regulations. They document compliance with these in a professional manner. The pupils conduct independent checks on the functionality and safety of automated plants and put these into operation. The pupils carry out maintenance and diagnostic works on automated plants and drive systems, including remote diagnoses. For these purposes, they deploy strategies for systematic identification and elimination of errors. The pupils draw up and modify documentation, also use English language documentation and present their results. They use standard and bespoke software for these purposes.	
Contents: Levels and networked structures of automation technology Ratings and norms of bus systems Configuration of networks and bus systems Digital software control systems Types of operation of automated plants Value processing, analogue value processing Use, analysis and processing of data Open and closed loop control systems for communication drive systems Inverter fed drive systems Network perturbation and electromagnetic compatibility measures Potential error and error influence analysis Continuous improvement process Conflict resolution strategies	

Learning field 12 4th year of training	Plan and realise electrical plants Suggested time allocation: 80 hours
Formulation of objectives: The pupils plan control systems for electrical plants. They define targets, analyse and structure tasks in respect of their feasibility and accord due consideration to areas of deployment in the project selection process. The pupils plan, develop and realise practice oriented solutions. During this process, they assume responsibility for project organisation and coordination of the learning and work processes. The pupils document project progress and analyse and evaluate the process. They comply with basic quality management standards and processes thus securing the quality of products and processes. The pupils set up the electrical plants or plant components, put these into operation and test partial and overall functions. They demonstrate the structure and function of the plants or plant components. During the project realisation process, the pupils accord due consideration to recycling opportunities and environmental compatibility issues. They draw up and modify documentation, also use English language documentation and present their results. They use current information and communication media in order to do this. The pupils evaluate project results in accordance with learning organisation, work organisation, technical and economic aspects.	
Contents: Project description Time and work planning Economic efficiency, organisational and process procedures Plant and product design Standards, regulations and rules Quality assurance Project evaluation	

Learning field 13 4th year of training	Maintain and adjust electrical plants Suggested time allocation: 60 hours
Formulation of objectives: The pupils plan maintenance and adjustment measures in electrical plants. The pupils analyse malfunctions and deploy strategies for systematic identification and elimination of errors in electrical plants or plant components. They adjust electrical plants or plant components in accordance with customer wishes and document this in a professional manner. The pupils instruct customers in the operation of the adjusted plants, provide information about statutory stipulations applying in respect of maintenance and explain the revised maintenance conditions. The pupils also use English language documentation for project documentation and present their results. The pupils reflect upon their vocational learning and work processes. They use appropriate training opportunities and a variety of learning techniques and learning media to develop their competences and skills further.	
Contents: Time and work planning Maintenance concepts Standards, regulations and rules Customer advice and instruction Process documentation Knowledge management	