Bundesinstitut für Berufsbildung (BIBB)

Ordinance on vocational education and training in the industrial mechanic [1])

Plant mechanic

Industrial mechanic

Construction mechanic

Tools mechanic

Milling machine operator

promulgated on 23 July 2007

and Examples for

Skeleton Curricula for the training occupation

in

Industrial mechanic

Milling machine operator

(Resolution of the Standing Conference of the Ministers of Education and Cultural Affairs of 25 March 2004)

Bundesinstitut für Berufsbildung (BIBB)
Der Präsident
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1The present Statutory Ordinance constitutes training regulations within the meaning of § 4 of the Vocational Training Act. The training regulations and the coordinated skeleton curriculum for the vocational school adopted by the Standing Conference of the Ministers of Education and Cultural Affairs of the Länder of the Federal Republic of Germany will shortly be published as an Annex to the Federal Gazette.

Ordinance
on vocational education and training
in the industrial metal occupations

promulgated on 23 July 2007

On the basis of § 4 Paragraph 1 of the Vocational Training Act of 23 March 2005 in conjunction with Paragraph 5 of said Act (Federal Law Gazette I p. 931), § 4 Paragraph 1 having been amended by Article 232, Clause 1 of the Ordinance dated 31 October 2006 (Federal Law Gazette I p. 2407), the Federal Ministry of Economics and Technology issues the following Ordinance in agreement with the Federal Ministry of Education and Research.

Part 1
Joint provisions

§ 1

State recognition of the training occupations

The training occupations of

1. Plant mechanic
2. Industrial mechanic
3. Construction mechanic
4. Tools mechanic
5. Milling machine operator

are accorded state recognition pursuant to § 4 Paragraph 1 of the Vocational Training Act.

§ 2

Duration of training

Duration of training is three and a half years.

§ 3

Structure and objective of vocational education and training

(1) The skills, knowledge and competences (employability skills) stated in the present Ordinance should be imparted in a process-related way. These qualifications should be imparted in such a way so as to enable trainees to exercise a qualified occupational activity within the meaning of § 1 Paragraph 3 of the Vocational Training Act, this particularly to encompass the autonomous planning, execution and checking of work and acting within the overall context of the company. Evidence of the competence described in No. 2 below is to be provided in the examinations pursuant to §§ 9 and 10, 13 and 14, 17, 18, 21, 22 and 25 and 26.

(2) The joint core skills pursuant to § 7 Paragraph 1 No.1 to 12,§11Paragraph 1 No.1 to 12, §15 Paragraph 1 No. 1 to 12, § 19 Paragraph 1 No. 1 to 12 and § 23 Paragraph 1 No. 1 to 12 and the occupationally specific specialist skills pursuant to §7Paragraph 1 No.13 to 17, §11 Paragraph 1 No.13 to17, §15 Paragraph 1 No.13 to 20, §19 Paragraph 1 No.13 to19 and §23 Paragraph 1 No.13 to 18 each have a time frame of 21 months and are imparted in an integrated way distributed across the whole of the period of training and in a manner that accords due consideration to the aspect of sustainability. Within the scope of the occupationally specific specialist skills, employability skills in at least one areas of deployment should be expanded and deepened via qualifications which enable the holistic execution of complex tasks in the respective business process.

§ 4

Training plan

Trainers shall use the general training plan as the basis for the drawing up of a training plan for trainees.

§ 5

Written record of training

Trainees are to keep a written record of their training. They are to be afforded the opportunity to maintain this written record of training during training time. Trainees shall review the written record of training on a regular basis.

§ 6

Final examination

1) The final examination comprises Parts 1 and 2, which are held at separate times. The objective of the final examination is to ascertain whether candidates have acquired occupational employability skills. In the final examination, candidates should demonstrate mastery of the necessary occupational skills, possession of the required occupational knowledge and competences and familiarity with the teaching material to be imparted via teaching at vocational school. Skills which have already constituted an object of examination in Part 1 of the final examination shall only be included in Part 2 of the final examination to the extent that such inclusion is necessary for the determination of the requisite occupational competence pursuant to § 38 of the Vocational Training Act.

Part 2
Provisions for the training occupation of plant mechanic

§ 7

Training profile

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

1. Vocational education and training, 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. Company and technical communication
6. Planning and organisation of work, evaluation of work results
7. Differentiate, allocate and handle materials and auxiliary materials
8. Produce components and sub-assemblies
9. Maintain operating equipment
10. Control systems
11. Fix, secure and transport
12. Customer orientation
13. Process orders
14. Produce and assemble components and sub-assemblies
15. Maintenance; identify, localise and remedy errors and malfunctions
16. Check components and equipment
17. Business processes and quality management within the area of deployment

(2) Skills pursuant to Paragraph 1 above should be applied and deepened in at least one of the following areas of deployment.

1. Plant construction
2. Apparatus and container construction
3. Servicing
4. Pipe system technology
5. Welding technology

The area of deployment is stipulated by the company providing training. Other areas of deployment are permissible if the skills pursuant to Paragraph 1 above can be imparted.

§ 8

General training plan

The skills stated in § 7 Paragraph 1 above should be imparted in accordance with the instructions regarding the content and time structure of vocational education and training (general training plan) contained in Annex 1 and Annex 2. 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.

§ 9

Part 1 of the final examination

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

(2) Part 1 of the final examination encompasses such skills for the first three half years of training as are listed in Annex 2 and extends to include teaching material to be imparted at vocational school insofar as such teaching material is integral to the vocational education and training.

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

1. evaluate technical documentation, determine technical parameters, plan and agree work processes, plan material and tool requirements;
2. select production procedures, manufacture components using manual and machine production processes, apply prevention measures and accord due consideration to environmental protection regulations;
3. evaluate the safety of operating equipment;
4. select and apply testing procedures and equipment, check the deployability of test equipment, document and evaluate results;
5. document and explain the execution of orders, prepare technical documentation including test protocols.

These requirements should be demonstrated via the production of pipelines, plant or container components using sheet metals, profiles and semi-finished products. Tacking and welding works should be carried out. Candidates make a selection from several procedures on offer.

(4) The examination consists of the execution of a complex work-related task, which comprises situational oral examination phases and written examination assignments. The maximum examination time is 8 hours, whereby the situational oral examination phases should be of a total maximum duration of 10 minutes. The duration of the written assignments should not exceed 90 minutes.

§ 10

Part 2 of the final examination

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

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

1. A work order
2. Order and functional analysis
3. Production engineering
4. Business and social studies

Due consideration should be accorded to vocational education and training, employment and collective wage agreement law, structure and organisation of the company providing training, health and safety at work, environmental protection, company and technical communication, planning and organisation of work, evaluation of work results, quality management and the safety of plants and operating equipment.

(3) In the examination area work order, candidates should demonstrate that they are able to:

1. clarify the nature and scope of orders, identify specific services, agree particular characteristics and deadlines with customers, procure information for the processing of the order;

2. evaluate and use information for the processing of the order, take technical developments into account, comply with stipulations relevant to safety, accord due consideration to business management and ecological points of view in planning the processing of orders, reach agreement with upstream and downstream divisions, prepare planning documents;

3. execute orders whilst in particular taking account of health and safety at work, environmental protection and deadlines, apply company quality assurance systems in their own work area, systematically seek out, remedy and document the causes of quality defects, arrange for partial orders;

4. select and apply testing procedures and equipment, identify the deployability of test equipment, apply test plans and company test regulations, check and document results, document order processes, services and consumption, handover technical systems or products to customers and explain such systems and products, prepare acceptance protocols;

5. execute three welding engineering test pieces with two different materials and two welding procedures in the field of welding technology or apply joining procedures in the other areas of deployment.

Manufacture, altering or servicing of plants or plant components are particularly considered as evidence of satisfactory performance.

(4) In order to demonstrate fulfilment of requirements in the examination area work order candidates should:

1. execute a company order within 18 hours including provision of practical documentation and to take part in a specialist oral examination of no more than 30 minutes' duration; the specialist oral examination should be conducted on the basis of the practically related documentation of the company order processed; the specialist oral examination should act as a vehicle for evaluating relevant process skills with regard to the execution of the order under due consideration of the practically related documentation; prior to the execution of the company order the assignment including planned processing time should be presented to the Examination Board for approval; or

2. prepare, execute and follow-up a practical work task in 14 hours, including documentation via task specific records, and to conduct a supplementary specialist oral examination of no more than 20 minutes' duration; the execution of the work task lasts six hours; observations of the way in which the task is executed, the task specific documentation and the specialist oral examination should act as a vehicle for evaluating relevant process skills with regard to the execution of the work task.

(5) The company providing training should select the examination option in accordance with Paragraph 4 above and should notify the candidate and the competent body of the selection at the same time as registration for the examination takes place.

(6) In the examination area order and functional analysis, candidates should analyse an order within the maximum examination time of 120 minutes. Candidates should demonstrate that they are able to accord due consideration to technical rules and guidelines in checking and supplementing technical documentation to ensure completeness and correctness, select test equipment and procedures, apply test plans and company test regulations, document results and contribute to the optimisation of stipulations and work processes.

(7) In the examination area production engineering, candidate should plan the process of manufacture or alteration of plant components within the maximum examination time of 120 minutes. Candidates should demonstrate that they are able to analyse technical problems, develop solution concepts whilst according due consideration to production procedures, material properties, regulations, technical rules, guidelines, cost-effectiveness and company processes, stipulate system specifications to suit applications, determine costs, prepare technical documents, accord due consideration to health and safety at work and health protection and select welding or other joining procedures in an order-related manner.

(8) In the examination area business and social studies, candidates should process practically related employment-oriented tasks within the maximum examination time of 60 minutes and demonstrate that they are able to present and evaluate general business and societal correlations within the world of employment and work.

Part 3
Provisions for the training occupation of industrial mechanic

§ 11
Training profile

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

1. Vocational education and training, 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. Company and technical communication

6. Planning and organisation of work, evaluation of work results

7. Differentiate, allocate and handle materials and auxiliary materials

8. Produce components and sub-assemblies

9. Maintain operating equipment

10. Control systems

11. Fix, secure and transport

11. Customer orientation

12. Produce, assemble and dismantle components, sub-assemblies and systems

13. Ensure the functionality of technical systems

14. Maintain technical systems

15. Build, expand and check electrical control engineering components

16. Business processes and quality management within the area of deployment

(2) Skills pursuant to Paragraph 1 above should be applied and deepened in at least one of the following areas of deployment.

1. Construction of precision devices
2. Servicing
3. Machine and plant construction
4. Production engineering

The area of deployment is stipulated by the company providing training. Other areas of deployment are permissible if the skills pursuant to Paragraph 1 above can be imparted.

§ 12

General training plan

The skills stated in § 11 Paragraph 1 above should be imparted in accordance with the instructions regarding the content and time structure of vocational education and training (general training plan) contained in Annex 1 and Annex 3. 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 should take place before the end of the second year of training.

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

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

1. evaluate technical documentation, determine technical parameters, plan and agree work processes, plan material and tool requirements;
2. select production procedures, manufacture components using manual and machine production processes, apply prevention measures and accord due consideration to environmental protection regulations;
3. evaluate the safety of operating equipment;
4. select and apply testing procedures and equipment, check the deployability of test equipment, document and evaluate results;
5. document and explain the execution of orders, prepare technical documentation including test protocols.

These requirements should be demonstrated via the production of a sub-assembly with a control engineering function.

(4) The examination consists of the execution of a complex work-related task, which comprises situational oral examination phases and written examination assignments. The maximum examination time is 8 hours, whereby the situational oral examination phases should be of a total maximum duration of 10 minutes. The duration of the written assignments should not exceed 90 minutes.

§ 14

Part 2 of the final examination

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

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

1. A work order
2. Order and functional analysis
3. Production engineering
4. Business and social studies

Due consideration should be accorded to vocational education and training, employment and collective wage agreement law, structure and organisation of the company providing training, health and safety at work, environmental protection, company and technical communication, planning and organisation of work, evaluation of work results, quality assurance systems and the safety of plants and operating equipment.

(3) In the examination area work order, candidates should demonstrate that they are able to:

1. clarify the nature and scope of orders, identify specific services, agree particular characteristics and deadlines with customers, procure information for the processing of the order;
2. evaluate and use information for the processing of the order, take technical developments into account, comply with stipulations relevant to safety, accord due consideration to business management and ecological points of view in planning the processing of orders, reach agreement with upstream and downstream divisions, prepare planning documents;
3. execute orders whilst in particular taking account of health and safety at work, environmental protection and deadlines, apply company quality assurance systems in their own work area, systematically seek out, remedy and document the causes of quality defects, arrange for partial orders;

4. select and apply testing procedures and equipment, identify the deployability of test equipment, apply test plans and company test regulations, check and document results, document order processes, services and consumption, handover technical systems or products to customers and explain such systems and products, prepare acceptance protocols.

Manufacture, set up, altering, retrofitting or servicing of plants or plant components are particularly considered as evidence of satisfactory performance.

(4) In order to demonstrate fulfilment of requirements in the examination area work order candidates should:

1. execute a company order within 18 hours including provision of practical documentation and to take part in a specialist oral examination of no more than 30 minutes' duration; the specialist oral examination should be conducted on the basis of the practically related documentation of the company order processed; the specialist oral examination should act as a vehicle for evaluating relevant process skills with regard to the execution of the order under due consideration of the practically related documentation; prior to the execution of the company order the assignment including planned processing time should be presented to the Examination Board for approval; or
2. prepare, execute and follow-up a practical work task in 14 hours, including documentation via task specific records, and

to conduct a supplementary specialist oral examination of no more than 20 minutes' duration; the execution of the work task lasts six hours; observations of the way in which the task is executed, the task specific documentation and the specialist oral examination should act as a vehicle for evaluating relevant process skills with regard to the execution of the work task.

(5) The company providing training should select the examination option in accordance with Paragraph 4 above and should notify the candidate and the competent body of the selection at the same time as registration for the examination takes place.

(6) In the examination area order and functional analysis, candidates should analyse technical systems within the maximum examination time of 120 minutes. Candidates should demonstrate that they are able to recognise problems arising from the areas of production, assembly, commissioning and maintenance, accord due consideration to technical rules in selecting the necessary components, tools and auxiliary materials, adapt assembly plans and circuit diagrams and plan the required work stages.

(7) In the examination area production engineering, candidates should plan the production of technical systems within the maximum examination time of 120 minutes. Candidates should demonstrate that they are able to evaluate manufacturing procedures for the production of components and sub-assemblies and select such procedures whilst taking account of technical, business and economic points of view, calculate technological data, plan the mechanisation of technical systems, the use of materials and auxiliary materials and the necessary work stages and allocate tools and machines.

(8) In the examination area business and social studies, candidates should process practically related employment-oriented tasks within the maximum examination time of 60 minutes and demonstrate that they are able to present and evaluate general business and societal correlations within the world of employment and work.

Part 4
Provisions for the training occupation of construction mechanic

§ 15
Training profile

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

1. Vocational education and training, 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. Company and technical communication
6. Planning and organisation of work, evaluation of work results
7. Differentiate, allocate and handle materials and auxiliary materials
8. Produce components and sub-assemblies
9. Maintain operating equipment
10. Control systems
11. Fix, secure and transport
12. Customer orientation
13. Use technical documentation
14. Separate and reform
15. Use production machines
16. Join components
17. Use mechanisams and auxiliary structures
18. Assemble and dismantle metal constructions
19. Test components and sub-assemblies
20. Business processes and quality management within the area of deployment

(2) Skills pursuant to Paragraph 1 above should be applied and deepened in at least one of the following areas of deployment.

1. Equipment technology
2. Precision sheet metal working
3. Shipbuilding
4. Welding technology
5. Steel and metal engineering technology

The area of deployment is stipulated by the company providing training. Other areas of deployment are permissible if the skills pursuant to Paragraph 1 above can be imparted.

§ 16
General training plan

The skills stated in § 15 Paragraph 1 above should be imparted in accordance with the instructions regarding the content and time structure of vocational education and training (general training plan) contained in Annex 1 and Annex 4. 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.

§ 17
Part 1 of the final examination

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

(2) Part 1 of the final examination encompasses such skills for the first three half years of training as are listed in Annex 4 and extends to include teaching material to be imparted at vocational school insofar as such teaching material is integral to the vocational education and training.

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

1. evaluate technical documentation, determine technical parameters, plan and agree work processes, plan material and tool requirements;
2. select production procedures, manufacture components using manual and machine production processes, apply prevention measures and accord due consideration to environmental protection regulations;
3. evaluate the safety of operating equipment;
4. select and apply testing procedures and equipment, check the deployability of test equipment, document and evaluate results;

5. document and explain the execution of orders, prepare technical documentation including test protocols.

These requirements should be demonstrated via the production of components and sub-assemblies using manual and machine manufacturing and reforming processes and soluble and non-soluble joining techniques.

(4) The examination consists of the execution of a complex work-related task, which comprises situational oral examination phases and written examination assignments.

The maximum examination time is 8 hours, whereby the situational oral examination phases should be of a total maximum duration of 10 minutes. The duration of the written assignments should not exceed 90 minutes.

§ 18

Part 2 of the final examination

(1) Part 2 of the final examination encompasses such skills as are listed in Annex 1 and Annex 4 and extends to include teaching material to be imparted at vocational school insofar as such teaching material is integral to the vocational education and training.

(2) The final examination comprises the following examination areas.

1. A work order
2. Order and functional analysis
3. Production engineering
4. Business and social studies

Due consideration should be accorded to vocational education and training, employment and collective wage agreement law, structure and organisation of the company providing training, health and safety at work, environmental protection, company and technical communication, planning and organisation of work, evaluation of work results, quality assurance systems and the safety of plants and operating equipment.

(3) In the examination area work order, candidates should demonstrate that they are able to:

1. clarify the nature and scope of orders, identify specific services, agree particular characteristics and deadlines with customers, procure information for the processing of the order;
2. evaluate and use information for the processing of the order, take technical developments into account, comply with stipulations relevant to safety, accord due consideration to business management and ecological points of view in planning the processing of orders, reach agreement with upstream and downstream divisions, prepare planning documents;
3. execute orders whilst in particular taking account of health and safety at work, environmental protection and deadlines, apply company quality assurance systems in their own work area, systematically seek out, remedy and document the causes of quality defects, arrange for partial orders;
4. select and apply testing procedures and equipment, identify the deployability of test equipment, apply test plans and company test regulations, check and document results, document order processes, services and consumption, handover technical systems or products to customers and explain such systems and products, prepare acceptance protocols;
5. execute three welding engineering test pieces with two different materials and two welding procedures in the field of welding technology or apply joining procedures in the other areas of deployment.

Production, assembly and dismantling of metal constructions are particularly considered as evidence of satisfactory performance.

(4) In order to demonstrate fulfilment of requirements in the examination area work order candidates should:

1. execute a company order within 18 hours including provision of practical documentation and to take part in a specialist oral examination of no more than 30 minutes' duration; the specialist oral examination should be conducted on the basis of the practically related documentation of the company order processed; the specialist oral examination should act as a vehicle for evaluating relevant process skills with regard to the execution of the order under due consideration of the practically related documentation; prior to the execution of the company order the assignment including planned processing time should be presented to the Examination Board for approval; or

   prepare, execute and follow-up a practical work task in 14 hours, including documentation via task specific records, and to conduct a supplementary specialist oral examination of no more than 20 minutes' duration; the execution of the work task lasts six hours; observations of the way in which the task is executed, the task specific documentation and the specialist oral examination should act as a vehicle for evaluating relevant process skills with regard to the execution of the work task.

(5) The company providing training should select the examination option in accordance with Paragraph 4 above and should notify the candidate and the competent body of the selection at the same time as registration for the examination takes place.

(6) In the examination area order and functional analysis, candidates should work out a sequence of work stages within the maximum examination time of 120 minutes. Candidates should demonstrate that they are able to accord due consideration to work organisation, safety regulations, environmental provisions and cost-effectiveness in setting up their workplace, evaluate documents, carry out calculations, explain complex correlations of metal constructions, select materials and auxiliary materials and align tools and machines to the respective production procedures.

(7) In the examination area production engineering, candidate should plan the production, assembly and dismantling of metal constructions within the maximum examination time of 120 minutes whilst according due consideration to quality assurance systems. Candidates should demonstrate that they are able to take account of material properties in differentiating production procedures, in particular the separation and reforming of sheet metals, pipes or profiles, stipulate mechanisms and auxiliary structures, accord due consideration to health and safety at work and health protection and select welding procedures or other joining techniques in a way that is related to the order.

(8) In the examination area business and social studies, candidates should process practically related employment-oriented tasks within the maximum examination time of 60 minutes and demonstrate that they are able to present and

evaluate general business and societal correlations within the world of employment and work.

Part 5

Provisions for the training occupation of tools mechanic

§ 19

Training profile

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

1. Vocational education and training, 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. Company and technical communication
6. Planning and organisation of work, evaluation of work results
7. Differentiate, allocate and handle materials and auxiliary materials
8. Produce components and sub-assemblies
9. Maintain operating equipment
10. Control systems
11. Fix, secure and transport
12. Customer orientation
13. Use different manufacturing procedures to produce components
14. Assembly and dismantling
15. Trialing and handover
16. Maintenance of components and sub-assemblies
17. Programme machines and systems
18. Testing
19. Business processes and quality management within the area of deployment

(2) Skills pursuant to Paragraph 1 above should be applied and deepened in at least one of the following areas of deployment.

1. Moulding technology
2. Instrument technology
3. Pressing technology
4. Jig and fixture technology

The area of deployment is stipulated by the company providing training. Other areas of deployment are permissible if the skills pursuant to Paragraph 1 above can be imparted.

§ 20

General training plan

The skills stated in § 19 Paragraph 1 above should be imparted in accordance with the instructions regarding the content and time structure of vocational education and training (general training plan) contained in Annex 1 and Annex 5. 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.

§ 21

Part 1 of the final examination

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

(2) Part 1 of the final examination encompasses such skills for the first three half years of training as are listed in Annex 5 and extends to include teaching material to be imparted at vocational school insofar as such teaching material is integral to the vocational education and training.

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

1. evaluate technical documentation, determine technical parameters, plan and agree work processes, plan material and tool requirements;
2. select production procedures, manufacture components using manual and machine production processes, apply prevention measures and accord due consideration to environmental protection regulations;
3. evaluate the safety of operating equipment;
4. select and apply testing procedures and equipment, check the deployability of test equipment, document and evaluate results;
5. document and explain the execution of orders, prepare technical documentation including test protocols.

These requirements should be demonstrated via the production of components, the joining of components to form sub-assemblies, the securing of functions and the assembly of a drive element.

(4) The examination consists of the execution of a complex work-related task, which comprises situational oral examination phases and written examination assignments. The maximum examination time is 8 hours, whereby the situational oral examination phases should be of a total maximum duration of 10 minutes. The duration of the written assignments should not exceed 90 minutes.

§ 22

Part 2 of the final examination

(1) Part 2 of the final examination encompasses such skills as are listed in Annex 1 and Annex 5 and extends to include teaching material to be imparted at vocational school insofar as such teaching material is integral to the vocational education and training.

(2) The final examination comprises the following examination areas.

1. A work order
2. Order and functional analysis
3. Production engineering
4. Business and social studies

Due consideration should be accorded to vocational education and training, employment and collective wage agreement law, structure and organisation of the company providing training, health and safety at work, environmental protection, company and technical communication, planning and organisation of work, evaluation of work results, quality assurance systems and the safety of plants and operating equipment.

(3) In the examination area work order, candidates should demonstrate that they are able to:

1. clarify the nature and scope of orders, identify specific services, agree particular characteristics and deadlines with customers, procure information for the processing of the order;
2. evaluate and use information for the processing of the order, take technical developments into account, comply with stipulations relevant to safety, accord due consideration to business management and ecological points of view in planning the processing of orders, reach agreement with upstream and downstream divisions, prepare planning documents;
3. execute orders whilst in particular taking account of health and safety at work, environmental protection and deadlines, apply company quality assurance systems in their own work area, systematically seek out, remedy and document the causes of quality defects, arrange for partial orders;
4. select and apply testing procedures and equipment, identify the deployability of test equipment, apply test plans and company test regulations, check and document results, document order processes, services and consumption, handover technical systems or products to customers and explain such systems and products, prepare acceptance protocols.

Manufacture, altering or servicing of plants, mechanisms or instruments are particularly considered as evidence of satisfactory performance.

(4) In order to demonstrate fulfilment of requirements in the examination area work order candidates should:

1. execute a company order within 18 hours including provision of practical documentation and to take part in a specialist oral examination of no more than 30 minutes' duration; the specialist oral examination should be conducted on the basis of the practically related documentation of the company order processed; the specialist oral examination should act as a vehicle for evaluating relevant process skills with regard to the execution of the order under due consideration of the practically related documentation; prior to the execution of the company order the assignment including planned processing time should be presented to the Examination Board for approval; or
2. prepare, execute and follow-up a practical work task in 14 hours, including documentation via task specific records, and to conduct a supplementary specialist oral examination of no more than 20 minutes' duration; the execution of the work task lasts six hours; observations of the way in which the task is executed, the task specific documentation and the specialist oral examination should act as a vehicle for evaluating relevant process skills with regard to the execution of the work task.

(5) The company providing training should select the examination option in accordance with Paragraph 4 above and should notify the candidate and the competent body of the selection at the same time as registration for the examination takes place.

(6) In the examination area order and functional analysis, candidates should describe the function of a technical system within the maximum examination time of 120 minutes. Candidates should demonstrate that they are able to recognise possibilities and approaches for the systematic identification of errors and the combined effect of technical components, carry out dismantling, assembly, commissioning and repairs in accordance with stipulated requirements, highlight maintenance procedures and present the cost-effectiveness of such procedures.

(7) In the examination area production engineering, candidates should select production procedures for the manufacture of components and sub-assemblies, give reasons for their selection and present quality assurance measures within the maximum examination time of 120 minutes. Candidates should demonstrate that they are able to plan the use of materials and auxiliary materials, select the necessary tools and technological data for this purpose, comply with technical rules and standards, present methods for the assembly of the finished components, select the necessary tools and equipment and accord due consideration to health and safety at work and environmental protection regulations.

In the examination area business and social studies, candidates should process practically related employment-oriented tasks within the maximum examination time of 60 minutes and demonstrate that they are able to present and evaluate general business and societal correlations within the world of employment and work.

Part 6

Provisions for the training occupation of milling machine operator

§ 23

Training profile

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

1. Vocational education and training, 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. Company and technical communication
6. Planning and organisation of work, evaluation of work results
7. Differentiate, allocate and handle materials and auxiliary materials
8. Produce components and sub-assemblies
9. Maintain operating equipment
10. Control systems
11. Fix, secure and transport
12. Customer orientation
13. Plan the production process
14. Programme numerically controlled machine tools or production systems
15. Set up machine tools or production systems
16. Produce workpieces
17. Monitor and optimise production processes
18. Business processes and quality management within the area of deployment

(2) Skills pursuant to Paragraph 1 above should be applied and deepened in at least one of the following areas of deployment.

1. Automatic lathe systems
2. Engine lathe systems
3. Milling machine systems
4. Grinding machine systems

The area of deployment is stipulated by the company providing training. Other areas of deployment are permissible if the skills pursuant to Paragraph 1 above can be imparted.

§ 24

General training plan

The skills stated in § 23 Paragraph 1 above should be imparted in accordance with the instructions regarding the content and time structure of vocational education and training (general training plan) contained in Annex 1 and Annex 6. 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.

§ 25

Part 1 of the final examination

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

(2) Part 1 of the final examination encompasses such skills for the first three half years of training as are listed in Annex 6 and extends to include teaching material to be imparted at vocational school insofar as such teaching material is integral to the vocational education and training.

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

1. evaluate technical documentation, determine technical parameters, plan and agree work processes, plan material and tool requirements;
2. select production procedures, manufacture components using manual and machine production processes, apply prevention measures and accord due consideration to environmental protection regulations;
3. evaluate the safety of operating equipment;
4. select and apply testing procedures and equipment, check the deployability of test equipment, document and evaluate results;
5. document and explain the execution of orders, prepare technical documentation including test protocols.

These requirements should be demonstrated via the processing of a combined production order from the area of lathe turning and milling, lathe turning and grinding or milling and grinding technology.

(4) The examination consists of the execution of a complex work-related task, which comprises situational oral examination phases and written examination assignments. The maximum examination time is 8 hours, whereby the situational oral examination phases should be of a total maximum duration of 10 minutes. The duration of the written assignments should not exceed 90 minutes.

§ 26

Part 2 of the final examination

(1) Part 2 of the final examination encompasses such skills as are listed in Annex 1 and Annex 6 and extends to include teaching material to be imparted at vocational school insofar as such teaching material is integral to the vocational education and training.

(2) The final examination comprises the following examination areas.

1. A work order
2. Order and functional analysis
3. Production engineering
4. Business and social studies

Due consideration should be accorded to vocational education and training, employment and collective wage agreement law, structure and organisation of the company providing training, health and safety at work, environmental protection, company and technical communication, planning and organisation of work, evaluation of work results, quality assurance systems and the safety of plants and operating equipment.

(3) In the examination area work order, candidates should demonstrate that they are able to:

1. clarify the nature and scope of orders, identify specific services, agree particular characteristics and deadlines with customers, procure information for the processing of the order;
2. evaluate and use information for the processing of the order, take technical developments into account, comply with stipulations relevant to safety, accord due consideration to business management and ecological points of view in planning the processing of orders, reach agreement with upstream and downstream divisions, prepare planning documents;
3. execute orders whilst in particular taking account of health and safety at work, environmental protection and deadlines, apply company quality assurance systems in their own work area, systematically seek out, remedy and document the causes of quality defects, arrange for partial orders;
4. select and apply testing procedures and equipment, identify the deployability of test equipment, apply test plans and company test regulations, check and document results, document order processes, services and consumption, handover technical systems or products to customers and explain such systems and products, prepare acceptance protocols.

The execution and monitoring of manufacturing processes on machine tools or production systems are particularly considered as evidence of satisfactory performance.

(4) In order to demonstrate fulfilment of requirements in the examination area work order candidates should:

1. execute a company order within 15 hours including provision of practical documentation and to take part in a specialist oral examination of no more than 30 minutes' duration; the specialist oral examination should be conducted on the basis of the practically related documentation of the company order processed; the specialist oral examination should act as a vehicle for evaluating relevant process skills with regard to the execution of the order under due consideration of the

practically related documentation; prior to the execution of the company order the assignment including planned processing time should be presented to the Examination Board for approval; or

2. prepare, execute and follow-up a practical work task in 14 hours, including documentation via task specific records, and to conduct a supplementary specialist oral examination of no more than 20 minutes' duration; the execution of the work task lasts six hours; observations of the way in which the task is executed, the task specific documentation and the specialist oral examination should act as a vehicle for evaluating relevant process skills with regard to the execution of the work task.

(5) The company providing training should select the examination option in accordance with Paragraph 4 above and should notify the candidate and the competent body of the selection at the same time as registration for the examination takes place.

(6) In the examination area order and functional analysis, candidates should analyse an order within the maximum examination time of 120 minutes. Candidates should demonstrate that they are able to check and supplement technical documentation to ensure completeness and correctness, stipulate production strategies, accord due consideration to health and safety at work and environmental protection in planning the set-up of their workplace and apply technical rules, guidelines and test regulations.

(7) In the examination area production engineering, candidates should plan the execution of a production order within the maximum examination time of 120 minutes. Candidates should demonstrate that they are able to process an order, align and programme machine tools and production systems and accord due consideration to the maintenance of such tools and systems, stipulate production procedures, production parameters, test methods and test equipment and document quality and work results.

(8) In the examination area business and social studies, candidates should process practically related employment-oriented tasks within the maximum examination time of 60 minutes and demonstrate that they are able to present and evaluate general business and societal correlations within the world of employment and work.

Part 7

Joint pass regulations, transitional and final provisions

§ 27

Pass regulation

(1) The pass regulations listed in the paragraphs below each apply to the training occupations stated in the present Ordinance.

(2) In determining the overall result, a weighting of 40 percent shall be accorded to Part 1 of the final examination and a weighting of 60 percent to Part 2 of the examination.

(3) In determining the result of Part 2 of the final examination, a weighting of 50 percent shall be accorded to the examination area work order, a weighting of 20 percent shall be accorded to each of the examination areas order and functional analysis and production engineering and a weighting of 10 percent shall be accorded to th examination area business and social studies.

(4) The final examination is deemed to have been passed if

a mark of at least "pass" is achieved:

1. for the overall result pursuant to Paragraph 2 above;
2. in the examination area work order and
3. for the overall result in the examination areas order and functional analysis, production engineering and business and social studies.

A mark of at least "pass" must be achieved in two of the examination areas pursuant to 3 above. In the third area pursuant to 3 above, no mark of "fail" must be awarded.

(5) Upon application by the candidate or at the discretion of the Examination Board, the examination areas order and functional analysis, production engineering and business and social studies may be supplemented by an oral examination if this may be decisive for the passing of the examination. In calculating the result for the examination areas tested orally, the previous result and the result of the supplementary oral examination should be accorded weighting in the ratio of 2:1.

§ 28

Transitional regulation

Existing regulations shall continue to apply to vocational education and training contractual arrangements already in place at the time the present Ordinance comes into effect insofar as the contractual parties do not agree that the provisions of the present Ordinance should apply.

§ 29

Entry into force, ceasing to be in force

The present Ordinance enters into force on 1 August 2007. The Ordinance of 9 July 2004 (Federal Law Gazette I p. 1502) in respect of vocational education and training in the industrial metal occupations ceases to be in force at this time.

Berlin, 23 July 2007

The Federal Minister of Economics and Technology

per procurationem

Bernd Pfaffenbach

Annex 1
(to §§ 8, 12, 16, 20 und 24)

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

Joint core skills

Occupational profile position	Part of the training occupation profile	Core 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 Paragraph 1 No. 1, § 11 Paragraph 1 No. 1, § 15 Paragraph 1 No. 1, § 19 Paragraph 1 No. 1, § 23 Paragraph 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 Paragraph 1 No. 2, § 11 Paragraph 1 No. 2, § 15 Paragraph 1 No. 2, § 19 Paragraph 1 No. 2, § 23 Paragraph 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 Paragraph 1 No. 3, § 11 Paragraph 1 No. 3, § 15 Paragraph 1 No. 3, § 19 Paragraph 1 No. 3, § 23 Paragraph 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 ire and initiate fire fighting measures
4	Environmental protection (§ 7 Paragraph 1 No. 4, § 11 Paragraph 1 No. 4, § 15 Paragraph 1 No. 4, § 19 Paragraph 1 No. 4), § 23 Paragraph 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	Company and technical communication (§ 7 Paragraph 1 No. 5, § 11 Paragraph 1 No. 5, § 15 Paragraph 1 No. 5, § 19 Paragraph 1 No. 5, § 23 Paragraph 1 No. 5)	a) Select information sources, procure and evaluate information b) Evaluate and use technical drawings and lists of parts, prepare sketches c) Compile, supplement, evaluate and use documents and occupationally related regulations d) Accord due consideration to data protection in managing, securing and archiving data and documents e) Conduct appropriate and target oriented discussions with customers, line managers and within the team, take cultural identities into account f) Present facts and circumstances, prepare protocols; use specialist English language terms in communications g) Procure and use information from technical documents or files, including in English h) Organise and chair meetings, document and present results i) Resolve disputes within the team

Occupational profile position	Part of the training occupation profile	Core skills to be imparted, incorporating autonomous planning, execution and checking and integrated with occupationally specific specialist skills
1	2	3
6	Planning and organisation of work, evaluation of work results (§ 7 Paragraph 1 No. 6), § 11 Paragraph 1 No. 6, § 15 Paragraph 1 No. 6, § 19 Paragraph 1 No. 6, § 23 Paragraph 1 No. 6)	a) Take company stipulations into account in setting up the workplace b) Select tools and materials, requisition tools and materials in a timely manner, test and transport tools and materials and make such tools and materials available for use c) Plan and execute work processes and subtasks whilst according due consideration to business and scheduling stipulations d) Use instruments for the processing of orders and tracking of deadlines e) Record and evaluate data relevant to business administration f) Check and present possible solutions and compare their cost-effectiveness g) Contribute to continuous improvement of work processes in own work area h) Identify skills deficits, use training opportunities i) Apply different learning techniques j) Select and use test procedures and test equipment, ascertain the deployability of test equipment k) Monitor, evaluate and document work results l) Plan and execute tasks within the team
7	Differentiate, allocate and handle materials and auxiliary materials (§ 7 Paragraph 1 No. 7, § 11 Paragraph 1 No. 7, § 15 Paragraph 1 No. 7, § 19 Paragraph 1 No. 7, § 23 Paragraph 1 No. 7)	a) Evaluate material properties and changes to such properties and select and handle materials in accordance with their use b) Allocate, use and dispose of auxiliary materials in accordance with their use
8	Produce components and sub-assemblies (§ 7 Paragraph 1 No. 8, § 11 Paragraph 1 No. 8, § 15 Paragraph 1 No. 8, § 19 Paragraph 1 No. 8, § 23 Paragraph 1 No. 8)	a) Ensure the operational readiness of machine tools including tools b) Select tools and clamping devices, align and clamp workpieces c) Manufacture workpieces using manual and machine production processes d) Produce components by separating and reforming e) Join components, including in different materials, to form sub-assemblies
9	Maintain operating equipment (§ 7 Paragraph 1 No. 9, § 11 Paragraph 1 No. 9, § 15 Paragraph 1 No. 9, § 19 Paragraph 1 No. 9, § 23 Paragraph 1 No. 9)	a) Inspect, care for and maintain operating equipment, document execution b) Visually inspect mechanical and electrical components and connections for mechanical damage, repair or arrange for repair c) Select, use and dispose of materials
10	Control systems (§ 7 Paragraph 1 No. 10, § 11 Paragraph 1 No. 10, § 15 Paragraph 1 No. 10, § 19 Paragraph 1 No. 10, § 23 Paragraph 1 No. 10)	a) Evaluate control systems documents b) Use control technology
11	Fix, secure and transport (§ 7 Paragraph 1 No. 11, § 11 Paragraph 1 No. 11, § 15 Paragraph 1 No. 11, § 19 Paragraph 1 No. 11, § 23 Paragraph 1 No. 11)	a) Select transport equipment, fittings and lifting equipment, evaluate the operational safety of such fittings and equipment, take the relevant regulations into account in deploying or arranging for the deployment of such fittings and equipment b) Deposit, store and secure transported goods
12	Customer orientation (§ 7 Paragraph 1 No. 12, § 11 Paragraph 1 No. 12, § 15 Paragraph 1 No. 12, § 19 Paragraph 1 No. 12, § 23 Paragraph 1 No. 12)	a) Procure order-specific requirements and information, test, implement or forward to those involved b) Make customers aware of particular order-specific characteristics and safety regulations

Annex 2
(to § 8)

General training plan for vocational education and training in the occupation of plant mechanic

Part A: Content structure for the occupationally specific specialist skills

Occupational profile position	Part of the training occupation profile	Specialist skills to be imparted, incorporating autonomous planning, execution and checking and integrated with core skills
1	2	3
13	Process orders (§ 7 Paragraph 1 No. 13)	a) Read and use drawings, in particular pipeline plans, isometric representations, developed views, foundation and site plans and layout plans b) Prepare isometric sketches of pipe fittings c) Record pipe routes and sketch isometrically d) Act cross-occupationally to coordinate technical facts and circumstances with regard to order processing e) Plan requirements in respect of raw materials, auxiliary materials and operating materials f) Take upstream and downstream procedural stages into account in stipulating and securing the work process g) Read and implement welding and assembly plans h) Execute security measures at construction sites or assembly locations
14	Produce and assemble components and sub-assemblies (§ 7 Paragraph 1 No. 14)	a) Select and deploy materials and combinations of materials according to intended purpose b) Separate pipes, sheet metals and profiles thermally and mechanically c) Reform pipes, sheet metals and profiles using cold and hot processes d) Select and install fittings e) Construct, mark off and produce templates and developed views f) Produce pipe, flange and hose connections g) Produce soluble and non-soluble pipe connections taking account of the media to be transported, pressure and temperature h) Protect plant components against external influences and secure insulation measures i) Tack components and weld using fillet and I-seams j) Take account of technical welding conditions in tacking and welding pipe fittings or plant and container components k) Produce pipe systems or containers in accordance with documents l) Accord due consideration to part-specific conditions in joining components and sub-assemblies m) Pre and post-treat weld seams thermally n) Heat align pipes, sheet metals and profiles o) Carry out material or component related heat treatment p) Assemble and dismantle plant components
15	Maintenance; identify, localise and remedy errors and malfunctions (§ 7 Paragraph 1 No. 15)	a) Inspect plants or plant components, identify and localise errors, damage and malfunctions b) Accord due consideration to procedural and safety regulations in carrying out preparatory measures for the maintenance of plant components c) Visually inspect components for wear and tear and damage d) Accord due consideration to procedural and safety regulations in decommissioning plant components or supply equipment e) Maintain plants or plant components f) Repair plants or plant components g) Document inspection findings and maintenance measures
16	Check components and equipment (§ 7 Paragraph 1 No. 16)	a) Take account of technical documents and general technical conditions in testing or commissioning components and equipment b) Check the functionality of open and closed loop control systems and of safety equipment c) Carry out visual inspection procedures, in particular colour penetration and magnetic particle checks at weld seams d) Check containers, pipe systems or plant components for leaks via pressure check e) Draw up test protocols

Occupational profile position	Part of the training occupation profile	Specialist skills to be imparted, incorporating autonomous planning, execution and checking and integrated with core skills
1	2	3
17	Business processes and quality management within the area of deployment (§ 7 Paragraph 1 No. 17)	a) Clarify the nature and scope of orders, identify specific services, agree particular characteristics and deadlines with customers b) Procure, evaluate and use information for the processing of the order, take technical developments into account, comply with stipulations relevant to safety c) Accord due consideration to business management and ecological points of view in planning the processing of orders, reach agreement with upstream and downstream divisions, prepare planning documents d) Arrange for partial orders, check results e) Execute orders whilst in particular taking account of health and safety at work, environmental protection and deadlines f) Apply company quality assurance systems in their own work area, systematically seek out, remedy and document the causes of quality defects g) Select and apply test procedures and equipment, check the deployability of test equipment, apply test plans and company test regulations, document and evaluate results h) Document order processing, services and consumption i) Handover technical systems or products to customers and explain such systems and products, prepare acceptance protocols j) Evaluate work results and execution of work and contribute to the continuous improvement of work processes k) Arrange for the optimisation of stipulations, particularly of documentation

Part B: Time structure

Section I:

Occupational profile position	Part of the training occupation profile	Core and specialist skills to be imparted in an integrated manner, incorporating autonomous planning, execution and checking	Time framework in months
1	2	3	4
1	VET, employment and collective wage agreement law (§ 7 Paragraph 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 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 (§ 7 Paragraph 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 Paragraph 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 Paragraph 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	

Section II

Occupational profile position	Part of the training occupation profile	Core 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 1		1st year of training	
5	Company and technical communication (§ 7 Paragraph 1 No. 5)	a) Select information sources, procure and evaluate information b) Evaluate and use technical drawings and lists of parts, prepare sketches	
6	Planning and organisation of work, evaluation of work results (§ 7 Paragraph 1 No. 6)	a) Take company stipulations into account in setting up the workplace b) Select tools and materials, requisition tools and materials in a timely manner, test and transport tools and materials and make such tools and materials available for use g) Contribute to continuous improvement of work processes in own work area h) Identify skills deficits, use training opportunities i) Apply different learning techniques j) Select and use test procedures and test equipment, ascertain the deployability of test equipment k) Monitor, evaluate and document work results	
7	Differentiate, allocate and handle materials and auxiliary materials (§ 7 Paragraph 1 No. 7)	a) Evaluate material properties and changes to such properties and select and handle materials in accordance with their use b) Allocate, use and dispose of auxiliary materials in accordance with their use	
8	Produce components and sub-assemblies (§ 7 Paragraph 1 No. 8)	a) Ensure the operational readiness of machine tools including tools b) Select tools and clamping devices, align and clamp workpieces c) Manufacture workpieces using manual and machine production processes d) Produce components by separating and reforming	
14	Produce and assemble components and sub-assemblies (§ 7 Paragraph 1 No. 14)	a) Select and deploy materials and combinations of materials according to intended purpose	
Time framework 2			
5	Company and technical communication (§ 7 Paragraph 1 No. 5)	b) Evaluate and use technical drawings and lists of parts, prepare sketches e) Conduct appropriate and target oriented discussions with customers, line managers and within the team, take cultural identities into account i) Resolve disputes within the team	
6	Planning and organisation of work, evaluation of work results (§ 7 Paragraph 1 No. 6)	c) Plan and execute work processes and subtasks whilst according due consideration to business and scheduling stipulations m) Plan and execute tasks within the team	
8	Produce components and sub-assemblies (§ 7 Paragraph 1 No. 8)	e) Join components, including in different materials, to form sub-assemblies	4 to 6
11	Fix, secure and transport (§ 7 Paragraph 1 No. 11)	a) Select transport equipment, fittings and lifting equipment, evaluate the operational safety of such fittings and equipment, take the relevant regulations into account in deploying or arranging for the deployment of such fittings and equipment b) Deposit, store and secure transported goods	
13	Process orders (§ 7 Paragraph 1 No. 13)	e) Plan requirements in respect of raw materials, auxiliary materials and operating materials g) Read and implement welding and assembly plans	
14	Produce and assemble components and sub-assemblies (§ 7 Paragraph 1 No. 14)	a) Select and deploy materials and combinations of materials according to intended purpose i) Tack components and weld using fillet and I-seams	

Occupational profile position	Part of the training occupation profile	Core 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 3		
5	Company and technical communication (§ 7 Paragraph 1 No. 5)	a) Select information sources, procure and evaluate information g) Procure and use information from technical documents or files, including in English	1 to 3
6	Planning and organisation of work, evaluation of work results (§ 7 Paragraph 1 No. 6)	b) Select tools and materials, requisition tools and materials in a timely manner, test and transport tools and materials and make such tools and materials available for use c) Plan and execute work processes and subtasks whilst according due consideration to business and scheduling stipulations	
9	Maintain operating equipment (§ 7 Paragraph 1 No. 9)	a) Inspect, care for and maintain operating equipment, document execution b) Visually inspect mechanical and electrical components and connections for mechanical damage, repair or arrange for repair c) Select, use and dispose of materials	
13	Process orders (§ 7 Paragraph 1 No. 13)	e) Plan requirements in respect of raw materials, auxiliary materials and operating materials	
	Time framework 4	2nd year of training, 1st half year	
5	Company and technical communication (§ 7 Paragraph 1 No. 5)	h) Organise and chair meetings, document and present results	
8	Produce components and sub-assemblies (§ 7 Paragraph 1 No. 8)	a) Ensure the operational readiness of machine tools including tools b) Select tools and clamping devices, align and clamp workpieces c) Manufacture workpieces using manual and machine production processes	
13	Process orders (§ 7 Paragraph 1 No. 13)	a) Read and take account of drawings, in particular pipeline plans, isometric representations, developed views, foundation and site plans and layout plans b) Prepare isometric sketches of pipe fittings c) Record pipe routes and sketch isometrically g) Read and implement welding and assembly plans	2 to 4
14	Produce and assemble components and sub-assemblies (§ 7 Paragraph 1 No. 14)	b) Separate pipes, sheet metals and profiles thermally and mechanically c) Reform pipes, sheet metals and profiles using cold and hot processes f) Produce pipe, flange and hose connections h) Protect plant components against external influences and secure insulation measures i) Tack components and weld using fillet and I-seams	
16	Check components and equipment (§ 7 Paragraph 1 No. 16)	c) Carry out visual inspection procedures, in particular colour penetration and magnetic particle checks at weld seams d) Check containers, pipe systems or plant components for leaks via pressure check	
	Time framework 5		
5	Company and technical communication (§ 7 Paragraph 1 No. 5)	b) Compile, supplement, evaluate and use documents and occupationally related regulations	2 to 4
6	Planning and organisation of work, evaluation of work results (§ 7 Paragraph 1 No. 6)	a) Take company stipulations into account in setting up the workplace l) Plan and execute tasks within the team	
8	Produce components and sub-assemblies (§ 7 Paragraph 1 No. 8)	j) Produce components by separating and reforming e) Join components in different materials to form sub-assemblies	

Occupational profile position	Part of the training occupation profile	Core and specialist skills to be imparted in an integrated manner, incorporating autonomous planning, execution and checking	Time framework in months
1	2	3	4
11	Fix, secure and transport (§ 7 Paragraph 1 No. 11)	a) Select transport equipment, fittings and lifting equipment, evaluate the operational safety of such fittings and equipment and take the relevant regulations into account in deploying or arranging for the deployment of such fittings and equipment b) Deposit, store and secure transported goods	
13	Process orders (§ 7 Paragraph 1 No. 13)	a) Read and take account of drawings, in particular pipeline plans, isometric representations, developed views, foundation and site plans and layout plans d) Act cross-occupationally to coordinate technical facts and circumstances with regard to order processing g) Read and implement welding and assembly plans h) Execute security measures at construction sites or assembly locations	
14	Produce and assemble components and sub-assemblies (§ 7 Paragraph 1 No. 14)	d) Select and install fittings e) Construct, mark off and produce templates and developed views h) Protect plant components against external influences and secure insulation measures i) Tack components and weld using fillet and I-seams l) Accord due consideration to part-specific conditions in joining components and sub-assemblies p) Assemble and dismantle plant components	
16	Check components and equipment (§ 7 Paragraph 1 No. 16)	c) Check containers, pipe systems or plant components for leaks via pressure check	
Time framework 6		2nd year of training, 2nd half year, 3rd and 4th year of training	
5	Company and technical communication (§ 7 Paragraph 1 No. 5)	c) Compile, supplement, evaluate and use documents and occupationally related regulations g) Procure and use information from technical documents or files, including in English	2 to 4
6	Planning and organisation of work, evaluation of work results (§ 7 Paragraph 1 No. 6)	j) Select and use test procedures and test equipment, ascertain the deployability of test equipment	
7	Differentiate, allocate and handle materials and auxiliary materials (§ 7 Paragraph 1 No. 7)	b) Allocate, use and dispose of auxiliary materials in accordance with their use	
10	Control systems (§ 7 Paragraph 1 No. 10)	a) Evaluate control systems documents	
15	Maintenance; identify, localise and remedy errors and malfunctions (§ 7 Paragraph 1 No. 15)	a) Inspect plants or plant components, identify and localise errors, damage and malfunctions b) Accord due consideration to procedural and safety regulations in carrying out maintenance of plant components c) Visually inspect components for wear and tear and damage d) Accord due consideration to procedural and safety regulations in decommissioning plant components or supply equipment e) Maintain plants or plant components g) Document inspection findings and maintenance measures	
16	Check components and equipment (§ 7 Paragraph 1 No. 16)	a) Take account of technical documents and general technical conditions in testing or commissioning components and equipment b) Check the functionality of open and closed loop control systems and of safety equipment e) Draw up test protocols	

Occupational profile position	Part of the training occupation profile	Core 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 7		
5	Company and technical communication (§ 7 Paragraph 1 No. 5)	e) Conduct appropriate and target oriented discussions with customers, line managers and within the team, take cultural identities into account f) Present facts and circumstances, prepare protocols; use specialist English language terms in communications	3 to 4
6	Planning and organisation of work, evaluation of work results (§ 7 Paragraph 1 No. 6)	f) Check and present possible solutions and compare their cost-effectiveness g) Contribute to continuous improvement of work processes in own work area h) Identify skills deficits, use training opportunities i) Apply different learning techniques k) Monitor, evaluate and document work results	
12	Customer orientation (§ 7 Paragraph 1 No. 12)	a) Procure order-specific requirements and information, test, implement or forward to those involved b) Make customers aware of particular order-specific characteristics and safety regulations	
14	Produce and assemble components and sub-assemblies (§ 7 Paragraph 1 No. 14)	d) Select and install fittings e) Construct, mark off and produce templates and developed views i) Tack components and weld using fillet and I-seams j) Take account of technical welding conditions in tacking and welding pipe fittings or plant and container components l) Accord due consideration to part-specific conditions in joining components and sub-assemblies	
15	Maintenance; identify, localise and remedy errors and malfunctions (§ 7 Paragraph 1 No. 15)	a) Inspect plants or plant components, identify and localise errors, damage and malfunctions b) Accord due consideration to procedural and safety regulations in carrying out preparatory measures for the maintenance of plant components d) Accord due consideration to procedural and safety regulations in decommissioning plant components or supply equipment f) Repair plants or plant components g) Document inspection findings and maintenance measures	
16	Check components and equipment (§ 7 Paragraph 1 No. 16)	d) Draw up test protocols	
	Zeitrahmen 8		
5	Company and technical communication (§ 7 Paragraph 1 No. 5)	c) Compile, supplement, evaluate and use documents and occupationally related regulations d) Accord due consideration to data protection in managing, securing and archiving data and documents	4 to 6
6	Planning and organisation of work, evaluation of work results (§ 7 Paragraph 1 No. 6)	d) Use instruments for the processing of orders and tracking of deadlines e) Record and evaluate data relevant to business administration j) Select and use test procedures and test equipment, ascertain the deployability of test equipment k) Monitor, evaluate and document work results	
7	Differentiate, allocate and handle materials and auxiliary materials (§ 7 Paragraph 1 No. 7)	a) Evaluate material properties and changes to such properties and select and handle materials in accordance with their use	
12	Customer orientation (§ 7 Paragraph 1 No. 12)	b) Procure order-specific requirements and information, test, implement or forward to those involved c) Make customers aware of particular order-specific characteristics and safety regulations	

Occupational profile position	Part of the training occupation profile	Core and specialist skills to be imparted in an integrated manner, incorporating autonomous planning, execution and checking	Time framework in months
1	2	3	4
13	Process orders (§ 7 Paragraph 1 No. 13)	f) Take upstream and downstream procedural stages into account in stipulating and securing the work process g) Read and implement welding and assembly plans	
14	Produce and assemble components and sub-assemblies (§ 7 Paragraph 1 No. 14)	g) Produce soluble and non-soluble pipe connections taking account of the media to be transported, pressure and temperature j) Take account of technical welding conditions in tacking and welding pipe fittings or plant and container components k) Produce pipe systems or containers in accordance with documents m) Pre and post-treat weld seams thermally n) Heat align pipes, sheet metals and profiles o) Carry out material or component related heat treatment	
16	Check components and equipment (§ 7 Paragraph 1 No. 16)	d) Check containers, pipe systems or plants for leaks via pressure check e) Draw up test protocols	
	Time framework 9		
10	Control systems (§ 7 Paragraph 1 No. 10)	b) Use control technology	
13	Process orders (§ 7 Paragraph 1 No. 13)	e) Take upstream and downstream procedural stages into account in stipulating and securing the work process	
15	Maintenance; identify, localise and remedy errors and malfunctions (§ 7 Paragraph 1 No. 15)	d) Accord due consideration to procedural and safety regulations in decommissioning plant components or supply equipment	1 to 2
16	Check components and equipment (§ 7 Paragraph 1 No. 16)	a) Take account of technical documents and general technical conditions in testing or commissioning components and equipment b) Check the functionality of open and closed loop control systems and of safety equipment	
	Time framework 10		
17	Business processes and quality management within the area of deployment (§ 7 Paragraph 1 No. 17)	a) Clarify the nature and scope of orders, identify specific services, agree particular characteristics and deadlines with customers b) Procure, evaluate and use information for the processing of the order, take technical developments into account, comply with stipulations relevant to safety c) Accord due consideration to business management and ecological points of view in planning the processing of orders, reach agreement with upstream and downstream divisions, prepare planning documents d) Arrange for partial orders, check results e) Execute orders whilst in particular taking account of health and safety at work, environmental protection and deadlines f) Apply company quality assurance systems in their own work area, systematically seek out, remedy and document the causes of quality defects g) Select and apply test procedures and equipment, check the deployability of test equipment, apply test plans and company test regulations, document and evaluate results h) Document order processing, services and consumption i) Handover technical systems or products to customers and explain such systems and products, prepare acceptance protocols j) Evaluate work results and execution of work and contribute to the continuous improvement of work processes k) Arrange for the optimisation of stipulations, particularly of documentation	10 to 12

Anlage 3
(zu §12)

General training plan for vocational education and training in the occupation of industrial mechanic

Part A: Content structure for the occupationally specific specialist skills

Occupational profile position	Part of the training occupation profile	Specialist skills to be imparted, incorporating autonomous planning, execution and checking and integrated with core skills
1	2	3
13	Produce, assemble and dismantle components, sub-assemblies and systems (§ 11 Paragraph 1 No. 13)	a) Analyse technical documents b) Draw up and use assembly and disassembly plans c) Produce and adapt components via a combination of different joining procedures d) Assemble sub-assemblies and components in a manner appropriate to the location and their functionality e) Dismantle and label sub-assemblies, systems or plants f) Clean, manage and store sub-assemblies and components g) Retool machines and production systems
14	Ensure the functionality of technical systems (§ 11 Paragraph 1 No. 14)	a) Take account of interfaces in identifying malfunctions to machines and systems and localise errors b) Identify causes of malfunctions and errors, evaluate the possibility of the rectification of such malfunctions and errors and carry out or arrange for repair c) Inspect plants and systems, ensure operational readiness d) Ensure or improve the functionality of machines and systems by controlling and monitoring work movements and their auxiliary functions e) Use protective and safety equipment and test the function of such equipment
15	Maintain technical systems (§ 11 Paragraph 1 No. 15)	a) Maintain, inspect, repair or improve machines and systems b) Document maintenance measures c) Carry out measures to rectify damage and ensure the effectiveness of such measures d) Draw up maintenance and inspection plans
16	Build, expand and check electrical control engineering components (§ 11 Paragraph 1 No. 16)	a) Apply relevant safety regulations for working on electrical systems b) Use circuit diagrams and functional plans of various systems c) Mechanically construct electrical sub-assemblies or components d) Install and test low-voltage electrical sub-assemblies and components e) Check the proper functional sequence of control systems, execute or initiate measures in the case of malfunctions
17	Business processes and quality management within the area of deployment (§ 11 Paragraph 1 No. 17)	a) Clarify the nature and scope of orders, identify specific services, agree particular characteristics and deadlines with customers b) Procure, evaluate and use information for the processing of the order, take technical developments into account, comply with stipulations relevant to safety c) Accord due consideration to business management and ecological points of view in planning the processing of orders, reach agreement with upstream and downstream divisions, prepare planning documents d) Arrange for partial orders, check results e) Execute orders whilst in particular taking account of health and safety at work, environmental protection and deadlines f) Apply company quality assurance systems in their own work area, systematically seek out, remedy and document the causes of quality defects g) Select and apply test procedures and equipment, check the deployability of test equipment, apply test plans and company test regulations, document and evaluate results h) Document order processing, services and consumption i) Handover technical systems or products to customers and explain such systems and products, prepare acceptance protocols j) Evaluate work results and execution of work and contribute to the continuous improvement of work processes k) Arrange for the optimisation of stipulations, particularly of documentation

Part B: Time structure

Section I:

Occupational profile position	Part of the training occupation profile	Core and specialist skills to be imparted in an integrated manner, incorporating autonomous planning, execution and checking	Time framework in months
1	2	3	4
1	VET, employment and collective wage agreement law (§ 11 Paragraph 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 Paragraph 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 Paragraph 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 Paragraph 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	

Section II

Occupational profile position	Part of the training occupation profile	Core 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 1		1st year of training	
5	Company and technical communication (§ 11 Paragraph 1 No. 5)	a) Select information sources, procure and evaluate information b) Evaluate and use technical drawings and lists of parts, prepare sketches e) Conduct appropriate and target oriented discussions with customers, line managers and within the team, take cultural identities into account h) Organise and chair meetings, document and present results	6 to 8
6	Planning and organisation of work, evaluation of work results (§ 11 Paragraph 1 No. 6)	a) Take company stipulations into account in setting up the workplace b) Select tools and materials, requisition tools and materials in a timely manner, test and transport tools and materials and make such tools and materials available for use c) Plan and execute work processes and subtasks whilst according due consideration to business and scheduling stipulations g) Contribute to continuous improvement of work processes in own work area i) Apply different learning techniques j) Select and use test procedures and test equipment, ascertain the deployability of test equipment k) Monitor, evaluate and document work results l) Plan and execute tasks within the team	
7	Differentiate, allocate and handle materials and auxiliary materials (§ 11 Paragraph 1 No. 7)	a) Evaluate material properties and changes to such properties and select and handle materials in accordance with their use b) Allocate, use and dispose of auxiliary materials in accordance with their use	
8	Produce components and sub-assemblies (§ 11 Paragraph 1 No. 8)	a) Ensure the operational readiness of machine tools including tools b) Select tools and clamping devices, align and clamp workpieces c) Manufacture workpieces using manual and machine production processes d) Produce components by separating and reforming e) Join components, including in different materials, to form sub-assemblies	
11	Fix, secure and transport (§ 11 Paragraph 1 No. 11)	a) Select transport equipment, fittings and lifting equipment, evaluate the operational safety of such fittings and equipment, take the relevant regulations into account in deploying or arranging for the deployment of such fittings and equipment b) Deposit, store and secure transported goods	
13	Produce, assemble and dismantle components, sub-assemblies and systems (§ 11 Paragraph 1 No. 13)	d) Assemble sub-assemblies and components in a manner appropriate to the location and their functionality g) Retool machines and production systems	
Time framework 2			
5	Company and technical communication (§ 11 Paragraph 1 No. 5)	c) Compile, supplement, evaluate and use documents and occupationally related regulations d) Accord due consideration to data protection in managing, securing and archiving data and documents e) Conduct appropriate and target oriented discussions with customers, line managers and within the team, take cultural identities into account f) Present facts and circumstances, prepare protocols; use specialist English language terms in communications	1 to 3

Occupational profile position	Part of the training occupation profile	Core and specialist skills to be imparted in an integrated manner, incorporating autonomous planning, execution and checking	Time framework in months
1	2	3	4
6	Planning and organisation of work, evaluation of work results (§ 11 Paragraph 1 No. 6)	a) Take company stipulations into account in setting up the workplace b) Select tools and materials, requisition tools and materials in a timely manner, test and transport tools and materials and make such tools and materials available for use c) Plan and execute work processes and subtasks whilst according due consideration to business and scheduling stipulations i) Apply different learning techniques j) Select and use test procedures and test equipment, ascertain the deployability of test equipment	
7	Differentiate, allocate and handle materials and auxiliary materials (§ 11 Paragraph 1 No. 7)	b) Allocate, use and dispose of auxiliary materials in accordance with their use	
9	Maintain operating equipment (§ 11 Paragraph 1 No. 9)	a) Inspect, care for and maintain operating equipment, document execution b) Visually inspect mechanical and electrical components and connections for mechanical damage, repair or arrange for repair c) Select, use and dispose of materials	
12	Customer orientation (§ 11 Paragraph 1 No. 12)	a) Procure order-specific requirements and information, test, implement or forward to those involved b) Make customers aware of particular order-specific characteristics and safety regulations	
13	Produce, assemble and dismantle components, sub-assemblies and systems (§ 11 Paragraph 1 No. 13)	f) Clean, manage and store sub-assemblies and components	
14	Ensure the functionality of technical systems (§ 11 Paragraph 1 No. 14)	c) Inspect plants and systems, ensure operational readiness e) Use protective and safety equipment and test the function of such equipment	
	Time framework 3		
5	Company and technical communication (§ 11 Paragraph 1 No. 5)	c) Compile, supplement, evaluate and use documents and occupationally related regulations	2 to 4
6	Planning and organisation of work, evaluation of work results (§ 11 Paragraph 1 No. 6)	a) Take company stipulations into account in setting up the workplace b) Select tools and materials, requisition tools and materials in a timely manner, test and transport tools and materials and make such tools and materials available for use j) Select and use test procedures and test equipment, ascertain the deployability of test equipment	
11	Fix, secure and transport (§ 11 Paragraph 1 No. 11)	a) Select transport equipment, fittings and lifting equipment, evaluate the operational safety of such fittings and equipment, take the relevant regulations into account in deploying or arranging for the deployment of such fittings and equipment b) Deposit, store and secure transported goods	
13	Produce, assemble and dismantle components, sub-assemblies and systems (§ 11 Paragraph 1 No. 13)	a) Analyse technical documents f) Clean, manage and store sub-assemblies and components g) Retool machines and production systems	
14	Ensure the functionality of technical systems (§ 11 Paragraph 1 No. 14)	e) Use protective and safety equipment and test the function of such equipment	

Occupational profile position	Part of the training occupation profile	Core 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 4	2nd year of training, 1st half year	
5	Company and technical communication (§ 11 Paragraph 1 No. 5)	a) Select information sources, procure and evaluate information b) Evaluate and use technical drawings and lists of parts, prepare sketches	3 to 5
6	Planning and organisation of work, evaluation of work results (§ 11 Paragraph 1 No. 6)	d) Use instruments for the processing of orders and tracking of deadlines g) Contribute to continuous improvement of work processes in own work area h) Identify skills deficits, use training opportunities j) Select and use test procedures and test equipment, ascertain the deployability of test equipment k) Monitor, evaluate and document work results	
7	Differentiate, allocate and handle materials and auxiliary materials (§ 11 Paragraph 1 No. 7)	a) Evaluate material properties and changes to such properties and select and handle materials in accordance with their use	
8	Produce components and sub-assemblies (§ 11 Paragraph 1 No. 8)	a) Ensure the operational readiness of machine tools including tools b) Select tools and clamping devices, align and clamp workpieces c) Manufacture workpieces using manual and machine production processes d) Produce components by separating and reforming e) Join components, including in different materials, to form sub-assemblies	
13	Produce, assemble and dismantle components, sub-assemblies and systems (§ 11 Paragraph 1 No. 13)	a) Analyse technical documents b) Draw up and use assembly and disassembly plans c) Produce and adapt components via a combination of different joining procedures d) Assemble sub-assemblies and components in a manner appropriate to the location and their functionality	
	Time framework 5		
5	Company and technical communication (§ 11 Paragraph 1 No. 5)	c) Compile, supplement, evaluate and use documents and occupationally related regulations f) Present facts and circumstances, prepare protocols; use specialist English language terms in communications h) Organise and chair meetings, document and present results	1 to 3
6	Planning and organisation of work, evaluation of work results (§ 11 Paragraph 1 No. 6)	c) Plan and execute work processes and subtasks whilst according due consideration to business and scheduling stipulations f) Check and present possible solutions and compare their cost-effectiveness i) Apply different learning techniques k) Monitor, evaluate and document work results l) Plan and execute tasks within the team	
10	Control systems (§ 11 Paragraph 1 No. 10)	a) Evaluate control systems documents b) Use control technology	
12	Customer orientation (§ 11 Paragraph 1 No. 12)	a) Procure order-specific requirements and information, test, implement or forward to those involved	
13	Produce, assemble and dismantle components, sub-assemblies and systems (§ 11 Paragraph 1 No. 13)	a) Analyse technical documents d) Assemble sub-assemblies and components in a manner appropriate to the location and their functionality	
14	Ensure the functionality of technical systems (§ 11 Paragraph 1 No. 14)	a) Take account of interfaces in identifying malfunctions to machines and systems and localise errors d) Ensure or improve the functionality of machines and systems by controlling and monitoring work movements and their auxiliary functions e) Use protective and safety equipment and test the function of such equipment	

Occupational profile position	Part of the training occupation profile	Core and specialist skills to be imparted in an integrated manner, incorporating autonomous planning, execution and checking	Time framework in months
1	2	3	4
16	Build, expand and check electrical control engineering components (§ 11 Paragraph 1 No. 16)	a) Apply relevant safety regulations for working on electrical systems b) Use circuit diagrams and functional plans of various systems c) Mechanically construct electrical sub-assemblies or components d) Install and test low-voltage electrical sub-assemblies and components e) Check the proper functional sequence of control systems, execute or initiate measures in the case of malfunctions	
Time framework 6 2nd year of training, 2nd half year, 3rd and 4th year of training			
5	Company and technical communication (§ 11 Paragraph 1 No. 5)	b) Evaluate and use technical drawings and lists of parts, prepare sketches c) Compile, supplement, evaluate and use documents and occupationally related regulations d) Accord due consideration to data protection in managing, securing and archiving data and documents e) Conduct appropriate and target oriented discussions with customers, line managers and within the team, take cultural identities into account f) Present facts and circumstances, prepare protocols; use specialist English language terms in communications g) Procure and use information from technical documents or files, including in English i) Resolve disputes within the team	
6	Planning and organisation of work, evaluation of work results (§ 11 Paragraph 1 No. 6)	a) Take company stipulations into account in setting up the workplace b) Select tools and materials, requisition tools and materials in a timely manner, test and transport tools and materials and make such tools and materials available for use c) Plan and execute work processes and subtasks whilst according due consideration to business and scheduling stipulations d) Use instruments for the processing of orders and tracking of deadlines f) Check and present possible solutions and compare their cost-effectiveness g) Contribute to continuous improvement of work processes in own work area h) Identify skills deficits, use training opportunities i) Apply different learning techniques j) Select and use test procedures and test equipment, ascertain the deployability of test equipment k) Monitor, evaluate and document work results l) Plan and execute tasks within the team	
7	Differentiate, allocate and handle materials and auxiliary materials (§ 11 Paragraph 1 No. 7)	a) Evaluate material properties and changes to such properties and select and handle materials in accordance with their use b) Allocate, use and dispose of auxiliary materials in accordance with their use	2 bis 4
9	Maintain operating equipment (§ 11 Paragraph 1 No. 9)	a) Visually inspect mechanical and electrical components and connections for mechanical damage, repair or arrange for repair b) Select, use and dispose of materials	
11	Fix, secure and transport (§ 11 Paragraph 1 No. 11)	a) Select transport equipment, fittings and lifting equipment, evaluate the operational safety of such fittings and equipment, take the relevant regulations into account in deploying or arranging for the deployment of such fittings and equipment b) Deposit, store and secure transported goods	

Occupational profile position	Part of the training occupation profile	Core and specialist skills to be imparted in an integrated manner, incorporating autonomous planning, execution and checking	Time framework in months
1	2	3	4
12	Customer orientation (§ 11 Paragraph 1 No. 12)	a) Procure order-specific requirements and information, test, implement or forward to those involved b) Make customers aware of particular order-specific characteristics and safety regulations	
13	Produce, assemble and dismantle components, sub-assemblies and systems (§ 11 Paragraph 1 No. 13)	b) Draw up and use assembly and disassembly plans d) Assemble sub-assemblies and components in a manner appropriate to the location and their functionality e) Dismantle and label sub-assemblies, systems or plants f) Clean, manage and store sub-assemblies and components	
14	Ensure the functionality of technical systems (§ 11 Paragraph 1 No. 14)	e) Use protective and safety equipment and test the function of such equipment	
15	Maintain technical systems (§ 11 Paragraph 1 No. 15)	a) Maintain, inspect, repair or improve machines and systems b) Document maintenance measures c) Carry out measures to rectify damage and ensure the effectiveness of such measures d) Draw up maintenance and inspection plans	
16	Build, expand and check electrical control engineering components (§ 11 Paragraph 1 No. 16)	a) Apply relevant safety regulations for working on electrical systems b) Use circuit diagrams and functional plans of various systems	
Time framework 7			
5	Company and technical communication (§ 11 Paragraph 1 No. 5)	c) Compile, supplement, evaluate and use documents and occupationally related regulations f) Present facts and circumstances, prepare protocols; use specialist English language terms in communications g) Procure and use information from technical documents or files, including in English	1 to 3
6	Planning and organisation of work, evaluation of work results (§ 11 Paragraph 1 No. 6)	e) Record and evaluate data relevant to business administration l) Plan and execute tasks within the team	
10	Control systems (§ 11 Paragraph 1 No. 10)	b) Use control technology	
14	Ensure the functionality of technical systems (§ 11 Paragraph 1 No. 14)	b) Identify causes of malfunctions and errors, evaluate the possibility of the rectification of such malfunctions and errors and carry out or arrange for repair d) Ensure or improve the functionality of machines and systems by controlling and monitoring work movements and their auxiliary functions e) Use protective and safety equipment and test the function of such equipment	
16	Build, expand and check electrical control engineering components (§ 11 Paragraph 1 No. 16)	a) Apply relevant safety regulations for working on electrical systems b) Use circuit diagrams and functional plans of control engineering	
Time framework 8			
5	Company and technical communication (§ 11 Paragraph 1 No. 5)	a) Select information sources, procure and evaluate information b) Evaluate and use technical drawings and lists of parts, prepare sketches d) Accord due consideration to data protection in managing, securing and archiving data and documents h) Organise and chair meetings, document and present results	

Occupational profile position	Part of the training occupation profile	Core and specialist skills to be imparted in an integrated manner, incorporating autonomous planning, execution and checking	Time framework in months
1	2	3	4
6	Planning and organisation of work, evaluation of work results (§ 11 Paragraph 1 No. 6)	f) Check and present possible solutions and compare their cost-effectiveness g) Contribute to continuous improvement of work processes in own work area h) Identify skills deficits, use training opportunities j) Select and use test procedures and test equipment, ascertain the deployability of test equipment k) Monitor, evaluate and document work results	
8	Produce components and sub-assemblies (§ 11 Paragraph 1 No. 8)	a) Ensure the operational readiness of machine tools including tools b) Select tools and clamping devices, align and clamp workpieces c) Manufacture workpieces using manual and machine production processes d) Produce components by separating and reforming e) Join components, including in different materials, to form sub-assemblies	3 to 5
11	Fix, secure and transport (§ 11 Paragraph 1 No. 11)	a) Select transport equipment, fittings and lifting equipment, evaluate the operational safety of such fittings and equipment, take the relevant regulations into account in deploying or arranging for the deployment of such fittings and equipment b) Deposit, store and secure transported goods	
12	Customer orientation (§ 11 Paragraph 1 No. 12)	a) Procure order-specific requirements and information, test, implement or forward to those involved b) Make customers aware of particular order-specific characteristics and safety regulations	
13	Produce, assemble and dismantle components, sub-assemblies and systems (§ 11 Paragraph 1 No. 13)	a) Analyse technical documents b) Draw up and use assembly and disassembly plans c) Produce and adapt components via a combination of different joining procedures d) Assemble sub-assemblies and components in a manner appropriate to the location and their functionality	
14	Ensure the functionality of technical systems (§ 11 Paragraph 1 No. 14)	e) Use protective and safety equipment and test the function of such equipment	
16	Build, expand and check electrical control engineering components (§ 11 Paragraph 1 No. 16)	a) Apply relevant safety regulations for working on electrical systems b) Use circuit diagrams and functional plans of various systems c) Mechanically construct electrical sub-assemblies or components d) Install and test low-voltage electrical sub-assemblies and components e) Check the proper functional sequence of control systems, execute or initiate measures in the case of malfunctions	
Time framework 9			
5	Company and technical communication (§ 11 Paragraph 1 No. 5)	c) Compile, supplement, evaluate and use documents and occupationally related regulations d) Accord due consideration to data protection in managing, securing and archiving data and documents e) Conduct appropriate and target oriented discussions with customers, line managers and within the team, take cultural identities into account f) Present facts and circumstances, prepare protocols; use specialist English language terms in communications g) Procure and use information from technical documents or files, including in English h) Organise and chair meetings, document and present results	1 to 3
6	Planning and organisation of work, evaluation of work results (§ 11 Paragraph 1 No. 6)	h) Identify skills deficits, use training opportunities	

Occupational profile position	Part of the training occupation profile	Core and specialist skills to be imparted in an integrated manner, incorporating autonomous planning, execution and checking	Time framework in months
1	2	3	4
10	Control systems (§ 11 Paragraph 1 No. 10)	a) Evaluate control systems documents	
14	Ensure the functionality of technical systems (§ 11 Paragraph 1 No. 14)	a) Take account of interfaces in identifying malfunctions to machines and systems and localise errors b) Identify causes of malfunctions and errors, evaluate the possibility of the rectification of such malfunctions and errors and carry out or arrange for repair e) Use protective and safety equipment and test the function of such equipment	
16	Build, expand and check electrical control engineering components (§ 11 Paragraph 1 No. 16)	a) Apply relevant safety regulations for working on electrical systems b) Use circuit diagrams and functional plans of various systems d) Install and test low-voltage electrical sub-assemblies and components e) Check the proper functional sequence of control systems, execute or initiate measures in the case of malfunctions	
Time framework 10			
5	Company and technical communication (§ 11 Paragraph 1 No. 5)	c) Compile, supplement, evaluate and use documents and occupationally related regulations d) Accord due consideration to data protection in managing, securing and archiving data and documents e) Conduct appropriate and target oriented discussions with customers, line managers and within the team, take cultural identities into account h) Organise and chair meetings, document and present results i) Resolve disputes within the team	
6	Planning and organisation of work, evaluation of work results (§ 11 Paragraph 1 No. 6)	e) Record and evaluate data relevant to business administration f) Check and present possible solutions and compare their cost-effectiveness g) Contribute to continuous improvement of work processes in own work area j) Select and use test procedures and test equipment, ascertain the deployability of test equipment k) Monitor, evaluate and document work results l) Plan and execute tasks within the team	1 to 3
7	Differentiate, allocate and handle materials and auxiliary materials (§ 11 Paragraph 1 No. 7)	a) Evaluate material properties and changes to such properties and select and handle materials in accordance with their use	
12	Customer orientation (§ 11 Paragraph 1 No. 12)	b) Make customers aware of particular order-specific characteristics and safety regulations	
13	Produce, assemble and dismantle components, sub-assemblies and systems (§ 11 Paragraph 1 No. 13)	a) Analyse technical documents e) Dismantle and label sub-assemblies, systems or plants	
14	Ensure the functionality of technical systems (§ 11 Paragraph 1 No. 14)	b) Identify causes of malfunctions and errors, evaluate the possibility of the rectification of such malfunctions and errors and carry out or arrange for repair d) Ensure or improve the functionality of machines and systems by controlling and monitoring work movements and their auxiliary functions	
16	Build, expand and check electrical control engineering components (§ 11 Paragraph 1 No. 16)	a) Apply relevant safety regulations for working on electrical systems b) Use circuit diagrams and functional plans of various systems c) Mechanically construct electrical sub-assemblies or components d) Install and test low-voltage electrical sub-assemblies and components e) Check the proper functional sequence of control systems, execute or initiate measures in the case of malfunctions	

Occupational profile position	Part of the training occupation profile	Core 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 11			
17	Business processes and quality management within the area of deployment (§ 11 Paragraph 1 No. 17)	a) Clarify the nature and scope of orders, identify specific services, agree particular characteristics and deadlines with customers b) Procure, evaluate and use information for the processing of the order, take technical developments into account, comply with stipulations relevant to safety	
		c) Accord due consideration to business management and ecological points of view in planning the processing of orders, reach agreement with upstream and downstream divisions, prepare planning documents d) Arrange for partial orders, check results e) Execute orders whilst in particular taking account of health and safety at work, environmental protection and deadlines f) Apply company quality assurance systems in their own work area, systematically seek out, remedy and document the causes of quality defects g) Select and apply test procedures and equipment, check the deployability of test equipment, apply test plans and company test regulations, document and evaluate results h) Document order processing, services and consumption i) Handover technical systems or products to customers and explain such systems and products, prepare acceptance protocols j) Evaluate work results and execution of work and contribute to the continuous improvement of work processes k) Arrange for the optimisation of stipulations, particularly of documentation	10 to 12

Annex 4
(to § 16)

General training plan for vocational education and training in the occupation of construction mechanic
Part A: Content structure for the occupationally specific specialist skills

Occupational profile position	Part of the training occupation profile	Specialist skills to be imparted, incorporating autonomous planning, execution and checking and integrated with core skills
1	2	3
13	Use technical documentation (§ 15 Paragraph 1 No. 13)	a) Obtain and use overall and detail drawings b) Produce developed views in accordance with various procedures c) Read and apply welding instructions and plans
14	Separate and reform (§ 15 Paragraph 1 No. 14)	a) Select tools and machines, in particular according consideration to the material and the production procedure b) Align sheet metals, pipes or profiles in accordance with drawings and templates c) Reform and separate sheet metals, pipelines or profiles by machine, manually and thermally d) Select and use auxiliary tools in accordance with purpose e) Evaluate the quality of cutting areas and surfaces f) Identify and remedy errors and initiate measures for the avoidance of errors
15	Use production machines (§ 15 Paragraph 1 No. 15)	a) Select and set up machines according to production procedures b) Calculate and set machine values c) Prepare equipment for auxiliary materials d) Execute test runs and optimise production processes
16	Join components (§ 15 Paragraph 1 No. 16)	a) Prepare joining components in line with the joining procedure b) Join sheet metals, pipes, profiles or sub-assemblies using force, form and bond processes in accordance with drawings
17	Use mechanisms and auxiliary structures (§ 15 Paragraph 1 No. 17)	a) Plan, construct and dismantle auxiliary structures and mechanisms b) Produce and use templates
18	Assemble and dismantle metal constructions (§ 15 Paragraph 1 No. 18)	a) Identify components and sub-assemblies and test and take function into account in preparing such components and sub-assemblies for assembly and disassembly in accordance with technical documents b) Select and deploy tools and equipment c) Take account of measurement tolerances in fitting components and sub-assemblies, align such components and sub-assemblies in a manner appropriate to functionality via measurement, gauging and visual inspection and secure position d) Assemble components and sub-assemblies in accordance with technical documents e) Disassemble components and sub-assemblies and label in accordance with position and functional alignment f) Secure assembly location and sub-assemblies against accident risks, check safety equipment
19	Test components and sub-assemblies (§ 15 Paragraph 1 No. 19)	a) Select test procedures and test equipment in accordance with intended purpose b) Test components for leaks, tensile strength, compressive strength, deviations in dimensions, form and position and function c) Check prefabricated components and sub-assemblies for further processing by welding d) Apply the usual workshop welding test procedures

Occupational profile position	Part of the training occupation profile	Specialist skills to be imparted, incorporating autonomous planning, execution and checking and integrated with core skills
1	2	3
20	Business processes and quality management within the area of deployment (§ 15 Paragraph 1 No. 20)	a) Clarify the nature and scope of orders, identify specific services, agree particular characteristics and deadlines with customers b) Procure, evaluate and use information for the processing of the order, take technical developments into account, comply with stipulations relevant to safety c) Accord due consideration to business management and ecological points of view in planning the processing of orders, reach agreement with upstream and downstream divisions, prepare planning documents d) Arrange for partial orders, check results e) Execute orders whilst in particular taking account of health and safety at work, environmental protection and deadlines f) Apply company quality assurance systems in their own work area, systematically seek out, remedy and document the causes of quality defects g) Select and apply test procedures and equipment, check the deployability of test equipment, apply test plans and company test regulations, document and evaluate results h) Document order processing, services and consumption i) Handover technical systems or products to customers and explain such systems and products, prepare acceptance protocols j) Evaluate work results and execution of work and contribute to the continuous improvement of work processes k) Arrange for the optimisation of stipulations, particularly of documentation

Part B: Time structure Section I:

Occupational profile position	Part of the training occupation profile	Core and specialist skills to be imparted in an integrated manner, incorporating autonomous planning, execution and checking	Time framework in months
1	2	3	4
1	VET, employment and collective wage agreement law (§ 15 Paragraph 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 (§ 15 Paragraph 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 (§ 15 Paragraph 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 (§ 15 Paragraph 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	

Section II

Occupational profile position	Part of the training occupation profile	Core 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 1	1st year of training	
	Company and technical communication (§ 15 Paragraph 1 No. 5)	a) Select information sources, procure and evaluate information b) Evaluate and use technical drawings and lists of parts, prepare sketches	6 to 8
6	Planning and organisation of work, evaluation of work results (§ 15 Paragraph 1 No. 6)	a) Take company stipulations into account in setting up the workplace b) Select tools and materials, requisition tools and materials in a timely manner, test and transport tools and materials and make such tools and materials available for use j) Select and use test procedures and test equipment, ascertain the deployability of test equipment k) Monitor, evaluate and document work results	
7	Differentiate, allocate and handle materials and auxiliary materials (§ 15 Paragraph 1 No. 7)	a) Evaluate material properties and changes to such properties and select and handle materials in accordance with their use b) Allocate, use and dispose of auxiliary materials in accordance with their use	
8	Produce components and sub-assemblies (§ 15 Paragraph 1 No. 8)	a) Ensure the operational readiness of machine tools including tools b) Select tools and clamping devices, align and clamp workpieces c) Manufacture workpieces using manual and machine production processes d) Produce components by separating and reforming	
16	Join components (§ 15 Paragraph 1 No. 16)	a) Prepare joining components in line with the joining procedure b) Join sheet metals, pipes, profiles or sub-assemblies using force, form and bond processes in accordance with drawings	
	Time framework 2		
5	Company and technical communication (§ 15 Paragraph 1 No. 5)	a) Select information sources, procure and evaluate information c) Compile, supplement, evaluate and use documents and occupationally related regulations d) Accord due consideration to data protection in managing, securing and archiving data and documents e) Conduct appropriate and target oriented discussions with customers, line managers and within the team, take cultural identities into account f) Present facts and circumstances, prepare protocols; use specialist English language terms in communications g) Procure and use information from technical documents or files, including in English h) Organise and chair meetings, document and present results i) Resolve disputes within the team	2 to 4
6	Planning and organisation of work, evaluation of work results (§ 15 Paragraph 1 No. 6)	a) Take company stipulations into account in setting up the workplace b) Select tools and materials, requisition tools and materials in a timely manner, test and transport tools and materials and make such tools and materials available for use f) Check and present possible solutions and compare their cost-effectiveness h) Identify skills deficits, use training opportunities i) Apply different learning techniques j) Select and use test procedures and test equipment, ascertain the deployability of test equipment k) Monitor, evaluate and document work results	
8	Produce components and sub-assemblies (§ 15 Paragraph 1 No. 8)	e) Join components, including in different materials, to form sub-assemblies	

Occupational profile position	Part of the training occupation profile	Core and specialist skills to be imparted in an integrated manner, incorporating autonomous planning, execution and checking	Time framework in months
1	2	3	4
11	Fix, secure and transport (§ 15 Paragraph 1 No. 11)	a) Select transport equipment, fittings and lifting equipment, evaluate the operational safety of such fittings and equipment, take the relevant regulations into account in deploying or arranging for the deployment of such fittings and equipment b) Deposit, store and secure transported goods	
13	Use technical documentation (§ 15 Paragraph 1 No. 13)	a) Obtain and use overall and detail drawings b) Produce developed views in accordance with various procedures c) Read and apply welding instructions and plans	
	Time framework 3		
5	Company and technical communication (§ 15 Paragraph 1 No. 5)	a) Select information sources, procure and evaluate information c) Compile, supplement, evaluate and use documents and occupationally related regulations f) Present facts and circumstances, prepare protocols; use specialist English language terms in communications	1 to 3
7	Differentiate, allocate and handle materials and auxiliary materials (§ 15 Paragraph 1 No. 7)	a) Evaluate material properties and changes to such properties and select and handle materials in accordance with their use b) Allocate, use and dispose of auxiliary materials in accordance with their use	
9	Maintain operating equipment (§ 15 Paragraph 1 No. 9)	a) Inspect, care for and maintain operating equipment, document execution	
		b) Visually inspect mechanical and electrical components and connections for mechanical damage, repair or arrange for repair c) Select, use and dispose of materials	
15	Use production machines (§ 15 Paragraph 1 No. 15)	c) Prepare equipment for auxiliary materials	
	Time framework 4	2nd year of training, 1st half year	
6	Planning and organisation of work, evaluation of work results (§ 15 Paragraph 1 No. 6)	b) Select tools and materials, requisition tools and materials in a timely manner, test and transport tools and materials and make such tools and materials available for use g) Contribute to continuous improvement of work processes in own work area j) Select and use test procedures and test equipment, ascertain the deployability of test equipment k) Monitor, evaluate and document work results	2 to 4
7	Differentiate, allocate and handle materials and auxiliary materials (§ 15 Paragraph 1 No. 7)	a) Evaluate material properties and changes to such properties and select and handle materials in accordance with their use b) Allocate, use and dispose of auxiliary materials in accordance with their use	
8	Produce components and sub-assemblies (§ 15 Paragraph 1 No. 8)	a) Ensure the operational readiness of machine tools including tools b) Select tools and clamping devices, align and clamp workpieces c) Manufacture workpieces using manual and machine production processes d) Produce components by separating and reforming	
11	Fix, secure and transport (§ 15 Paragraph 1 No. 11)	a) Select transport equipment, fittings and lifting equipment, evaluate the operational safety of such fittings and equipment, take the relevant regulations into account in deploying or arranging for the deployment of such fittings and equipment b) Deposit, store and secure transported goods	
12	Customer orientation (§ 15 Paragraph 1 No. 12)	a) Procure order-specific requirements and information, test, implement or forward to those involved b) Make customers aware of particular order-specific characteristics and safety regulations	

Occupational profile position	Part of the training occupation profile	Core and specialist skills to be imparted in an integrated manner, incorporating autonomous planning, execution and checking	Time framework in months
1	2	3	4
14	Separate and reform (§ 15 Paragraph 1 No. 14)	a) Select tools and machines, in particular according consideration to the material and the production procedure b) Align sheet metals, pipes or profiles in accordance with drawings and templates c) Reform and separate sheet metals, pipelines or profiles by machine, manually and thermally d) Select and use auxiliary tools in accordance with purpose	
		e) Evaluate the quality of cutting areas and surfaces f) Identify and remedy errors and initiate measures for the avoidance of errors	
16	Join components (§ 15 Paragraph 1 No. 16)	a) Prepare joining components in line with the joining procedure b) Join sheet metals, pipes, profiles or sub-assemblies using force, form and bond processes in accordance with drawings	
	Time framework 5		
5	Company and technical communication (§ 15 Paragraph 1 No. 5)	e) Conduct appropriate and target oriented discussions with customers, line managers and within the team, take cultural identities into account f) Present facts and circumstances, prepare protocols; use specialist English language terms in communications g) Procure and use information from technical documents or files, including in English h) Organise and chair meetings, document and present results i) Resolve disputes within the team	2 to 4
6	Planning and organisation of work, evaluation of work results (§ 15 Paragraph 1 No. 6)	a) Take company stipulations into account in setting up the workplace c) Plan and execute work processes and subtasks whilst according due consideration to business and scheduling stipulations d) Use instruments for the processing of orders and tracking of deadlines e) Record and evaluate data relevant to business administration f) Check and present possible solutions and compare their cost-effectiveness g) Contribute to continuous improvement of work processes in own work area h) Identify skills deficits, use training opportunities i) Apply different learning techniques j) Select and use test procedures and test equipment, ascertain the deployability of test equipment l) Plan and execute tasks within the team	
7	Differentiate, allocate and handle materials and auxiliary materials (§ 15 Paragraph 1 No. 7)	b) Allocate, use and dispose of auxiliary materials in accordance with their use	
8	Produce components and sub-assemblies (§ 15 Paragraph 1 No. 8)	e) Join components, including in different materials, to form sub-assemblies	
11	Fix, secure and transport (§ 15 Paragraph 1 No. 11)	a) Select transport equipment, fittings and lifting equipment, evaluate the operational safety of such fittings and equipment, take the relevant regulations into account in deploying or arranging for the deployment of such fittings and equipment b) Deposit, store and secure transported goods	
13	Anwenden von technischen Unterlagen (§ 15 Paragraph 1 No. 13)	c) Read and apply welding instructions and plans	
17	Use mechanisms and auxiliary structures (§ 15 Paragraph 1 No. 17)	a) Plan, construct and dismantle auxiliary structures and mechanisms	

Occupational profile position	Part of the training occupation profile	Core 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 6	2nd year of training, 2nd half year, 3rd and 4th year of training	
5	Company and technical communication (§ 15 Paragraph 1 No. 5)	a) Select information sources, procure and evaluate information b) Evaluate and use technical drawings and lists of parts, prepare sketches c) Compile, supplement, evaluate and use documents and occupationally related regulations g) Procure and use information from technical documents or files, including in English	3 to 5
6	Planning and organisation of work, evaluation of work results (§ 15 Paragraph 1 No. 6)	c) Plan and execute work processes and subtasks whilst according due consideration to business and scheduling stipulations d) Use instruments for the processing of orders and tracking of deadlines e) Record and evaluate data relevant to business administration f) Check and present possible solutions and compare their cost-effectiveness k) Monitor, evaluate and document work results l) Plan and execute tasks within the team	
7	Differentiate, allocate and handle materials and auxiliary materials (§ 15 Paragraph 1 No. 7)	a) Evaluate material properties and changes to such properties and select and handle materials in accordance with their use	
10	Control systems (§ 15 Paragraph 1 No. 10)	a) Evaluate control systems documents b) Use control technology	
13	Use technical documentation (§ 15 Paragraph 1 No. 13)	a) Obtain and use overall and detail drawings b) Produce developed views in accordance with various procedures	
14	Separate and reform (§ 15 Paragraph 1 No. 14)	a) Select tools and machines, in particular according consideration to the material and the production procedure b) Align sheet metals, pipes or profiles in accordance with drawings and templates	
		c) Reform and separate sheet metals, pipelines or profiles by machine, manually and thermally d) Select and use auxiliary tools in accordance with purpose e) Evaluate the quality of cutting areas and surfaces f) Identify and remedy errors and initiate measures for the avoidance of errors	
15	Use production machines (§ 15 Paragraph 1 No. 15)	a) Select and set up machines according to production procedures b) Calculate and set machine values c) Prepare equipment for auxiliary materials d) Execute test runs and optimise production processes	
17	Use mechanisms and auxiliary structures (§ 15 Paragraph 1 No. 17)	a) Plan, construct and dismantle auxiliary structures and mechanisms b) Produce and use templates	
19	Test components and sub-assemblies (§ 15 Paragraph 1 No. 19)	a) Select test procedures and test equipment in accordance with intended purpose b) Test components for leaks, tensile strength, compressive strength, deviations in dimensions, form and position and function c) Check prefabricated components and sub-assemblies for further processing by welding d) Apply the usual workshop welding test procedures	
	Time framework 7		
6	Planning and organisation of work, evaluation of work results (§ 15 Paragraph 1 No. 6)	g) Contribute to continuous improvement of work processes in own work area) Select and use test procedures and test equipment, ascertain the deployability of test equipment	1 to 3
8	Produce components and sub-assemblies (§ 15 Paragraph 1 No. 8)	c) Manufacture workpieces using manual and machine production processes d) Produce components by separating and reforming	
16	Join components (§ 15 Paragraph 1 No. 16)	a) Prepare joining components in line with the joining procedure b) Join sheet metals, pipes, profiles or sub-assemblies using force, form and bond processes in accordance with drawings	

Occupational profile position	Part of the training occupation profile	Core 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 8		
6	Planen und Organisieren der Arbeit, Bewerten der Arbeitsergebnisse (§ 15 Paragraph 1 No. 6)	c) Plan and execute work processes and subtasks whilst according due consideration to business and scheduling stipulations d) Use instruments for the processing of orders and tracking of deadlines e) Record and evaluate data relevant to business administration	
		f) Check and present possible solutions and compare their cost-effectiveness) Select and use test procedures and test equipment, ascertain the deployability of test equipment k) Monitor, evaluate and document work results) Plan and execute tasks within the team	1 to 3
11	Fix, secure and transport (§ 15 Paragraph 1 No. 11)	a) Select transport equipment, fittings and lifting equipment, evaluate the operational safety of such fittings and equipment, take the relevant regulations into account in deploying or arranging for the deployment of such fittings and equipment	
12	Customer orientation (§ 15 Paragraph 1 No. 12)	a) Procure order-specific requirements and information, test, implement or forward to those involved b) Make customers aware of particular order-specific characteristics and safety regulations	
17	Use mechanisms and auxiliary structures (§ 15 Paragraph 1 No. 17)	a) Plan, construct and dismantle auxiliary structures and mechanisms	
	Time framework 9		
6	Planning and organisation of work, evaluation of work results (§ 15 Paragraph 1 No. 6)	c) Plan and execute work processes and subtasks whilst according due consideration to business and scheduling stipulations d) Use instruments for the processing of orders and tracking of deadlines e) Record and evaluate data relevant to business administration f) Check and present possible solutions and compare their cost-effectiveness) Select and use test procedures and test equipment, ascertain the deployability of test equipment	1 to 3
8	Produce components and sub-assemblies (§ 15 Paragraph 1 No. 8)	c) Manufacture workpieces using manual and machine production processes d) Produce components by separating and reforming	
10	Control systems (§ 15 Paragraph 1 No. 10)	a) Evaluate control systems documents b) Use control technology	
14	Separate and reform (§ 15 Paragraph 1 No. 14)	a) Select tools and machines, in particular according consideration to the material and the production procedure b) Align sheet metals, pipes or profiles in accordance with drawings and templates c) Reform and separate sheet metals, pipelines or profiles by machine, manually and thermally	
15	Use production machines (§ 15 Paragraph 1 No. 15)	a) Select and set up machines according to production procedures b) Calculate and set machine values	
		c) Prepare equipment for auxiliary materials d) Execute test runs and optimise production processes	
16	Join components (§ 15 Paragraph 1 No. 16)	a) Prepare joining components in line with the joining procedure b) Join sheet metals, pipes, profiles or sub-assemblies using force, form and bond processes in accordance with drawings	
17	Use mechanisms and auxiliary structures (§ 15 Paragraph 1 No. 17)	a) Plan, construct and dismantle auxiliary structures and mechanisms b) Produce and use templates	
19	Test components and sub-assemblies (§ 15 Paragraph 1 No. 19)	a) Select test procedures and test equipment in accordance with intended purpose b) Test components for leaks, tensile strength, compressive strength, deviations in dimensions, form and position and function c) Check prefabricated components and sub-assemblies for further processing by welding d) Apply the usual workshop welding test procedures	

Occupational profile position	Part of the training occupation profile	Core 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			
12	Customer orientation (§ 15 Paragraph 1 No. 12)	a) Procure order-specific requirements and information, test, implement or forward to those involved b) Make customers aware of particular order-specific characteristics and safety regulations	2 to 4
16	Join components (§ 15 Paragraph 1 No. 16)	a) Prepare joining components in line with the joining procedure b) Join sheet metals, pipes, profiles or sub-assemblies using force, form and bond processes in accordance with drawings	
17	Use mechanisms and auxiliary structures (§ 15 Paragraph 1 No. 17)	a) Plan, construct and dismantle auxiliary structures and mechanisms b) Produce and use templates	
18	Assemble and dismantle metal constructions (§ 15 Paragraph 1 No. 18)	a) Identify components and sub-assemblies and test and take function into account in preparing such components and sub-assemblies for assembly and disassembly in accordance with technical documents b) Select and deploy tools and equipment c) Take account of measurement tolerances in fitting components and sub-assemblies, align such components and sub-assemblies in a manner appropriate to functionality via measurement, gauging and visual inspection and secure position d) Assemble components and sub-assemblies in accordance with technical documents	
		e) Disassemble components and sub-assemblies and label in accordance with position and functional alignment f) Secure assembly location and sub-assemblies against accident risks, check safety equipment	
19	Test components and sub-assemblies (§ 15 Paragraph 1 No. 19)	c) Check prefabricated components and sub-assemblies for further processing by welding d) Apply the usual workshop welding test procedures	
Time framework 11			
20	Business processes and quality management within the area of deployment (§ 15 Paragraph 1 No. 20)	a) Clarify the nature and scope of orders, identify specific services, agree particular characteristics and deadlines with customers b) Procure, evaluate and use information for the processing of the order, take technical developments into account, comply with stipulations relevant to safety c) Accord due consideration to business management and ecological points of view in planning the processing of orders, reach agreement with upstream and downstream divisions, prepare planning documents d) Arrange for partial orders, check results e) Execute orders whilst in particular taking account of health and safety at work, environmental protection and deadlines f) Apply company quality assurance systems in their own work area, systematically seek out, remedy and document the causes of quality defects g) Select and apply test procedures and equipment, check the deployability of test equipment, apply test plans and company test regulations, document and evaluate results h) Document order processing, services and consumption) Handover technical systems or products to customers and explain such systems and products, prepare acceptance protocols) Evaluate work results and execution of work and contribute to the continuous improvement of work processes k) Arrange for the optimisation of stipulations, particularly of documentation	10 to 12

Annex 5
(to § 20)

General training plan for vocational education and training in the occupation of tools mechanic

Part A: Content structure for the occupationally specific specialist skills

Occupational profile position	Part of the training occupation profile	Specialist skills to be imparted, incorporating autonomous planning, execution and checking and integrated with core skills
1	2	3
13	Use different manufacturing procedures to produce components (§ 19 Paragraph 1 No. 13)	a) Obtain and use production documents or samples b) Calculate and set machine values, select tools, make tools available and use tools c) Accord due consideration to the production procedure and to material properties in aligning and clamping semi-finished parts and workpieces d) Measure production tools and take correction values into account e) Produce components from various materials and in accordance with company production documents via manual and machine grinding or abrasion procedures f) Execute alterations on the basis of constructive and technical requirements g) Alter material properties h) Select production procedures
14	Assembly and dismantling (§ 19 Paragraph 1 No. 14)	a) Check components and sub-assemblies for correct functional assembly b) Assemble components and sub-assemblies in the correct functional manner in accordance with assembly plans, in particular to form tools, gauges, mechanisms, moulds or instruments, secure position and label c) Dismantle and label sub-assemblies, check and document the condition of components d) Provide for operational readiness, in particular of tools, gauges, mechanisms, moulds and instruments e) Secure assembly location and sub-assemblies against accident risks, check safety equipment f) Use various joining techniques, in particular screwing, press-in fitting, bonding or welding g) Select standard parts
15	Trialling and handover (§ 19 Paragraph 1 No. 15)	a) Test individual and overall function, carry out an error analysis b) Establish and document functionality c) Test mechanical or pneumatic components, establish operational safety d) Carry out or arrange for testing and optimise the process according due consideration to qualitative and business points of view e) Test samples or test pieces, particularly with regard to stability of dimensions and form and function f) Document the sampling process g) Take account of the relevant safety regulations when operating machines, use means of transport h) Check safety equipment, ensure safety in the work area
16	Maintenance of components and sub-assemblies (§ 19 Paragraph 1 No. 16)	a) Inspect components and sub-assemblies, particularly visually and by using optical and mechanical test devices b) Document actual status c) Localise malfunctions and errors, identify the causes of such malfunctions and errors, illustrate possibilities for rectification, remedy and document and match against company regulations d) Identify and rectify wear and tear, exchange parts subject to wear and tear e) Test and document function f) Carry out and document maintenance measures in line with company regulations
17	Programme machines and plants (§ 19 Paragraph 1 No. 17)	a) Handle data entry and data output devices and storage media b) Use computer-aided techniques for programming c) Produce, enter, test, alter, optimise and secure programmes d) Check functional processes and take account of production technology in adapting programme sequences

Occupational profile position	Part of the training occupation profile	Specialist skills to be imparted, incorporating autonomous planning, execution and checking and integrated with core skills
1	2	3
18	Testing (§ 19 Paragraph 1 No. 18)	a) Select test procedures and test equipment in accordance with intended purpose b) Use mechanical, optical, electrical or pneumatic measuring devices to test components for form tolerances c) Use mechanical, optical, electrical or pneumatic measuring devices to test sub-assemblies for deviations in position d) Use various procedures to test surface characteristics
19	Business processes and quality management within the area of deployment (§ 19 Paragraph 1 No. 19)	a) Clarify the nature and scope of orders, identify specific services, agree particular characteristics and deadlines with customers b) Procure, evaluate and use information for the processing of the order, take technical developments into account, comply with stipulations relevant to safety c) Accord due consideration to business management and ecological points of view in planning the processing of orders, reach agreement with upstream and downstream divisions, prepare planning documents d) Arrange for partial orders, check results e) Execute orders whilst in particular taking account of health and safety at work, environmental protection and deadlines f) Apply company quality assurance systems in their own work area, systematically seek out, remedy and document the causes of quality defects g) Select and apply test procedures and equipment, check the deployability of test equipment, apply test plans and company test regulations, document and evaluate results h) Document order processing, services and consumption i) Handover technical systems or products to customers and explain such systems and products, prepare acceptance protocols j) Evaluate work results and execution of work and contribute to the continuous improvement of work processes k) Arrange for the optimisation of stipulations, particularly of documentation

Part B: Time structure Section I:

Occupational profile position	Part of the training occupation profile	Core and specialist skills to be imparted in an integrated manner, incorporating autonomous planning, execution and checking	Time framework in months
1	2	3	4
1	VET, employment and collective wage agreement law (§ 19 Paragraph 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 (§ 19 Paragraph 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 (§ 19 Paragraph 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 (§ 19 Paragraph 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	

Section II

Occupational profile position	Part of the training occupation profile	Core 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 1		1st year of training	
5	Company and technical communication (§ 19 Paragraph 1 No. 5)	b) Evaluate and use technical drawings and lists of parts, prepare sketches	
6	Planning and organisation of work, evaluation of work results (§ 19 Paragraph 1 No. 6)	a) Take company stipulations into account in setting up the workplace b) Select tools and materials, requisition tools and materials in a timely manner, test and transport tools and materials and make such tools and materials available for use c) Plan and execute work processes and subtasks whilst according due consideration to business and scheduling stipulations j) Select and use test procedures and test equipment, ascertain the deployability of test equipment k) Monitor, evaluate and document work results	
7	Differentiate, allocate and handle materials and auxiliary materials (§ 19 Paragraph 1 No. 7)	a) Evaluate material properties and changes to such properties and select and handle materials in accordance with their use b) Allocate, use and dispose of auxiliary materials in accordance with their use	
8	Produce components and sub-assemblies (§ 19 Paragraph 1 No. 8)	a) Ensure the operational readiness of machine tools including tools b) Select tools and clamping devices, align and clamp workpieces c) Manufacture workpieces using manual and machine production processes d) Produce components by separating and reforming	
18	Testing (§ 19 Paragraph 1 No. 18)	a) Select test procedures and test equipment in accordance with intended purpose	
Time framework 2			
5	Company and technical communication (§ 19 Paragraph 1 No. 5)	a) Select information sources, procure and evaluate information b) Evaluate and use technical drawings and lists of parts, prepare sketches c) Compile, supplement, evaluate and use documents and occupationally related regulations	
6	Planning and organisation of work, evaluation of work results (§ 19 Paragraph 1 No. 6)	b) Select tools and materials, requisition tools and materials in a timely manner, test and transport tools and materials and make such tools and materials available for use c) Plan and execute work processes and subtasks whilst according due consideration to business and scheduling stipulations j) Select and use test procedures and test equipment, ascertain the deployability of test equipment	
7	Differentiate, allocate and handle materials and auxiliary materials (§ 19 Paragraph 1 No. 7)	b) Allocate, use and dispose of auxiliary materials in accordance with their use	5 to 7
8	Produce components and sub-assemblies (§ 19 Paragraph 1 No. 8)	a) Ensure the operational readiness of machine tools including tools b) Select tools and clamping devices, align and clamp workpieces c) Manufacture workpieces using manual and machine production processes d) Produce components by separating and reforming	
13	Use different manufacturing procedures to produce components (§ 19 Paragraph 1 No. 13)	b) Calculate and set machine values, select tools, make tools available and use tools c) Accord due consideration to the production procedure and to material properties in aligning and clamping semi-finished parts and workpieces	

Occupational profile position	Part of the training occupation profile	Core and specialist skills to be imparted in an integrated manner, incorporating autonomous planning, execution and checking	Time framework in months
1	2	3	4
18	Testing (§ 19 Paragraph 1 No. 18)	a) Select test procedures and test equipment in accordance with intended purpose b) Use mechanical, optical, electrical or pneumatic measuring devices to test components for form tolerances	
	Time framework 3		
5	Company and technical communication (§ 19 Paragraph 1 No. 5)	a) Select information sources, procure and evaluate information b) Evaluate and use technical drawings and lists of parts, prepare sketches c) Compile, supplement, evaluate and use documents and occupationally related regulations	2 to 3
6	Planning and organisation of work, evaluation of work results (§ 19 Paragraph 1 No. 6)	a) Take company stipulations into account in setting up the workplace b) Select tools and materials, requisition tools and materials in a timely manner, test and transport tools and materials and make such tools and materials available for use c) Plan and execute work processes and subtasks whilst according due consideration to business and scheduling stipulations j) Select and use test procedures and test equipment, ascertain the deployability of test equipment k) Monitor, evaluate and document work results	
7	Differentiate, allocate and handle materials and auxiliary materials (§ 19 Paragraph 1 No. 7)	b) Allocate, use and dispose of auxiliary materials in accordance with their use	
8	Produce components and sub-assemblies (§ 19 Paragraph 1 No. 8)	e) Join components, including in different materials, to form sub-assemblies	
13	Use different manufacturing procedures to produce components (§ 19 Paragraph 1 No. 13)	a) Obtain and use production documents or samples	
14	Assembly and dismantling (§ 19 Paragraph 1 No. 14)	a) Check components and sub-assemblies for correct functional assembly e) Secure assembly location and sub-assemblies against accident risks, check safety equipment	
18	Testing (§ 19 Paragraph 1 No. 18)	a) Select test procedures and test equipment in accordance with intended purpose b) Use mechanical, optical, electrical or pneumatic measuring devices to test components for form tolerances	
	Time framework 4		
5	Company and technical communication (§ 19 Paragraph 1 No. 5)	a) Select information sources, procure and evaluate information c) Compile, supplement, evaluate and use documents and occupationally related regulations d) Accord due consideration to data protection in managing, securing and archiving data and documents f) Present facts and circumstances, prepare protocols; use specialist English language terms in communications	1 to 2
6	Planning and organisation of work, evaluation of work results (§ 19 Paragraph 1 No. 6)	e) Record and evaluate data relevant to business administration k) Monitor, evaluate and document work results	
9	Maintain operating equipment (§ 19 Paragraph 1 No. 9)	a) Inspect, care for and maintain operating equipment, document execution c) Select, use and dispose of materials	
16	Maintenance of components and sub-assemblies (§ 19 Paragraph 1 No. 16)	a) Inspect components and sub-assemblies, particularly visually and by using optical and mechanical test devices c) Localise malfunctions and errors, identify the causes of such malfunctions and errors, illustrate possibilities for rectification, remedy and document and match against company regulations	

Occupational profile position	Part of the training occupation profile	Core 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 5	2nd year of training, 1st half year	
5	Company and technical communication (§ 19 Paragraph 1 No. 5)	b) Evaluate and use technical drawings and lists of parts, prepare sketches c) Compile, supplement, evaluate and use documents and occupationally related regulations g) Procure and use information from technical documents or files, including in English	
6	Planning and organisation of work, evaluation of work results (§ 19 Paragraph 1 No. 6)	a) Take company stipulations into account in setting up the workplace g) Contribute to continuous improvement of work processes in own work area h) Identify skills deficits, use training opportunities i) Apply different learning techniques j) Select and use test procedures and test equipment, ascertain the deployability of test equipment k) Monitor, evaluate and document work results	1 to 2
13	Use different manufacturing procedures to produce components (§ 19 Paragraph 1 No. 13)	a) Obtain and use production documents or samples c) Accord due consideration to the production procedure and to material properties in aligning and clamping semi-finished parts and workpieces	
14	Assembly and dismantling (§ 19 Paragraph 1 No. 14)	a) Check components and sub-assemblies for correct functional assembly c) Dismantle and label sub-assemblies, check and document the condition of components	
15	Trialling and handover (§ 19 Paragraph 1 No. 15)	a) Test individual and overall function, carry out an error analysis	
18	Testing (§ 19 Paragraph 1 No. 18)	a) Select test procedures and test equipment in accordance with intended purpose b) Use mechanical, optical, electrical or pneumatic measuring devices to test components for form tolerances	
	Time framework 6		
5	Company and technical communication (§ 19 Paragraph 1 No. 5)	c) Compile, supplement, evaluate and use documents and occupationally related regulations	1 to 3
6	Planning and organisation of work, evaluation of work results (§ 19 Paragraph 1 No. 6)	b) Select tools and materials, requisition tools and materials in a timely manner, test and transport tools and materials and make such tools and materials available for use c) Plan and execute work processes and subtasks whilst according due consideration to business and scheduling stipulations j) Select and use test procedures and test equipment, ascertain the deployability of test equipment k) Monitor, evaluate and document work results	
7	Differentiate, allocate and handle materials and auxiliary materials (§ 19 Paragraph 1 No. 7)	b) Allocate, use and dispose of auxiliary materials in accordance with their use	
8	Produce components and sub-assemblies (§ 19 Paragraph 1 No. 8)	a) Ensure the operational readiness of machine tools including tools	
11	Fix, secure and transport (§ 19 Paragraph 1 No. 11)	b) Select tools and clamping devices, align and clamp workpieces a) Select transport equipment, fittings and lifting equipment, evaluate the operational safety of such fittings and equipment, take the relevant regulations into account in deploying or arranging for the deployment of such fittings and equipment	
13	Use different manufacturing procedures to produce components (§ 19 Paragraph 1 No. 13)	a) Obtain and use production documents or samples b) Calculate and set machine values, select tools, make tools available and use tools c) Accord due consideration to the production procedure and to material properties in aligning and clamping semi-finished parts and workpieces	

Occupational profile position	Part of the training occupation profile	Core and specialist skills to be imparted in an integrated manner, incorporating autonomous planning, execution and checking	Time framework in months
1	2	3	4
18	Testing (§ 19 Paragraph 1 No. 18)	a) Select test procedures and test equipment in accordance with intended purpose b) Use mechanical, optical, electrical or pneumatic measuring devices to test components for form tolerances c) Use mechanical, optical, electrical or pneumatic measuring devices to test sub-assemblies for deviations in position	
	Time framework 7		
8	Produce components and sub-assemblies (§ 19 Paragraph 1 No. 8)	a) Ensure the operational readiness of machine tools including tools b) Select tools and clamping devices, align and clamp workpieces c) Manufacture workpieces using manual and machine production processes d) Produce components by separating and reforming e) Join components, including in different materials, to form sub-assemblies	2 to 3
10	Control systems (§ 19 Paragraph 1 No. 10)	a) Evaluate control systems documents b) Use control technology	
12	Customer orientation (§ 19 Paragraph 1 No. 12)	a) Procure order-specific requirements and information, test, implement or forward to those involved	
13	Use different manufacturing procedures to produce components (§ 19 Paragraph 1 No. 13)	a) Obtain and use production documents or samples b) Calculate and set machine values, select tools, make tools available and use tools c) Accord due consideration to the production procedure and to material properties in aligning and clamping semi-finished parts and workpieces	
14	Assembly and dismantling (§ 19 Paragraph 1 No. 14)	a) Check components and sub-assemblies for correct functional assembly b) Assemble components and sub-assemblies in the correct functional manner in accordance with assembly plans, in particular to form tools, gauges, mechanisms, moulds or instruments, secure position and label d) Provide for operational readiness, in particular of tools, gauges, mechanisms, moulds and instruments e) Secure assembly location and sub-assemblies against accident risks, check safety equipment	
	Time framework 8	2nd year of training, 2nd half year, 3rd and 4th year of training	
8	Produce components and sub-assemblies (§ 19 Paragraph 1 No. 8)	a) Ensure the operational readiness of machine tools including tools b) Select tools and clamping devices, align and clamp workpieces	S to S
13	Use different manufacturing procedures to produce components (§ 19 Paragraph 1 No. 13)	c) Accord due consideration to the production procedure and to material properties in aligning and clamping semi-finished parts and workpieces d) Measure production tools and take correction values into account	
17	Programme machines and plants (§ 19 Paragraph 1 No. 17)	a) Handle data entry and data output devices and storage media c) Produce, enter, test, alter, optimise and secure programmes	
	Time framework 9		
5	Company and technical communication (§ 19 Paragraph 1 No. 5)	e) Conduct appropriate and target oriented discussions with customers, line managers and within the team, take cultural identities into account h) Organise and chair meetings, document and present results i) Resolve disputes within the team	
6	Planning and organisation of work, evaluation of work results (§ 19 Paragraph 1 No. 6)	e) Record and evaluate data relevant to business administration f) Check and present possible solutions and compare their cost-effectiveness g) Contribute to continuous improvement of work processes in own work area k) Monitor, evaluate and document work results l) Plan and execute tasks within the team	

Occupational profile position	Part of the training occupation profile	Core and specialist skills to be imparted in an integrated manner, incorporating autonomous planning, execution and checking	Time framework in months
1	2	3	4
7	Differentiate, allocate and handle materials and auxiliary materials (§ 19 Paragraph 1 No. 7)	a) Evaluate material properties and changes to such properties and select and handle materials in accordance with their use	
g	Maintain operating equipment (§ 19 Paragraph 1 No. 9)	b) Visually inspect mechanical and electrical components and connections for mechanical damage, repair or arrange for repair	
10	Control systems (§ 19 Paragraph 1 No. 10)	a) Evaluate control systems documents b) Use control technology	
11	Fix, secure and transport (§ 19 Paragraph 1 No. 11)	a) Select transport equipment, fittings and lifting equipment, evaluate the operational safety of such fittings and equipment, take the relevant regulations into account in deploying or arranging for the deployment of such fittings and equipment b) Deposit, store and secure transported goods	3 to 5
12	Customer orientation (§ 19 Paragraph 1 No. 12)	b) Make customers aware of particular order-specific characteristics and safety regulations	
13	Use different manufacturing procedures to produce components (§ 19 Paragraph 1 No. 13)	g) Alter material properties	
14	Assembly and dismantling (§ 19 Paragraph 1 No. 14)	f) Use various joining techniques, in particular screwing, press-in fitting, bonding or welding	
16	Maintenance of components and sub-assemblies (§ 19 Paragraph 1 No. 16)	a) Inspect components and sub-assemblies, particularly visually and by using optical and mechanical test devices b) Document actual status c) Localise malfunctions and errors, identify the causes of such malfunctions and errors, illustrate possibilities for rectification, remedy and document and match against company regulations d) Identify and rectify wear and tear, exchange parts subject to wear and tear e) Test and document function	
	Time framework 10		
8	Produce components and sub-assemblies (§ 19 Paragraph 1 No. 8)	c) Manufacture workpieces using manual and machine production processes d) Produce components by separating and reforming	1 to 3
13	Use different manufacturing procedures to produce components (§ 19 Paragraph 1 No. 13)	e) Produce components from various materials and in accordance with company production documents via manual and machine grinding or abrasion procedures f) Execute alterations on the basis of constructive and technical requirements	
17	Programme machines and plants (§ 19 Paragraph 1 No. 17)	b) Use computer-aided techniques for programming c) Produce, enter, test, alter, optimise and secure programmes d) Check functional processes and take account of production technology in adapting programme sequences	
18	Testing (§ 19 Paragraph 1 No. 18)	d) Use various procedures to test surface characteristics	
	Time framework 11		
10	Control systems (§ 19 Paragraph 1 No. 10)	a) Evaluate control systems documents b) Use control technology	1 to 2
13	Use different manufacturing procedures to produce components (§ 19 Paragraph 1 No. 13)	h) Select productiion procedures	
17	Programme machines and plants (§ 19 Paragraph 1 No. 17)	d) Check functional processes and take account of production technology in adapting programme sequences	
	Time framework 12		
5	Company and technical communication (§ 19 Paragraph 1 No. 5)	e) Conduct appropriate and target oriented discussions with customers, line managers and within the team, take cultural identities into account h) Organise and chair meetings, document and present results	1 to 2

Occupational profile position	Part of the training occupation profile	Core and specialist skills to be imparted in an integrated manner, incorporating autonomous planning, execution and checking	Time framework in months
1	2	3	4
6	Planning and organisation of work, evaluation of work results (§ 19 Paragraph 1 No. 6)	b) Select tools and materials, requisition tools and materials in a timely manner, test and transport tools and materials and make such tools and materials available for use d) Use instruments for the processing of orders and tracking of deadlines	
12	Customer orientation (§ 19 Paragraph 1 No. 12)	a) Procure order-specific requirements and information, test, implement or forward to those involved b) Make customers aware of particular order-specific characteristics and safety regulations	
14	Assembly and dismantling (§ 19 Paragraph 1 No. 14)	g) Select standard parts	
15	Trialling and handover (§ 19 Paragraph 1 No. 15)	a) Test individual and overall function, carry out an error analysis b) Establish and document functionality c) Test mechanical or pneumatic components, establish operational safety d) Carry out or arrange for testing and optimise the process according due consideration to qualitative and business points of view e) Test samples or test pieces, particularly with regard to stability of dimensions and form and function f) Document the sampling process g) Take account of the relevant safety regulations when operating machines, use means of transport h) Check safety equipment, ensure safety in the work area	
16	Maintenance of components and sub-assemblies (§ 19 Paragraph 1 No. 16)	f) Carry out and document maintenance measures in line with company regulations	
	Time framework 13		
19	Business processes and quality management within the area of deployment (§ 19 Paragraph 1 No. 19)	a) Clarify the nature and scope of orders, identify specific services, agree particular characteristics and deadlines with customers b) Procure, evaluate and use information for the processing of the order, take technical developments into account, comply with stipulations relevant to safety c) Accord due consideration to business management and ecological points of view in planning the processing of orders, reach agreement with upstream and downstream divisions, prepare planning documents d) Arrange for partial orders, check results e) Execute orders whilst in particular taking account of health and safety at work, environmental protection and deadlines f) Apply company quality assurance systems in their own work area, systematically seek out, remedy and document the causes of quality defects g) Select and apply test procedures and equipment, check the deployability of test equipment, apply test plans and company test regulations, document and evaluate results h) Document order processing, services and consumption i) Handover technical systems or products to customers and explain such systems and products, prepare acceptance protocols j) Evaluate work results and execution of work and contribute to the continuous improvement of work processes k) Arrange for the optimisation of stipulations, particularly of documentation	10 to 12

Annex 6
(to § 24)

General training plan for vocational education and training in the occupation of milling machine operator

Part A: Content structure for the occupationally specific specialist skills

Occupational profile position	Part of the training occupation profile	Specialist skills to be imparted, incorporating autonomous planning, execution and checking and integrated with core skills
1	2	3
14	Programme numerically controlled machine tools or production systems (§ 23 Paragraph 1 No. 14)	a) Handle data entry and data output devices and storage media b) Produce programmes c) Enter, test, alter and optimise programmes d) Carry out data back-up according due consideration to company provisions
15	Set up machine tools or production systems (§ 23 Paragraph 1 No. 15)	a) Prepare, assemble and align workpiece clamping devices b) Prepare clamping devices and clamp tools c) Calculate and save tool correction data d) Set and enter production parameters e) Prepare equipment for auxiliary and operating materials f) Assemble protective equipment and check functionality g) Carry out a test run
16	Produce workpieces (§ 23 Paragraph 1 No. 16)	a) Align and clamp workpieces according due consideration to form and material properties b) Produce workpieces from various materials using matching production procedures in accordance with technical documents c) Evaluate suitability for milling of workpieces taking account of materials composition, condition of delivery and condition of heat treatment d) Take account of safety regulations in carrying out the milling process e) Take economic factors into account in producing workpieces
17	Monitor and optimise production processes (§ 23 Paragraph 1 No. 17)	a) Monitor and optimise the production process b) Recognise and analyse errors in the production process, identify and rectify causes c) Rectify machine-related malfunctions or arrange for rectification d) Monitor safety equipment and secure functionality e) Guide quality and quantity by optimising the process parameters
18	Business processes and quality management within the area of deployment (§ 23 Paragraph 1 No. 18)	a) Clarify the nature and scope of orders, identify specific services, agree particular characteristics and deadlines with customers b) Procure, evaluate and use information for the processing of the order, take technical developments into account, comply with stipulations relevant to safety c) Accord due consideration to business management and ecological points of view in planning the processing of orders, reach agreement with upstream and downstream divisions, prepare planning documents d) Arrange for partial orders, check results e) Execute orders whilst in particular taking account of health and safety at work, environmental protection and deadlines f) Apply company quality assurance systems in their own work area, systematically seek out, remedy and document the causes of quality defects g) Select and apply test procedures and equipment, check the deployability of test equipment, apply test plans and company test regulations, document and evaluate results h) Document order processing, services and consumption i) Handover technical systems or products to customers and explain such systems and products, prepare acceptance protocols j) Evaluate work results and execution of work and contribute to the continuous improvement of work processes k) Arrange for the optimisation of stipulations, particularly of documentation

Part B: Time structure

Section I:

Occupational profile position	Part of the training occupation profile	Core and specialist skills to be imparted in an integrated manner, incorporating autonomous planning, execution and checking	Time framework in months
1	2	3	4
1	VET, employment and collective wage agreement law (§ 23 Paragraph 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 (§ 23 Paragraph 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 (§ 23 Paragraph 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 (§ 23 Paragraph 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	

Section II

Occupational profile position	Part of the training occupation profile	Core 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 1	1st year of training	
5	Company and technical communication (§ 23 Paragraph 1 No. 5)	a) Select information sources, procure and evaluate information b) Evaluate and use technical drawings and lists of parts, prepare sketches	
6	Planning and organisation of work, evaluation of work results (§ 23 Paragraph 1 No. 6)	a) Take company stipulations into account in setting up the workplace b) Select tools and materials, requisition tools and materials in a timely manner, test and transport tools and materials and make such tools and materials available for use f) Check and present possible solutions and compare their cost-effectiveness h) Identify skills deficits, use training opportunities i) Apply different learning techniques j) Select and use test procedures and test equipment, ascertain the deployability of test equipment	
7	Differentiate, allocate and handle materials and auxiliary materials (§ 23 Paragraph 1 No. 7)	b) Allocate, use and dispose of auxiliary materials in accordance with their use	
8	Produce components and sub-assemblies (§ 23 Paragraph 1 No. 8)	a) Ensure the operational readiness of machine tools including tools b) Select tools and clamping devices, align and clamp workpieces c) Manufacture workpieces using manual and machine production processes d) Produce components by separating and reforming	
15	Set up machine tools or production systems (§ 23 Paragraph 1 No. 15)	f) Assemble protective equipment and check functionality	
	Time framework 2		
5	Company and technical communication (§ 23 Paragraph 1 No. 5)	b) Evaluate and use technical drawings and lists of parts, prepare sketches c) Compile, supplement, evaluate and use documents and occupationally related regulations	
6	Planning and organisation of work, evaluation of work results (§ 23 Paragraph 1 No. 6)	e) Record and evaluate data relevant to business administration j) Select and use test procedures and test equipment, ascertain the deployability of test equipment	
7	Differentiate, allocate and handle materials and auxiliary materials (§ 23 Paragraph 1 No. 7)	a) Evaluate material properties and changes to such properties and select and handle materials in accordance with their use	3 to 5
8	Produce components and sub-assemblies (§ 23 Paragraph 1 No. 8)	b) Select tools and clamping devices, align and clamp workpieces c) Manufacture workpieces using manual and machine production processes e) Join components, including in different materials, to form sub-assemblies	
9	Maintain operating equipment (§ 23 Paragraph 1 No. 9)	a) Inspect, care for and maintain operating equipment, document execution	
13	Plan the production process (§ 23 Paragraph 1 No. 13)	b) Analyse production order and evaluate technical feasibility	
15	Set up machine tools or production systems (§ 23 Paragraph 1 No. 15)	f) Assemble protective equipment and check functionality	
	Time framework 3		
5	Company and technical communication (§ 23 Paragraph 1 No. 5)	d) Accord due consideration to data protection in managing, securing and archiving data and documents f) Present facts and circumstances, prepare protocols; use specialist English language terms in communications	1 to 2

Occupational profile position	Part of the training occupation profile	Core and specialist skills to be imparted in an integrated manner, incorporating autonomous planning, execution and checking	Time framework in months
1	2	3	4
6	Planning and organisation of work, evaluation of work results (§ 23 Paragraph 1 No. 6)	a) Take company stipulations into account in setting up the workplace b) Select tools and materials, requisition tools and materials in a timely manner, test and transport tools and materials and make such tools and materials available for use f) Check and present possible solutions and compare their cost-effectiveness	
8	Produce components and sub-assemblies (§ 23 Paragraph 1 No. 8)	e) Join components, including in different materials, to form sub-assemblies	
15	Set up machine tools or production systems (§ 23 Paragraph 1 No. 15)	a) Prepare, assemble and align workpiece clamping devices b) Prepare clamping devices and clamp tools	
	Time framework 4		
5	Company and technical communication (§ 23 Paragraph 1 No. 5)	a) Select information sources, procure and evaluate information d) Accord due consideration to data protection in managing, securing and archiving data and documents	
7	Differentiate, allocate and handle materials and auxiliary materials (§ 23 Paragraph 1 No. 7)	b) Allocate, use and dispose of auxiliary materials in accordance with their use	
9	Maintain operating equipment (§ 23 Paragraph 1 No. 9)	a) Inspect, care for and maintain operating equipment, document execution b) Visually inspect mechanical and electrical components and connections for mechanical damage, repair or arrange for repair c) Select, use and dispose of materials	1 to 2
15	Set up machine tools or production systems (§ 23 Paragraph 1 No. 15)	e) Prepare equipment for auxiliary and operating materials	
	Time framework 5	2nd year of training, 1st half year	
5	Company and technical communication (§ 23 Paragraph 1 No. 5)	a) Select information sources, procure and evaluate information	4 to 5
6	Planning and organisation of work, evaluation of work results (§ 23 Paragraph 1 No. 6)	g) Contribute to continuous improvement of work processes in own work area h) Identify skills deficits, use training opportunities i) Apply different learning techniques j) Select and use test procedures and test equipment, ascertain the deployability of test equipment	
11	Fix, secure and transport (§ 23 Paragraph 1 No. 11)	a) Select transport equipment, fittings and lifting equipment, evaluate the operational safety of such fittings and equipment, take the relevant regulations into account in deploying or arranging for the deployment of such fittings and equipment b) Deposit, store and secure transported goods	
12	Customer orientation (§ 23 Paragraph 1 No. 12)	a) Procure order-specific requirements and information, test, implement or forward to those involved	
13	Plan the production process (§ 23 Paragraph 1 No. 13)	a) Procure order-related documents and check for completeness b) b) Analyse production order and evaluate technical feasibility c) Stipulate production procedures and process stages d) Select machine tool in accordance with workpiece requirements e) Take account of the material to be processed, processing stability and workpiece geometry in stipulating tools and cutting materials f) Set production parameters depending on workpiece, material, tool and cutting material	
16	Produce workpieces (§ 23 Paragraph 1 No. 16)	a) Align and clamp workpieces according due consideration to form and material properties	

Occupational profile position	Part of the training occupation profile	Core and specialist skills to be imparted in an integrated manner, incorporating autonomous planning, execution and checking	Time framework in months
1	2	3	4
		b) Produce workpieces from various materials using matching production procedures in accordance with technical documents c) Evaluate suitability for milling of workpieces taking account of materials composition, condition of delivery and condition of heat treatment	
	Time framework 6		
5	Company and technical communication (§ 23 Paragraph 1 No. 5)	c) Compile, supplement, evaluate and use documents and occupationally related regulations f) Present facts and circumstances, prepare protocols; use specialist English language terms in communications g) Procure and use information from technical documents or files, including in English	1 to 2
9	Maintain operating equipment (§ 23 Paragraph 1 No. 9)	a) Inspect, care for and maintain operating equipment, document execution b) Visually inspect mechanical and electrical components and connections for mechanical damage, repair or arrange for repair c) Select, use and dispose of materials	
11	Fix, secure and transport (§ 23 Paragraph 1 No. 11)	a) Select transport equipment, fittings and lifting equipment, evaluate the operational safety of such fittings and equipment, take the relevant regulations into account in deploying or arranging for the deployment of such fittings and equipment	
17	Monitor and optimise production processes (§ 23 Paragraph 1 No. 17)	c) Rectify machine-related malfunctions or arrange for rectification d) Monitor safety equipment and secure functionality	
	Time framework 7	2nd year of training, 2nd half year, 3rd and 4th year of training	
5	Company and technical communication (§ 23 Paragraph 1 No. 5)	a) Select information sources, procure and evaluate information g) Procure and use information from technical documents or files, including in English	2 to 3
10	Control systems (§ 23 Paragraph 1 No. 10)	a) Evaluate control systems documents b) Use control technology	
17	Monitor and optimise production processes (§ 23 Paragraph 1 No. 17)	a) Monitor and optimise the production process b) Recognise and analyse errors in the production process, identify and rectify causes c) Rectify machine-related malfunctions or arrange for rectification	
	Time framework 8		
8	Produce components and sub-assemblies (§ 23 Paragraph 1 No. 8)	a) Ensure the operational readiness of machine tools including tools	3 to 4
13	Plan the production process (§ 23 Paragraph 1 No. 13)	a) Procure order-related documents and check for completeness b) b) Analyse production order and evaluate technical feasibility d) Select machine tool in accordance with workpiece requirements e) Take account of the material to be processed, processing stability and workpiece geometry in stipulating tools and cutting materials f) Set production parameters depending on workpiece, material, tool and cutting material	
14	Programme numerically controlled machine tools or production systems (§ 23 Paragraph 1 No. 14)	a) Handle data entry and data output devices and storage media b) Produce programmes c) Enter, test, alter and optimise programmes d) Carry out data back-up according due consideration to company provisions	

Occupational profile position	Part of the training occupation profile	Core and specialist skills to be imparted in an integrated manner, incorporating autonomous planning, execution and checking	Time framework in months
1	2	3	4
15	Set up machine tools or production systems (§ 23 Paragraph 1 No. 15)	a) Prepare, assemble and align workpiece clamping devices b) Prepare clamping devices and clamp tools c) Calculate and save tool correction data d) Set and enter production parameters e) Prepare equipment for auxiliary and operating materials g) Carry out a test run	
16	Produce workpieces (§ 23 Paragraph 1 No. 16)	c) Evaluate suitability for milling of workpieces taking account of materials composition, condition of delivery and condition of heat treatment	
	Time framework 9		
5	Company and technical communication (§ 23 Paragraph 1 No. 5)	e) Conduct appropriate and target oriented discussions with customers, line managers and within the team, take cultural identities into account h) Organise and chair meetings, document and present results i) Resolve disputes within the team	
6	Planning and organisation of work, evaluation of work results (§ 23 Paragraph 1 No. 6)	c) Plan and execute work processes and subtasks whilst according due consideration to business and scheduling stipulations d) Use instruments for the processing of orders and tracking of deadlines, contribute to continuous improvement of work processes in own work area l) Plan and execute tasks within the team	
12	Customer orientation (§ 23 Paragraph 1 No. 12)	a) Procure order-specific requirements and information, test, implement or forward to those involved b) Make customers aware of particular order-specific characteristics and safety regulations	
13	Plan the production process (§ 23 Paragraph 1 No. 13)	a) Procure order-related documents and check for completeness b) b) Analyse production order and evaluate technical feasibility c) Stipulate production procedures and process stages d) Select machine tool in accordance with workpiece requirements e) Take account of the material to be processed, processing stability and workpiece geometry in stipulating tools and cutting materials f) Set production parameters depending on workpiece, material, tool and cutting material	
14	Programme numerically controlled machine tools or production systems (§ 23 Paragraph 1 No. 14)	a) Handle data entry and data output devices and storage media b) Produce programmes c) Enter, test, alter and optimise programmes d) Carry out data back-up according due consideration to company provisions	
15	Set up machine tools or production systems (§ 23 Paragraph 1 No. 15)	a) Prepare, assemble and align workpiece clamping devices b) Prepare clamping devices and clamp tools c) Calculate and save tool correction data d) Set and enter production parameters e) Prepare equipment for auxiliary and operating materials g) Carry out a test run	1 to 3
16	Produce workpieces (§ 23 Paragraph 1 No. 16)	a) Align and clamp workpieces according due consideration to form and material properties c) Evaluate suitability for milling of workpieces taking account of materials composition, condition of delivery and condition of heat treatment	
	Time framework 10		
6	Planning and organisation of work, evaluation of work results (§ 23 Paragraph 1 No. 6)	k) Monitor, evaluate and document work results	4 to 6

Occupational profile position	Part of the training occupation profile	Core and specialist skills to be imparted in an integrated manner, incorporating autonomous planning, execution and checking	Time framework in months
1	2	3	4
11	Fix, secure and transport (§ 23 Paragraph 1 No. 11)	a) Select transport equipment, fittings and lifting equipment, evaluate the operational safety of such fittings and equipment, take the relevant regulations into account in deploying or arranging for the deployment of such fittings and equipment b) Deposit, store and secure transported goods	
16	Produce workpieces (§ 23 Paragraph 1 No. 16)	b) Produce workpieces from various materials using matching production procedures in accordance with technical documents d) Take account of safety regulations in carrying out the milling process e) Take economic factors into account in producing workpieces	
17	Monitor and optimise production processes (§ 23 Paragraph 1 No. 17)	a) Monitor and optimise the production process b) Recognise and analyse errors in the production process, identify and rectify causes c) Rectify machine-related malfunctions or arrange for rectification d) d) Monitor safety equipment and secure functionality e) Guide quality and quantity by optimising the process parameters	
	Time framework 11		
18	Business processes and quality management within the area of deployment (§ 23 Paragraph 1 No. 18)	a) Clarify the nature and scope of orders, identify specific services, agree particular characteristics and deadlines with customers b) Procure, evaluate and use information for the processing of the order, take technical developments into account, comply with stipulations relevant to safety c) Accord due consideration to business management and ecological points of view in planning the processing of orders, reach agreement with upstream and downstream divisions, prepare planning documents d) Arrange for partial orders, check results e) Execute orders whilst in particular taking account of health and safety at work, environmental protection and deadlines f) Apply company quality assurance systems in their own work area, systematically seek out, remedy and document the causes of quality defects g) Select and apply test procedures and equipment, check the deployability of test equipment, apply test plans and company test regulations, document and evaluate results h) Document order processing, services and consumption i) Handover technical systems or products to customers and explain such systems and products, prepare acceptance protocols j) Evaluate work results and execution of work and contribute to the continuous improvement of work processes k) Arrange for the optimisation of stipulations, particularly of documentation	10 to 12

SKELETON CURRICULUM

for the training occupation of **industrial mechanic**

(Resolution of the Standing Conference of the Ministers of Education and Cultural Affairs of 25 March 2004)

Part I: Preliminary remarks

This 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 Economics and Technology or by the otherwise responsible ministry in agreement with the Federal Ministry for Education and Research). The process for such coordination 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.

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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 creation of the essential prerequisites for qualified employment and entry into school based and advanced vocational and continuing training courses.

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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: Education 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.

In 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 company-based 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 professional competence and general skills of a human and social nature;

- to develop occupational flexibility enabling the changing requirements within the world of work 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.

The aims listed are aligned towards 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 developed within the dimensions of professional competence, personal competence and social competence.

Professional 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 fundamentally 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 industrial mechanic is coordinated with the Ordinance on vocational education and training in the industrial metalworking occupations of 9 July 2004 (Federal Law Gazette, I p. 1502).[2]

The training occupation has been aligned to the occupational field of metal engineering pursuant to the Basic Vocational Training Year Accreditation Directive.[3]

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 industrial mechanic (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 18.05.84).

Industrial mechanics are primarily deployed within the fields of occupational activity of manufacture, installation, maintenance and automation of technical systems. The fields of occupational activity stated are mapped by the respective learning fields. The learning fields of the individual years of training are built up within the fields of occupational activity.

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

Industrial Mechanics

- plan and organise work processes, check and evaluate work results;
- test mechanical and physical values;
- manufacture components using manual and machine production processes;
- develop and optimise programmes and operate numerically controlled machinery, equipment or plants;
- assemble and dismantle machines, equipment, facilities and plants;
- commission systems and plants including open and closed loop control systems and instruct customers;
- carry out maintenance works and ensure the functionality of technical systems;
- draw up technical documentation;

[1] The updating of the Ordinance on vocational education and training in the industrial metalworking occupations on the occasion of the transfer into permanent law of the "extended final examination" on 23 July 2007 (Federal Law Gazette
I p. 1599) did not necessitate any amendments to the skeleton curriculum of the Standing Conference of the Ministers of Education and Cultural Affairs.

[3] The Basic Vocational Training Year Accreditation Directives were repealed by Article 8 of the Act on the Reform of Vocational Education and Training of 23 March 2005 (Federal Law Gazette I p. 931).

• apply standards and guidelines to secure process and product quality and make a contribution to continuous improvement of work processes within the company.

The aim is for the business and work process within the field of occupational activity to form the starting point for the didactic and methodological structuring of the learning situations in the individual learning fields. This process is mapped in the formulations of objectives of the various learning fields. The objectives of the learning fields determine the organisation of teaching and together with the supplementary contents constitute the minimum scope of such teaching.
The specialist contents of the individual learning fields are only stated in general terms and are not listed in differentiated form. Insofar as they are able, schools act in cooperation with the companies providing training to decide autonomously on the content organisation of the learning fields. There is close content correlation between the skeleton curriculum and the general training plan for company-based training. The recommendation is that the organisation of generic learning situations in the individual learning fields should be based on both plans. This means that the schools themselves are given more organisational tasks and accorded extended didactic responsibility.

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

Relevant standards, legal regulations and accident prevention provisions should always be applied, including in areas where they are not explicitly mentioned.

40 hours of English language objectives and contents are integrated into the learning fields.

The objectives and contents of learning fields one to six are coordinated with the requisite skills contained within the training regulations for the interim examination or Part 1 of the final examination.

The holistic assignment of projects tasks in the learning fields of the seventh half year of training accords 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.

Summary of the learning fields for the training occupation of industrial mechanic					
Learning fields		**Suggested time allocations**			
No.		1st year	2nd year	3rd year	4th year
1	Manufacture components using hand-controlled tools	80			
2	Manufacture components using machines	80			
3	**Produce simple sub-assemblies**	80			
4	Maintain technical systems	80			
5	Manufacture individual parts using machine tools		80		
6	Install and commission control engineering systems		60		
7	Assemble technical subsystems		40		
8	Carry out production using numerically controlled machine tools		60		
9	Repair technical systems		40		
10	Produce and commission technical systems			80	
11	Monitor product and process quality			60	
12	Service technical systems			60	
13	Ensure the functionality of automated systems			80	
14	Plan and realise technical systems				80
15	Optimise technical systems				60
	Total (overall time 1020 hours)	320	280	280	140

Learning field 1:	**Manufacture components using hand-controlled tools**	**1st year of training** **Suggested time allocation: 80 hours**

Formulation of objectives

Pupils prepare the manufacture of components typical to the occupation using hand-controlled tools. They evaluate layout plans and simple technical drawings for this purpose.
They draw up and amend detail drawings, sketches of components for functional units and simple sub-assemblies. They prepare and supplement lists of parts and work plans with the aid of application programmes.
They plan stages of work and the necessary tools, materials, semi-finished products and equipment on the basis of the basic theoretical principles of the technologies to be applied. They determine the technological data required and carry out the necessary calculations.
Pupils select and use suitable test equipment and draw up the relevant test protocols.
They use test procedures to try out the stages of work selected, evaluate work results and arrive at a rough estimate of production costs.
Pupils document and present their work results. They comply with regulations relating to health and safety at work and environmental protection.

Contents

Detail drawings
Group or assembly drawings
Technical documentation and information sources
Functional descriptions
Production plans
Ferrous and non-ferrous metals
Properties of metallic materials
Plastics
General tolerances
Semi-finished products and standardised parts
Bench tools, electrical tools
Auxiliary materials
Basic principles and processes of separating and reforming
Testing
Costs of materials, wages and tools
Mass of construction parts, unit calculation
Presentation techniques
Standards

Learning field 2:	**Manufacture components using machines**	**1st year of training** **Suggested time allocation: 80 hours**

Formulation of objectives

Pupils prepare the machine manufacture of components typical to the occupation. They evaluate group drawings, layout plans and lists of parts for this purpose. They prepare detail drawings and relevant work plans including with the assistance of application programmes.
They select materials whilst according due consideration to the specific properties of such materials and align materials in a product-related manner.
They plan production processes, identify technological data and carry out the necessary calculations.
They understand the fundamental structure and functionality of the machines, select machines and the relevant tools in an order-related way whilst taking account of functional, technological and business criteria and prepare machines for deployment. Pupils develop evaluation criteria, select test equipment and draw up and interpret test protocols.
They present work results, optimise work processes and develop alternatives whilst using modern media and forms of presentation.
They carry out tests to check selected work stages as well as alternative possibilities and evaluate the work results.
They are familiar with the influences of the production process on measurements and surface qualities. They address influences on the production process whilst taking the significance of product quality into account.
They comply with regulations relating to health and safety at work and environmental protection.

Contents

Technical documentation and information sources
Production plans
Functional descriptions
Selection criteria for test equipment and applications
ISO tolerances
Surface specifications
Measurement errors
Drilling, sinking, smoothing, milling, lathe turning
Functional units of machines and their functionality
Service life of tools
Production data and the calculations of such data
Coolants and lubricants
Basic principles of quality management
Costs of tools and machines, consumption of materials, working time

Learning field 3: Produce simple sub-assemblies **1st year of training**
Suggested time allocation: 80 hours

Formulation of objectives

Pupils prepare the production of simple sub-assemblies. For this purpose, they read overall and group drawings typical to the occupation, layout plans and simple circuit diagrams and are able to describe and explain the functional correlations of the sub-assemblies.
They prepare and amend detail and group drawings and lists of parts and apply information from technical documentation. They also use learning programmes to plan simple control systems and select the relevant construction parts.
They describe the proper installation of sub-assemblies and compare assembly proposals whilst also using specialist and English language terms. Individual parts are systematically labelled in accordance with standards. Pupils use assembly instructions and develop assembly plans taking account of installation tools and specific customer requirements.
They differentiate joining procedures in accordance with the functionality principles of such procedures and align them in an application-related manner.
They select the necessary tools, standardised parts and mechanisms in a product-related way and organise simple assembly work within a team.
They develop procedures for functional tests, draw up test plans and protocols and document and present such plans and protocols. They evaluate test results, remedy quality defects, optimise assembly processes and take the cost-effectiveness of these processes into account. They comply with regulations relating to health and safety at work and environmental protection.

Contents
Detail, group and overall drawings, layout plans
Technical information sources
Functional descriptions
List of parts and assembly plans
Assembly descriptions
Tools, facilities, materials, auxiliary materials, additional materials
Basic principles of force, form-fit and bonded joining
Standardised parts
Basic principles of quality management
Momentum and torque calculations
Basic principles of control engineering
Work organisation and work planning
Assembly costs

Learning field 4: Maintain technical systems **1st year of training**
Suggested time allocation: 80 hours

Formulation of objectives

Pupils prepare for the maintenance of technical systems, in particular of operating equipment, and identify influences on operational readiness. They evaluate the significance of this maintenance measure from the points of view of safety, availability and cost-effectiveness.
They read layout plans and maintenance plans and instructions, including in English. They plan maintenance works and determine the necessary tools and auxiliary equipment. They apply the basic principles of electro technology and control engineering and explain simple circuit diagrams in the various device technologies.
They comply with regulations relating to health and safety at work and environmental protection. They take particular account of the safety regulations for electrical operating equipment. They measure and calculate electrical and physical values. They evaluate, discuss and present their work results.

Contents

Basic terms relating to routine repairs
Maintenance plans
Layout plans
Operating instructions
Company organisation
Causes of wear and tear and of malfunctions Coolants and lubricants, disposal
Corrosion protection and corrosion protection agents
Functional check
Costs of maintenance and downtime, consequences of malfunctions
Damage analysis
Values in electrical circuits, Ohm’s Law
Risks of electrical current, electrical safety
Standards and ordinances

Learning field 5:	**Manufacture individual parts using machine tools**	**2nd year of training** **Suggested time allocation: 80 hours**

Formulation of objectives

Pupils act in an order-related manner and accord due consideration to health and safety at work and to environmental protection in using machine tools to produce workpieces from various materials. They obtain the necessary information from group drawings, detail drawings, sketches and lists of parts. They prepare and amend sketches including with the aid of application programmes. Pupils take technological aspects into account in selecting suitable production procedures. They decide whether procedures for the alteration of material properties need to be conducted prior to milling for production. They stipulate necessary technological data and select the required auxiliary materials. They draw up work plans for the production procedure chosen, select clamping devices for workpieces and tools and set the machine up for production. The pupils develop test plans on the basis of quality management provisions. They select test equipment and manage and interpret test protocols. They document and present work results, evaluate work results and develop alternatives.
They investigate the influences of the production process on measurements, surface qualities and form. They identify costs of production and evaluate the cost-effectiveness of the selected production processes. Pupils give reasons for their decisions and react in a task-oriented manner to criticism of their work.

Contents

Technical information sources
Production processes involving milling
Processing parameters
Cutting materials
Material standardisation
Annealing procedures
Main period of use
Cooling lubricants
Test instructions
Selection and monitoring of test equipment
Attributive and variable test characteristics
Form and storage tolerances

Learning field 6:	**Install and commission control engineering systems**	**2nd year of training** **Suggested time allocation: 60 hours**

Formulation of objectives

Pupils install and commission control engineering systems.
They use circuit diagrams and other documentation to calculate the control engineering components to be used for control systems in various device technologies and the functional sequence. They use documentation provided by the manufacturer, including English language documentation.
Pupils plan and realise the structure of the control system. They commission the control engineering system whilst according due consideration to health and safety at work. They develop and apply trouble shooting strategies and strategies to optimise the control engineering system.
They document and present their results and also use suitable application programmes.

Contents

Technology diagram
Pneumatic and hydraulic power components
Supply unit
Sensors
Material, energy, information flow
Circuit diagrams
Print media
Pressures, forces, speeds
Volume flow
Types of operation
Plant safety

Learning field 7: Assemble technical subsystems	**2nd year of training** **Suggested time allocation: 40 hours**

Formulation of objectives

The pupils plan the assembly of technical subsystems. They carry out a functional analysis with the aid of technical drawings, layout plans and lists of parts.
They draw up assembly plans according due consideration to the functions and properties of the components.
Pupils calculate the values necessary for assembly, select the required tools and equipment and install the subassemblies. They carry out functional checks and draw up test protocols. They evaluate test results, optimise assembly processes and take the cost-effectiveness of these processes into account. They document and present the work results applying various forms of visualisation.

Contents

Axles and spindles
Plain bearing
Cartridge-type bearings
Guides
Seals
Friction, heat expansion
Spindle and hub connections
Contact pressure
Stability indicators
Types of matching
Matching systems

Learning field 8:	**Carry out production using numerically controlled machine tools**	**2nd year of training** **Suggested time allocation: 60 hours**

Formulation of objectives

Pupils manufacture components via individual and series production on numerically controlled machine tools. They read and prepare sketches and detail drawings and use such sketches and drawings to obtain the necessary information for CNC production.
They identify the technological and geometric data for processing and draw up work and tool plans. Pupils plan the clamping for workpieces and tools and set up the machine tools. They develop CNC programmes including via the use of graphic programming procedures and check these programmes through simulations.
They create test plans, including with regard to series production, by using selected quality management elements. They select test equipment, evaluate the test results and use this as the basis for optimising the production process by taking into account the influences of production parameters on measurements, surface qualities and productivity.
They take health and safety at work provisions into account for work on CNC machines.

Contents

Measurement of coordinates
Work plan, tool plan, set-up sheet
Structure and function of CNC machines
Coordinates systems
Reference points
Geometric data
Technology data
Programme structure
Tool correction
Attributive and variable checking of characteristics

Learning field 9: Repair technical systems **2nd year of training**
Suggested time allocation: 40 hours

Formulation of objectives

Pupils carry out routine to technical systems. They take account of operational and business requirements in planning repair measures for technical systems. They procure the necessary technical information for this purpose.
Pupils accord due consideration to the respective interfaces in disassembling subsystems in subassemblies and components and select the necessary tools and equipment.
They analyse and document errors. They identify components to be replaced, plan replacement procurement and select suitable materials and auxiliary materials. They replace the defective components and assemble the system. During repair, they decide whether support is needed from other specialist departments and, if so, which support is required.
Pupils test the function and prepare acceptance. They plan the proper disposal of the defective parts and of the auxiliary materials used.
They apply regulations relating to health and safety at work and environmental protection.

Contents

Overall drawings
Circuit diagrams
Repairs caused by condition of equipment and failure
Downtime, costs of downtime
Replacement supplies
Wear and tear
Lubricants
Error analysis
Repair provisions
Inspections reports
Lists of replacement parts
Disassembly/assembly plans
Acceptance protocol

Learning field 10: Produce and commission technical systems **3rd year of training**
Suggested time allocation: 80 hours

Formulation of objectives

Pupils produce and commission technical systems. They use overall drawings as a basis for describing functional correlations of components and subassemblies. They accept amendment orders, prepare sketches, carry out necessary calculations and select suitable production procedures. Pupils select components and subassemblies in accordance with function or stipulations.
They also take ergonomic aspects into account in planning the work process. They stipulate assembly tools and collate the individual parts for assembly. Pupils decide if the assistance of specialist departments should be sought. They assemble subsystems to create overall systems and commission these systems. Necessary parameters are set, checked and documented. The pupils draw up operating instructions. They protocol the handover of the technical system to the customer.
Pupils comply with regulations in respect of health and safety at work and environmental protection and take economic aspects into account.

Contents

Functional specifications
Gears
Couplings
Pumps
Electrical drives
Mechanical and electrical indicators and response curves
Welding, bonding
Lifting equipment
Fixing of loads
Safety equipment
Dialogue with customers

Learning field 11: Monitor product and process quality **3rd year of training**
Suggested time allocation: 60 hours

Formulation of objectives

Pupils monitor product and process quality and conduct machine and process capability investigations in accordance with orders and instructions. They plan implementation, record process data and evaluate the indicators identified including with the assistance of graphics. They differentiate systematic and coincidental cause variables and identify such cause variables for selected processes on the basis of correlations between cause and effect. Pupils apply statistical quality assurance procedures in ongoing production including the use of application software. They document compliance with process and product quality in accordance with customer stipulations. They monitor the production process using quality assurance methods in mass and series production. They record process indicators for variable and attributive product characteristics and keep and interpret process control charts. They document the course of a process over time and use quality data to derive corrective measures for the process.
They present quality data, discuss consequences for the production process and secure results.

Contents

Quality standards
Statistical process control
Quality control charts
Cause and effect diagrams
Machine capability indices
Process capability indices
Normal distribution
Histograms
Standard deviation, arithmetical mean, median, spread
Test instructions

Learning field 12: Service technical systems **3rd year of training**
Suggested time allocation: 60 hours

Formulation of objectives

Pupils maintain technical systems by planning and implementing measures for the improvement of availability and reliability. They accept customer orders for the maintenance of technical systems. They investigate systems with regard to the causes of errors ascertained. They use technical documentation, including English language documentation, for this purpose. They delineate subsystems and determine entry and exit values.
Pupils select and apply suitable test procedures and equipment. They use error causes and error frequency to identify areas of weakness, which they analyse using suitable methods including with regard to load and wear and tear. They advise customers in respect of possible improvement measures and draw up the documentation and plans required for this purpose. Pupils procure the necessary components, restore the functionality of the technical system and document their results. They hand the technical system over to the customer at the conclusion of maintenance. They take account of the business and legal consequences of maintenance work and of the influence of such consequences on quality requirements in respect of production and the product. They comply with regulations relating to health and safety at work and environmental protection.

Contents

Maintenance caused by condition of equipment and failure and preventative maintenance
Damage analysis
Materials testing procedures
Heat treatment procedures
Statistical error evaluation
Pareto analysis
Cost estimates
Downtime
Maintenance costs
Product liability in compliance with quality management

Learning field 13: Ensure the functionality of automated systems	**3rd year of training Suggested time allocation: 80 hours**

Formulation of objectives

Pupils ensure the functionality of automated systems. For this purpose, they analyse automated systems using technical documentation, including English language technical documentation.
They take account of the stipulated process sequence and of manufacturer documentation in developing process optimisation solutions for individual subsystems. In order to remedy operational malfunctions, they draw up strategies for the identification of errors and eliminate errors whilst taking business aspects into account. Pupils modify, test and document systems and present their results. They take account of necessary health and safety at work measures in dealing with production and manual handling systems. They evaluate the economic and societal aspects of automation technology.

Contents

Electropneumatic and electrohydraulic functional units
Open-loop control systems
Closed-loop control systems
Programmable control systems
Types of operation
Sequential function chart, function block diagram
Flexible handling systems
Interfaces
Maintenance regulations
Safety equipment

Learning field 14: Plan and realise technical systems	**4th year of training** **Suggested time allocation: 80 hours**

Formulation of objectives

Pupils plan and realise technical systems. They analyse project orders with regard to their feasibility and define the objectives. Pupils assume responsibility for project organisation, document project progress, analyse and evaluate the process and instigate necessary measures. They comply with quality management stipulations thus securing the quality of products and processes.
They prepare 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, ecological and economic aspects.

Contents

User and functional specifications
Projekt structure plan
Evaluation

Learning field 15: Optimise technical systems	**4th year of training** **Suggested time allocation: 60 hours**

Formulation of objectives

Pupils optimise technical systems. They investigate systems and production processes that are operating in an error-free for opportunities for optimisation manner with regard to ergonomics, health and environmental protection and cost-effectiveness.
They also take account of technological developments and of new operating and auxiliary materials in drawing up proposals for improvement. Pupils present their proposals, discuss the decision-making process in groups, estimate economic benefits and decide whether proposals for optimisation should be forwarded to the company suggestion system.
They plan optimisation measures and decide on autonomous implementation. They document the works carried out.

Contents

Work organisation
Ideas management
Knowledge management

SKELETON CURRICULUM

for the training occupation of

Milling machine operator

(Resolution of the Standing Conference of the Ministers of Education and Cultural Affairs of 25 March 2004)

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- "to impart employability encompassing a combination of professional competence and general skills of a human and social nature;

- to develop occupational flexibility enabling the changing requirements within the world of work 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.

The aims listed are aligned towards 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.

Professional 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 milling machine operator is coordinated with the Ordinance on vocational education and training in the industrial metalworking occupations of 9 July 2004 (Federal Law Gazette, I p. 1502)[4]

The training occupation has been aligned to the occupational field of metal engineering pursuant to the Basic Vocational Training Year Accreditation Directive.[5]

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 milling machine operator (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).

Milling machine operators mainly use machining techniques to manufacture components in individual and series production. Their tasks include the preparation, execution, monitoring and securing of production processes and the identification and evaluation of test data within the scope of quality assurance systems.

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

Pupils

- evaluate and analyse production orders in terms of technical feasibility;
- plan, control and monitor work processes whilst taking scheduling and calculatory stipulations into account;
- set up production, handling and test systems;
- use standards, regulations and rules relating to securing product quality, ensure the process capability of production plants and make a contribution to continuous improvement of work processes;
- use machining production processes to manufacture components in accordance with qualitative stipulations and monitor the production process;
- apply test and measurement procedures, document and evaluate work results and derive measures to optimise production processes and the product;
- develop, alter and optimise programmes for numerically controlled manufacturing systems;
- monitor and check safety systems, carry out maintenance works, systematically detect errors and malfunctions and carry out routine repairs to production systems;

[4] The updating of the Ordinance on vocational education and training in the industrial metalworking occupations on the occasion of the transfer into permanent law of the "extended final examination" on 23 July 2007 (Federal Law Gazette I p. 1599) did not necessitate any amendments to the skeleton curriculum of the Standing Conference of the Ministers of Education and Cultural Affairs.

[5] The Basic Vocational Training Year Accreditation Directives were repealed by Article 8 of the Act on the Reform of Vocational Education and Training of 23 March 2005 (Federal Law Gazette I p. 931).

• apply standards and guidelines to secure process and product quality and make a contribution to continuous improvement of work processes within the company.

The aim is for the business and work process within the field of occupational activity to form the starting point for the didactic and methodological structuring of the learning situations in the individual learning fields. This process is mapped in the formulations of objectives of the various learning fields. The objectives of the learning fields determine the organisation of teaching and together with the supplementary contents constitute the minimum scope of such teaching.
The specialist contents of the individual learning fields are only stated in general terms and are not listed in differentiated form. Insofar as they are able, schools act in cooperation with the companies providing training to decide autonomously on the content organisation of the learning fields. There is close content correlation between the skeleton curriculum and the general training plan for company-based training. The recommendation is that the organisation of generic learning situations in the individual learning fields should be based on both plans. This means that the schools themselves are given more organisational tasks and accorded extended didactic responsibility.

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

Relevant standards, legal regulations and accident prevention provisions should always be applied, including in areas where they are not explicitly mentioned.

40 hours of English language objectives and contents are integrated into the learning fields.

The objectives and contents of learning fields one to six are coordinated with the requisite skills contained within the training regulations for the interim examination or Part 1 of the final examination.

The holistic assignment of projects tasks in the learning fields of the seventh half year of training accords 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.

Summary of the learning fields for the training occupation of milling machine operator					
Learning fields		**Suggested time allocations**			
No.		1st year	2nd year	3rd year	4th year
1	Manufacture construction elements using hand-controlled tools	80			
2	Manufacture construction elements using machines	80			
3	Produce simple sub-assemblies	80			
4	Maintain technical systems	80			
5	Manufacture components using machining production processes		100		
6	Maintain and inspect machine tools		40		
7	Commission control systems		60		
8	Programme and operate numerically controlled machine tools		80		
9	Use precision machining techniques to produce components			80	
10	Optimise the production process			100	
11	Plan and organise computer-aided production			100	
12	Prepare and execute an individual production order				60
13	Organise and monitor production processes in series manufacture				80
	Totals (overall time 1,020 hours)	320	280	280	140

Learning field 1:	**Manufacture construction elements using hand-controlled tools**	**1st year of training** **Suggested time allocation: 80 hours**

Formulation of objectives

Pupils prepare the manufacture of construction elements typical to the occupation using hand-controlled tools. They evaluate layout plans and simple technical drawings for this purpose.
They draw up and amend detail drawings, sketches of construction elements for functional units and simple sub-assemblies. They prepare and supplement lists of parts and work plans with the aid of application programmes.
They plan stages of work and the necessary tools, materials, semi-finished products and equipment on the basis of the basic theoretical principles of the technologies to be applied. They determine the technological data required and carry out the necessary calculations.
Pupils select and use suitable test equipment and draw up the relevant test protocols.
They use test procedures to try out the stages of work selected, evaluate work results and arrive at a rough estimate of production costs.
Pupils document and present their work results. They comply with regulations relating to health and safety at work and environmental protection.

Contents

Detail drawings
Group or assembly drawings
Technical documentation and information sources
Functional descriptions
Production plans
Ferrous and non-ferrous metals
Properties of metallic materials
Plastics
General tolerances
Semi-finished products and standardised parts
Bench tools, electrical tools
Auxiliary materials
Basic principles and processes of separating and reforming
Testing
Costs of materials, wages and tools
Mass of construction parts, unit calculation
Presentation techniques
Standards

Learning field 2:	**Manufacture construction elements using machines**	**1st year of training** **Suggested time allocation: 80 hours**

Formulation of objectives

Pupils prepare the machine manufacture of components typical to the occupation. They evaluate group drawings, layout plans and lists of parts for this purpose. They prepare detail drawings and relevant work plans including with the assistance of application programmes.
They select materials whilst according due consideration to the specific properties of such materials and align materials in a product-related manner.
They plan production processes, identify technological data and carry out the necessary calculations.
They understand the fundamental structure and functionality of the machines, select machines and the relevant tools in an order-related way whilst taking account of functional, technological and business criteria and prepare machines for deployment.
Pupils develop evaluation criteria, select test equipment and draw up and interpret test protocols.
They present work results, optimise work processes and develop alternatives whilst using modern media and forms of presentation. They carry out tests to check selected work stages as well as alternative possibilities and evaluate the work results.
They are familiar with the influences of the production process on measurements and surface qualities.
They address influences on the production process whilst taking the significance of product quality into account.
They comply with regulations relating to health and safety at work and environmental protection.

Contents

Technical documentation and information sources
Production plans
Functional descriptions
Selection criteria for test equipment and applications
ISO tolerances
Surface specifications
Measurement errors
Drilling, sinking, smoothing, milling, lathe turning
Functional units of machines and their functionality
Service life of tools
Production data and the calculations of such data
Coolants and lubricants
Basic principles of quality management
Costs of tools and machines, consumption of materials, working time

Learning field 3: Produce simple sub-assemblies **1st year of training**
Suggested time allocation: 80 hours

Formulation of objectives

Pupils prepare the production of simple sub-assemblies. For this purpose, they read overall and group drawings typical to the occupation, layout plans and simple circuit diagrams and are able to describe and explain the functional correlations of the sub-assemblies.
They prepare and amend detail and group drawings and lists of parts and apply information from technical documentation. They also use learning programmes to plan simple control systems and select the relevant construction parts. They describe the proper installation of sub-assemblies and compare assembly proposals whilst also using specialist and English language terms. Individual parts are systematically labelled in accordance with standards. Pupils use assembly instructions and develop assembly plans taking account of installation tools and specific customer requirements.
They differentiate joining procedures in accordance with the functionality principles of such procedures and align them in an application-related manner.
They select the necessary tools, standardised parts and mechanisms in a product-related way and organise simple assembly work within a team.
They develop procedures for functional tests, draw up test plans and protocols and document and present such plans and protocols. They evaluate test results, remedy quality defects, optimise assembly processes and take the cost-effectiveness of these processes into account. They comply with regulations relating to health and safety at work and environmental protection.

Contents

Detail, group and overall drawings, layout plans
Technical information sources
Functional descriptions
List of parts and assembly plans
Assembly descriptions
Tools, facilities, materials, auxiliary materials, additional materials
Basic principles of force, form-fit and bonded joining
Standardised parts
Basic principles of quality management
Functional check
Momentum and torque calculations
Basic principles of control engineering
Work organisation and work planning
Assembly costs

Learning field 4: Maintain technical systems	**1st year of training** **Suggested time allocation: 80 hours**

Formulation of objectives

Pupils prepare for the maintenance of technical systems, in particular of operating equipment, and identify influences on operational readiness. They evaluate the significance of this maintenance measure from the points of view of safety, availability and cost-effectiveness.
They read layout plans and maintenance plans and instructions, including in English. They plan maintenance works and determine the necessary tools and auxiliary equipment. They apply the basic principles of electro technology and control engineering and explain simple circuit diagrams in the various device technologies.
They comply with regulations relating to health and safety at work and environmental protection. They take particular account of the safety regulations for electrical operating equipment. They measure and calculate electrical and physical values. They evaluate, discuss and present their work results.

Contents

Basic terms relating to routine repairs
Maintenance plans
Layout plans
Operating instructions
Company organisation
Causes of wear and tear and of malfunctions
Coolants and lubricants, disposal
Corrosion protection and corrosion protection agents
Functional check
Costs of maintenance and downtime, consequences of malfunctions
Damage analysis
Values in electrical circuits, Ohm’s Law
Risks of electrical current, electrical safety
Standards and ordinances

Learning field 5:	**Manufacture components using machining production processes**	**2nd year of training** **Suggested time allocation: 100 hours**

Formulation of objectives

Pupils use machining processes to manufacture components from ferrous and non-ferrous metals and from plastics. They analyse, prepare and alter order-related documents for this purpose. They use technical information sources and application programmes.
They use appropriate investigatory procedures to identify the mechanical and technological properties of the material to be machined, determine the property profile of the material with regard to suitability for milling and derive from this suitable tool geometries and cutting materials.
They select suitable production procedures, machine tools and tools in accordance with the workpiece requirements and take account of technical functionality principles. They select workpiece and tool machining equipment and plan and set up the machine.
They determine the cooling lubricant and monitor its suitability for use. Pupils stipulate the necessary production stages and production parameters for the manufacture of the components and document these in a work plan. They discuss and evaluate possible alternative solutions including according due consideration to economic aspects. They take account of the influence of the production parameters on the dimensional accuracy and surface quality of the workpiece.
For the purpose of quality assurance in the production process, they select test procedures and test equipment in an order-related way, ascertain the suitability for use of such procedures and equipment, apply test plans and test regulations and document the results.
Pupils comply with regulations relating to health and safety at work and environmental protection. They reflect upon and evaluate the whole of the processing of the order within the team and react objectively to criticism of their work.

Contents

Detail, group and overall drawing
Production documentation: work plan, tooling sheet, tool data sheet, test plan
Lathe turning, milling and grinding technology
Cutting materials
Production parameters: technology data, cutting geometry, cutting force, cutting and machine performance, material removal rate, main period of use, production costs
Swarf formation
Wear and tear, service life
Functional descriptions of subsystems of the machine tool
Movements at machine tools
Machine elements, transmission ratio, torque
Clamping forces
Quality assurance

Learning field 6: Maintain and inspect machine tools **2nd year of training**
Suggested time allocation: 40 hours

Formulation of objectives

Pupils maintain and inspect machine tools, safety equipment and peripheral systems for the purpose of continuance of unimpeded production.
For this purpose, they use operating instructions, maintenance instructions, various information materials and media, including in English.
Pupils take account of possible economic and legal consequences of maintenance works and of the influence of such works on the quality requirements of production and of the product.
They investigate technical production systems with regard to functional and construction units, align such units to the sub-functions of support, bearing and transmission and calculate necessary indicators.
They differentiate maintenance, inspection and servicing as different areas of the field of maintenance. Pupils stipulate the maintenance measures located within their area of responsibility, carry out such measures whilst taking health and safety at work and environmental protection regulations into account and document the measures.
In the case of disruption, they systematically isolate causes of error, wear and tear and downtime, analyse these causes and are either able to rectify the malfunctions themselves or else arrange for rectification.
Pupils dispose of used auxiliary materials and defective parts in an environmentally appropriate way.

Contents

Machine tool as a production factor
Useful life, useful life contingency
Causes of wear and tear, types of wear and tear
Contact pressures, friction, reaction forces
Basic rules of maintenance
Servicing strategies
Technical documentation
Operational safety
Trouble shooting methods, types of error
Locations of malfunctions, causes of malfunctions
Inspections and maintenance regulations
Disposal regulations
Lubricants, specifications
Product liability
Standards, guidelines

Learning field 7: Commission control systems	**2nd year of training** **Suggested time allocation: 60 hours**

Formulation of objectives

Pupils analyse control systems and commission such systems whilst taking account of regulations regarding health and safety at work.
They monitor the functional control process on the basis of technical documentation and take account of material, information and energy flow in developing strategies for error identification and for the optimisation of the control system. Pupils identify and evaluate the respective pressure and force ratios and compare the cost-effectiveness and functionality of various equipment technologies. They discus and evaluate alternative solutions.
The pupils draw up and complete technical documentation and present their results. They also use suitable application programmes for this purpose.
Pupils use various information media for their work, including in English.

Contents

Technology diagram
Reference list
Step diagram
Circuit diagram and circuit layout
Logic plan, function table
Pneumatic, hydraulic, electrical control
Open and closed loop control systems
Control current circuit, operating current circuit
Basic logical circuits
Signal storage
Logical controllers and process controllers
Sensors, actuators
Standards

Learning field 8:	**Programme and operate numerically controlled machine tools**	**2nd year of training** **Suggested time allocation: 80 hours**

Formulation of objectives

Pupils manufacture components on numerically controlled machine tools. They analyse and prepare detail drawings that are suitable for production purposes and these to obtain the necessary information for CNC production.

They identify the technological and geometric data for processing and draw up work and tool plans. They develop computer-aided CNC programmes on the basis of these plans, use simulation to monitor and optimise the production process and carry out data back-up. They use programming instructions and manufacturer documentation for this purpose. Pupils plan the clamping of the workpiece and tools. They check safety equipment and ensure its functionality. They set up the machine tool and take account of regulations regarding health and safety at work and environmental protection in testing the CNC programmes.

Pupils select suitable test equipment on the basis of the test plans drawn up. They interpret and document the test results identified. Pupils differentiate in this regard between technological and programming influences of the production process on dimensional accuracy and surface quality. They discuss and reflect upon the processing of the order.

Pupils compare the cost-effectiveness and product quality of CNC production with conventional manufacture.

Contents

Work order
CNC lathe turning, CNC milling
Contour point calculation
Programme sequence plan
Structure and characteristics of machine systems
Coordinate systems and reference points
Types of control
Programme structure
Path conditions, additional functions
Cutting radius compensation, route correction
Cycles, sub-programme technology
Production parameters
Production documentation
Standards
Documentation and presentation technology

Learning field 9:	**Use precision machining techniques to produce components**	**2nd year of training** **Suggested time allocation: 80 hours**

Formulation of objectives

Pupils use precision machining techniques to manufacture components whilst according due consideration to accident prevention regulations. For this purpose, they analyse detail and overall drawings and derive the particular requirements of special functional areas with regard to mechanical and optical properties and precision of dimensions and form.
Pupils define product-related test characteristics, draw up a test plan and assign suitable test equipment.
They determine the production parameters for the manufacturing procedure selected whilst taking account of material and tool properties and of the auxiliary material used. Pupils evaluate the technological, qualitative and economic effects of the manufacturing procedure selected on the basis of procedural and tool-dependent functionality principles.
They take account of test regulations as amended in conducting testing and complete test protocols. Pupils conduct a target-performance comparison with the characteristic limit values defined in the test plan and evaluate process capability. They interpret possible causes of deviations and optimise the production parameters. They present the work results.

Contents

Machining via geometrically undefined cutting
Grind, hone, lap
Cool lubrication, dry grinding
Tool specifications
Removal rate
Surface quality
Roughness measurement
ISO tolerances
Form and positional tolerances
Main period of use
Business indicators
Health and safety at work and environmental protection

Learning field 10: Optimise the production process **3rd year of training**
Suggested time allocation: 100 hours

Formulation of objectives

Pupils design, evaluate and optimise the production process including whilst taking business indicators into account.
Pupils obtain information on alternative production processes from economic and ecological points of view. They plan manufacturing strategies for a production task and take the tool, the composition of the tool and the delivery condition of the tool into account in stipulating the production parameters. They use various information media for this purpose.
Pupils use quantitative indicators to evaluate wear and tear of the tool. Pupils monitor and analyse the effects of the wear and tear of the tool on the quality and cost-effectiveness of the milling process. The determine the correlation between place, location and cause of wear and tear. They optimise tool use and develop strategies for reducing wear and tear. Pupils analyse various forms of machine construction and drive concepts, calculate production-related performance data and evaluate possible uses and cost-effectiveness of the machines. They investigate the influences of machine and production parameters on quality and cost-effectiveness of the manufacturing process, determine and protocol measurements, evaluate measurement series and interpret and present the results.

Contents

Technical production development trends
Hardening and annealing procedures
Indicators of wear and tear
Tool monitoring systems
Cutting materials, coatings
Use of cooling lubricants
Machine concepts
Performance of control systems
Machine output
Main period of use, tooling and ancillary time
Calculation
Machine and process capability investigation

Learning field 11: Plan and organise computer-aided production **3rd year of training**
Suggested time allocation: 100 hours

Formulation of objectives

Pupils prepare a computer-aided production process in an order-related way and organise and monitor the production sequence whilst according due consideration to the requirements of computer-aided production.
Pupils create CNC programmes for the production of workpieces with complex geometries and also use graphical programme systems and CAD/CAM systems.
They simulate, alter, optimise, save and transmit the programmes created and test the programme sequence.
They identify tool correction data when carry out the preliminary tool settings. Pupils plan the stocking of the tool shop for the machine and prepare deployment of the tool. They use the advantages of a tool management system and of digital tool databases.
Pupils integrate programmable handling and production systems into the manufacturing process. They use programming instructions and manufacturer documentation for this purpose.
Pupils evaluate the work result in respect of qualitative stipulations and secure process capability.
They document and present solutions in order-related documentation. Pupils develop and discuss alternative proposals within the team and evaluate these proposals.

Contents

Programme structure
Parameter programming
Graphical contour description
Tool database
Tool coding
Flexible production systems
Material, energy and information flow
Feeding and handling systems
Handling functions
Industrial robots
Pallet systems
Safety requirements of production facilities

Learning field 12:	**Prepare and execute an individual production order**	**4rd year of training** **Suggested time allocation: 60 hours**

Formulation of objectives

Pupils autonomously plan the execution of an individual production order. For this purpose, they analyse the order documentation and take account of the geometric and qualitative stipulations of the component to be manufactured in determining the production strategy.
They calculate or monitor and optimise the production parameters. In selecting suitable clamping systems, pupils take account of the workpiece geometry and of the forces which occur and evaluate systems in accordance with functionality, possible uses and ease of handling. They use various information media for this purpose. Pupils select tools and clamping devices and make the necessary test equipment available. They accord due consideration to production, ecological and health aspects in designing an effective cooling lubricant. They draw up and present the production documentation and discuss possible alternative solutions from economic and qualitative perspectives. Pupils select fittings and lifting equipment for the realisation of material flow and evaluate the operational safety of such fittings and equipment. Pupils set up the machine and accord due consideration to risks of collision on the shop floor. They take account of regulations regarding health and safety at work in carrying out production of the workpiece and check the qualitative characteristics of the finished component. Pupils document the production and test data in suitable protocols and conduct a customer-oriented handover of the finished part and of the production documentation.
They carry out the servicing measures within their area of responsibility in accordance with company stipulations.

Contents

Order analysis
Workplace organisation
CAD/CAM technology
Production documentation
Workpiece clamping systems
Clamping and milling forces
Internal and external feeding of cooling lubricant
Multi-axle processing
Reference points
Material flow, lifting equipment
Company organisational structures
Product liability
Customer-supplier relationship
Safety regulations
Production costs
Measuring machines

Learning field 13:	**Organise and monitor production processes in series manufacture**	**4rd year of training** **Suggested time allocation: 80 hours**

Formulation of objectives

Pupils organise the series manufacture of components as part of overall company production in the area of deployment. They check the order-related production documentation for completeness and correctness and analyse said documentation. Pupils also obtain information on test regulations and standards relating to quality assurance as amended, on qualitative requirements, on the characteristics of the product to be tested and on the test equipment to be used. Pupils set up production subsystems and the necessary production equipment and document the production parameters. They check and optimise the control programmes for the respective subsystems and protocol changes executed.
Pupils ensure a smooth production process. They check product quality and monitor the production process.
Pupils draw up test protocols, including with the assistance of application programmes.
They interpret the test results and react by developing systematic solution strategies in the event of any malfunctions. They act autonomously to rectify the malfunctions or arrange for rectification. Pupils examine the product to check and evaluate the process management measures deployed, including from business points of view. Pupils document the operating, production and test data, forward this data for central evaluation and prepare the handover of the production order to the next downstream production area.
Pupils accord due consideration to the provisions regarding health and safety at work and environmental protection within their area of responsibility in carrying out servicing measures in accordance with company stipulations.

Contents

Company organisational structures
Company order system
Commissioning
DNC operation
Test systems
Audit, company test regulations, test instructions
Quality control chart
Quality control loop
Quality management
Process capability, machine capability
Recording of operational data
Documentation
Product liability
Servicing