



Bundesinstitut für Berufsbildung (BIBB)

**Ordinance on vocational education and training in
Technical product designer¹⁾**

promulgated on 21 June 2011

**Skeleton Curricula for the training occupation
in
Technical product designer**

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

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

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Stand: 01.2015

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 occupations of technical product designer and technical system planner

of 21 June 2011

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), Paragraph 1 having been amended by Article 232, Section 1 Clause a) 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.

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Part 1 Joint provisions

§ 1

State recognition of the training occupations

The training occupations of

1. Technical product designer
2. Technical system planner

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

§ 2

Duration of vocational education and training

Duration of training in both occupations is three and a half years.

§ 3

Structure of vocational education and training

(1) The training courses are structured in the following manner.

1. Joint qualifications for both training occupations over twelve months
2. Specific qualifications for each training occupation
3. In the training occupation of technical product designer the specialisms of
 - a) Product design and construction
 - b) Machinery and plant construction
4. In the training occupation of technical system planner the specialisms of
 - a) Supply and equipment technology
 - b) Steel and metal engineering technology
 - c) Electro technical systems

(2) The joint qualifications and the respective specific training and specialisms are imparted across the whole of the training period.

Part 2 Provisions for the training occupation of technical product designer

§ 4

Training profile, general training plan

(1) The skills, knowledge and competences (employability skills) listed in the general training plan (Annex 1, Content structure) constitute the minimum object of the vocational education and training. Organisation of training which deviates from that contained within the general training plan (Annex 2, Time structure) is permitted in particular insofar as specific practical company characteristics necessitate such a deviation.

(2) Vocational education and training in the occupation of technical product designer is structured in the following manner (training profile).

Section A

Joint skills, knowledge and competences making up the occupational profile pursuant to § 3 Paragraph 1 No. 1

1. Draw up and apply technical documents
2. Carry out computer-aided construction
3. Differentiate materials
4. Differentiate production procedures and assembly techniques
5. Carry out calculations

Section B

Further skills, knowledge and competences making up the occupational profile pursuant to § 3 Paragraph 1 No. 2

1. Assess materials and auxiliary materials
2. Product development:
 - 2.1. Product development process
 - 2.2. Plan and design components and sub-assemblies
 - 2.3. Design, draw up and calculate components and sub-assemblies
3. Select production and joining procedures and assembly techniques
4. Conduct simulations

Section C

Skills, knowledge and competences making up the occupational profile in the specialism of product design and construction pursuant to § 3 Paragraph 1 No. 3 a

1. Design and develop objects
2. Construct freeform surfaces
3. Construct objects
4. Simulation and presentation

Section D

Skills, knowledge and competences making up the occupational profile in the specialism of machinery and plant construction pursuant to § 3 Paragraph 1 No. 3 b

1. Alter and check material properties
2. Create constructions
3. Production engineering
4. Joining and assembly engineering
5. Control and electrical engineering

Section E

Joint integrative skills, knowledge and competences making up the occupational profile pursuant to § 3 Paragraph 1 No. 1

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. Use information and communication technology systems
6. Work planning and organisation
7. Carry out quality assurance measures
8. Customer orientation

§ 5

Implementation of vocational education and training

(1) The skills, knowledge and competences stated in the present Ordinance 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. Evidence of this competence is also to be provided in the examinations pursuant to §§ 6 to 8 and 10 to 12 below.

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

(3) 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 in the specialism of product design and construction

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 essential to the vocational education and training to be imparted via teaching at vocational school. The training regulations shall constitute the basis of the examination. Skills, knowledge and competences 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.

(2) In determining the overall result, a weighting of 30 percent shall be accorded to Part 1 of the final examination and a weighting of 70 percent to Part 2 of the examination.

§ 7

Part 1 of the final examination in the specialism of product design and construction

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

(2) Part 1 of the final examination encompasses such skills, knowledge and competences 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) Part 1 of the final examination takes place in the area of technical documentation.

(4) The following stipulations are in place in respect of the examination area of technical documents.

1. Candidates should demonstrate the ability to perform the following tasks.
 - a) Plan and document stages of work and align these to the product development process
 - b) Prepare freehand sketches
 - c) Create and alter structured 3D datasets in accordance with geometric, production and technical material characteristics
 - d) Carry out calculations
 - e) Draw up technical documents whilst in particular deriving drawings presented in views and sections and evaluating and entering measurements, tolerances, matching and surface characteristics
2. In addition, candidates should create an examination product and solve tasks relating to such an examination product in writing.
3. Total examination time is seven hours. This comprises five and a half hours for the creation of the examination product and 90 minutes for the written assignments.

§ 8

Part 2 of the final examination in the specialism of product design and construction

Part 2 of the final examination encompasses such skills, knowledge and competences as are listed in Annexes 1 and 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. Product development
3. Business and social studies

The following stipulations apply to the examination area of the work order.

1. Candidates should demonstrate the ability to perform the following tasks.
 - a) Analyse work orders, procure information, clarify technical and organisational interfaces
 - b) Apply company project management methods
 - c) Develop and sketch out possible solutions and evaluate and select such solutions whilst taking design, technical, business and ecological perspectives into consideration

- d) Apply methodological construction methods, in particular taking account of requirements relating to function, production, conditions of use, production, and testing, and in addition create a 3D dataset and technical documents
- e) Carry out calculations, simulations and animations
- f) Create documentation and presentations

2. Examination option 1

- a) Candidates should execute a company order including provision of practical documentation, present the work order, the execution of the order and work results and take part in a specialist oral examination with regard to the order. The specialist oral examination will relate to the 3D dataset, the documentation and the practically related written records. Prior to the conducting of the company-based order, the order must be submitted to the Examination Board for approval and information given regarding the planned time for completion.
- b) The total examination time for the completion of the company work order including documentation is 70 hours. The maximum time for the presentation is ten minutes, and the maximum period allowed for the order-related specialist oral examination is 20 minutes.

3. Examination option 2

- a) Candidates should create an examination product that corresponds to a company order. They should produce practically related accompanying documentation, present the work order, the implementation of the work order and the results of their work and take part in an order-related specialist oral examination. The specialist oral examination will relate to the 3D dataset, the documentation and the practically related written records.
- b) The total examination time for the creation of the examination product including documentation is 70 hours. The maximum time for the presentation is ten minutes, and the maximum period allowed for the order-related specialist oral examination is 20 minutes.

4. The company providing training should select the examination option in accordance with No. 2 or 3 above and should notify the candidate and the competent body of the selection at the same time as registration for the examination takes place.

(4) The following stipulations apply to the examination area of product development.

- 1. Candidates should demonstrate the ability to perform the following tasks.
 - a) Use information and communication systems
 - b) Explain information in technical documents
 - c) Analyse and describe functions, including in

English

- d) Evaluate production and joining procedures and assembly techniques
 - e) Evaluate materials requirements and properties
 - f) Carry out technical calculations
 - g) Describe design possibilities
 - h) Carry out quality assurance measures
 - i) Apply project management methods in the product development process
 - j) Communicate with customers, including in English
2. Candidates should complete written, practically related tasks.
3. The examination time is 150 minutes.

(5) The following stipulations are in place in respect of the examination area of business and social studies.

- 1. Candidates should demonstrate that they are in a position to present and evaluate general business and societal correlations within the world of employment and work.
- 2. Candidates should complete written, practically related tasks.
- 3. The examination time is 60 minutes.

§ 9

Weighting and pass regulations in the specialism of product design and construction

(1) The examination areas should be weighted as follows.

- | | |
|---|------------|
| 1. Examination area technical documents | 30 percent |
| 2. Examination area work order | 35 percent |
| 3. Examination area product development | 25 percent |
| 4. Examination area business and social studies | 10 percent |

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

- 1. an overall result of at least "pass" is achieved in Part 1 and Part 2 of the final examination;
- 2. an overall result of at least "pass" is achieved in the examination area work order;
- 3. a result of at least "pass" is achieved in Part 2 of the final examination;
- 4. a result of at least "pass" is achieved in at least one of the other examination areas of Part 2 of the final examination and
- 5. no mark of "fail" is recorded in any examination area of Part 2 of the final examination.

(3) At the request of the candidate, an examination in

an examination area of Part 2 for which a mark of worse than “pass” has been awarded should be supplemented by an oral examination of approximately 15 minutes if this may be decisive for the passing of the examination. In calculating the result for this examination area, the previous result and the result of the supplementary oral examination should be accorded weighting in the ratio of 2:1.

§ 10

Final examination in the specialism of machinery and plant construction

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 essential to the vocational education and training to be imparted via teaching at vocational school. The training regulations shall constitute the basis of the examination. Skills, knowledge and competences 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.

(2) In determining the overall result, a weighting of 30 percent shall be accorded to Part 1 of the final examination and a weighting of 70 percent to Part 2 of the examination.

§ 11

Part 1 of the final examination in the specialism of machinery and plant construction

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

(2) Part 1 of the final examination encompasses such skills, knowledge and competences for the first three half years of training as are listed in the Annex 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) Part 1 of the final examination takes place in the area of technical documentation.

(4) The following stipulations are in place in respect of the examination area of technical documents.

1. Candidates should demonstrate the ability to perform the following tasks.
 - a) Plan and document stages of work and align these to the product development process
 - b) Prepare freehand sketches
 - c) Create and alter structured 3D datasets in

accordance with geometric, production and technical material characteristics

- d) Carry out calculations
 - e) Draw up technical documents whilst in particular deriving drawings presented in views and sections and entering measurements, tolerances, matching and surface characteristics
2. In addition, candidates should create an examination product and solve tasks relating to such an examination product in writing.
 3. Total examination time is seven hours. This comprises five and a half hours for the creation of the examination product and 90 minutes for the written assignments.

§ 12

Part 2 of the final examination in the specialism of machinery and plant construction

Part 2 of the final examination encompasses such skills, knowledge and competences as are listed in Annexes 1 and 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. Development and construction
3. Business and social studies

The following stipulations apply to the examination area of the work order.

1. Candidates should demonstrate the ability to perform the following tasks.
 - a) Analyse work orders, procure information, clarify technical and organisational interfaces
 - b) Evaluate and select possible solutions whilst taking technical, business and ecological perspectives into consideration
 - c) Apply company project management methods
 - d) Take account of functional, conditions of use and monitoring requirements with regard to constructions
 - e) Construct in a methodological manner, carry out calculations and derive necessary technical documents
 - f) Create documentation and presentations
2. Examination option 1
 - a) Candidates should execute a company order including provision of practical documentation, present the work order, the execution of the order and work results and take part in a specialist oral examination with regard to the order. The specialist oral examination will relate to the 3D dataset, the documentation and the practically related written records. Prior to the conducting of

the company-based order, the order must be submitted to the Examination Board for approval and information given regarding the planned time for completion.

- b) The total examination time for the completion of the company work order including documentation is 70 hours. The maximum time for the presentation is ten minutes, and the maximum period allowed for the order-related specialist oral examination is 20 minutes.
3. Examination option 2
 - a) Candidates should create an examination product that corresponds to a company order. They should produce practically related accompanying documentation, present the work order, the implementation of the work order and the results of their work and take part in an order-related specialist oral examination. The specialist oral examination will relate to the 3D dataset and the practically related documentation.
 - b) The total examination time for the creation of the examination product including documentation is 70 hours. The maximum time for the presentation is ten minutes, and the maximum period allowed for the order-related specialist oral examination is 20 minutes.
 4. The company providing training should select the examination option in accordance with No. 2 or 3 above and should notify the candidate and the competent body of the selection at the same time as registration for the examination takes place.

(4) The following stipulations are in place in respect of the examination area of development and construction.

1. Candidates should demonstrate the ability to perform the following tasks.
 - a) Use information and communication systems
 - b) Explain information in technical documents
 - c) Analyse and describe functions, including in English
 - d) Evaluate production and joining procedures and assembly techniques
 - e) Evaluate materials requirements and properties
 - f) Apply and evaluate tolerances, matching and surface information
 - g) Accord due consideration to functional correlations in control engineering and electro technology
 - i) Use machine and connection elements
 - i) Carry out technical calculations
 - j) Carry out quality assurance measures
 - k) Communicate with customers, including in English
2. Candidates should complete written, practically related tasks.
3. The examination time is 150 minutes.

(5) The following stipulations are in place in respect of the examination area of business and social studies.

1. Candidates should demonstrate that they are in a position to present and evaluate general business and societal correlations within the world of employment and work.
2. Candidates should complete written, practically related tasks.
3. The examination time is 60 minutes.

§ 13

Weighting and pass regulations in the specialism of machinery and plant construction

(1) The examination areas should be weighted as follows.

1. Examination area technical documents 30 percent
2. Examination area work order 35 percent
3. Examination area development and construction 25 percent
4. Examination area business and social studies 10 percent

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

1. an overall result of at least "pass" is achieved in Part 1 and Part 2 of the final examination;
2. an overall result of at least "pass" is achieved in the examination area work order;
3. a result of at least "pass" is achieved in Part 2 of the final examination;
4. a result of at least "pass" is achieved in at least one of the other examination areas of Part 2 of the final examination and
5. no mark of "fail" is recorded in any examination area of Part 2 of the final examination.

(3) At the request of the candidate, an examination in an examination area of Part 2 for which a mark of worse than "pass" has been awarded should be supplemented by an oral examination of approximately 15 minutes if this may be decisive for the passing of the examination. In calculating the result for this examination area, the previous result and the result of the supplementary oral examination should be accorded weighting in the ratio of 2:1.

Part 3
Provisions for the training occupation
of technical system planner

§ 14

Training profile, general training plan

(1) The skills, knowledge and competences (employability skills) listed in the general training plan (Annex 3, Content structure) constitute the minimum object of the vocational education and training. Organisation of training which deviates from that contained within the general training plan (Annex 4, Time structure) is permitted in particular insofar as specific practical company characteristics necessitate such a deviation.

(2) Vocational education and training in the occupation of technical system planner is structured in the following manner (training profile).

Section A

Joint skills, knowledge and competences making up the occupational profile pursuant to § 3 Paragraph 1 No. 1

1. Draw up and apply technical documents
2. Carry out computer-aided construction
3. Differentiate materials
4. Differentiate production procedures and assembly techniques
5. Carry out calculations

Section B

Further skills, knowledge and competences making up the occupational profile pursuant to § 3 Paragraph 1 No. 2

1. Evaluate materials and corrosion protection procedures
2. Evaluate assembly and joining procedures
3. Draw up technical documents
4. Prepare sketches

Section C

Skills, knowledge and competences making up the occupational profile in the specialism of supply and equipment technology pursuant to § 3 Paragraph 1 No. 4 a

1. Draw up technical documents for supply and equipment technology
2. Carry out detailed constructions
3. Prepare schematic and perspective representations
4. Prepare technical documentation for supply and equipment technology
5. Carry out technical calculations
6. Evaluate system components

Section D

Skills, knowledge and competences making up the occupational profile in the specialism of steel and metal

engineering technology pursuant to § 3 Paragraph 1 No. 4 b

1. Prepare technical documentation relating to steel and metal engineering technology
2. Design and construct
3. Take account of construction physics requirements
4. Carry out calculations
5. Select production, assembly and joining procedures

Section E

Skills, knowledge and competences making up the occupational profile in the specialism of electro technical systems pursuant to § 3 Paragraph 1 No. 4 a

1. Prepare technical documents for electro technical systems
2. Carry out calculations
3. Evaluate and use system components
4. Execute detailed plans
5. Prepare schematic and perspective representations
6. Prepare technical documentation

Section F

Joint integrative skills, knowledge and competences making up the occupational profile pursuant to § 3 Paragraph 1 No. 1

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. Use information and communication technology systems
6. Work planning and organisation
7. Carry out quality assurance measures
8. Customer orientation

§ 15

Implementation of vocational education and training

(1) The skills, knowledge and competences stated in the present Ordinance 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. Evidence of this competence is also to be provided in the examinations pursuant to §§ 16 to 18 and 20 to 22 below.

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

(3) 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.

§ 16

Final examination in the specialism of supply and equipment technology

(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 essential to the vocational education and training to be imparted via teaching at vocational school. The training regulations shall constitute the basis of the examination. Skills, knowledge and competences 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.

(2) In determining the overall result, a weighting of 30 percent shall be accorded to Part 1 of the final examination and a weighting of 70 percent to Part 2 of the examination.

§ 17

Part 1 of the final examination in the specialism of supply and equipment technology

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

(2) Part 1 of the final examination encompasses such skills, knowledge and competences 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) Part 1 of the final examination takes place in the area of creation of technical documentation.

(4) The following stipulations are in place in respect of the examination area of creation of technical documents.

1. Candidates should demonstrate the ability to perform the following tasks.
 - a) Present views of basic structures
 - b) Present views and sections of construction components
 - c) Prepare sketches
 - d) Dimension and supplement technical drawings in accordance with standards
 - e) Differentiate materials and production and joining techniques
 - f) Select and present construction component details with the help of information regarding lists of parts and technical documentation

2. For this purpose, candidates should create an examination product in the form of a technical drawing and complete related written tasks.
3. Total examination time is seven hours. This comprises five hours for the creation of the examination product and 120 minutes for the written assignments.

§ 18

Part 2 of the final examination in the specialism of supply and equipment technology

Part 2 of the final examination encompasses such skills, knowledge and competences as are listed in Annexes 1 and 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) Part 2 of the final examination comprises the following examination areas.

1. A work order
2. System planning
3. Business and social studies

The following stipulations apply to the examination area of the work order.

1. Candidates should demonstrate the ability to perform the following tasks.
 - a) Analyse work orders, procure information, clarify technical and organisational interfaces
 - b) Prepare technical drawings with plant layout according due consideration to standards and stipulations
 - c) Prepare functional correlations and data sheets
 - d) Carry out specialist calculations, in particular relating to heat and fluid engineering
 - e) Identify parameters of plant components taking noise and fire protection into account, accord due consideration to legal stipulations
 - f) Draw up production documentation and material compositions and select fixing systems
2. One of the following areas should be selected for this purpose.
 - a) Heating engineering
 - b) Air conditioning systems
 - c) Sanitary systems
3. Examination option 1
 - a) Candidates should execute a company order including provision of practical documentation, present the work order, the execution of the order and work results and take part in a specialist oral examination with regard to the order. The specialist oral examination will relate to the 3D dataset, the documentation and the practically related written records. Prior to the

conducting of the company-based order, the order must be submitted to the Examination Board for approval and information given regarding the planned time for completion.

- b) The total examination time for the completion of the company work order including documentation is 40 hours. The maximum time for the presentation is ten minutes, and the maximum period allowed for the order-related specialist oral examination is 20 minutes.

4. Examination option 2

- a) Candidates should create an examination product that corresponds to a company order. They should produce practically related accompanying documentation, present the work order, the implementation of the work order and the results of their work and take part in an order-related specialist oral examination. The specialist oral examination will relate to the dataset and the practically related documentation.

- b) The total examination time for the creation of the examination product including documentation is 40 hours. The maximum time for the presentation is ten minutes, and the maximum period allowed for the order-related specialist oral examination is 20 minutes.

5. The company providing training should select the examination option in accordance with No. 3 or 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.

(4) The following stipulations apply to the examination area of system planning.

1. Candidates should demonstrate the ability to perform the following tasks.

- a) Draw up sketches, plant layouts or lists of selected materials
- b) Prepare spreadsheets and data sheets according due consideration to standards and guidelines
- c) Determine plant components in accordance with product documentation, in particular design diagrams
- d) Carry out heat engineering and fluid engineering calculations
- e) Calculate degrees of effectiveness
- f) Determine properties of fluid and gaseous media
- g) Prepare sketches or functional diagrams

2. Candidates should complete written, practically related tasks.

3. The total examination time is 180 minutes.

(5) The following stipulations are in place in respect of the examination area of business and social studies.

1. Candidates should demonstrate that they are in a position to present and evaluate general business and societal correlations within the world of employment and work.
2. Candidates should complete written, practically related tasks.
3. The examination time is 60 minutes.

§ 19

Weighting and pass regulations in the specialism of supply and equipment technology

(1) The examination areas should be weighted as follows.

1. Examination area
creation of technical documents 30 percent
2. Examination area work order 35 percent
3. Examination area system planning 25 percent
4. Examination area business and social studies 10 percent

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

1. an overall result of at least "pass" is achieved in Part 1 and Part 2 of the final examination;
2. an overall result of at least "pass" is achieved in the examination area work order;
3. a result of at least "pass" is achieved in Part 2 of the final examination;
4. a result of at least "pass" is achieved in at least one of the other examination areas of Part 2 of the final examination and
5. no mark of "fail" is recorded in any examination area of Part 2 of the final examination.

(3) At the request of the candidate, an examination in an examination area of Part 2 for which a mark of worse than "pass" has been awarded should be supplemented by an oral examination of approximately 15 minutes if this may be decisive for the passing of the examination. In calculating the result for this examination area, the previous result and the result of the supplementary oral examination should be accorded weighting in the ratio of 2:1.

§ 20

Final examination in the specialism of steel and metal engineering technology

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 essential to the vocational education and training to be imparted via

teaching at vocational school. The training regulations shall constitute the basis of the examination. Skills, knowledge and competences 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.

(2) In determining the overall result, a weighting of 25 percent shall be accorded to Part 1 of the final examination and a weighting of 75 percent to Part 2 of the examination.

§ 21

Part 1 of the final examination in the specialism of steel and metal engineering technology

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

(2) Part 1 of the final examination encompasses such skills, knowledge and competences 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) Part 1 of the final examination comprises the examination area of creation of technical documents.

(4) The following stipulations are in place in respect of the examination area of creation of technical documents.

1. Candidates should demonstrate the ability to perform the following tasks.
 - a) Present views of basic structures
 - b) Present views and sections of construction components
 - c) Present sub-assemblies comprising steel profiles perspectively
 - d) Prepare sketches
 - e) Dimension and supplement technical drawings of construction components in accordance with standards
 - f) Differentiate materials and production and joining techniques
 - g) Select and present construction component details with the help of information regarding lists of parts and technical documentation
2. For this purpose, candidates should create an examination product in the form of a technical drawing and complete related written tasks.
3. Total examination time is seven hours. This comprises five hours for the creation of the examination product and 120 minutes for the written assignments.

§ 22

Part 2 of the final examination in the specialism of steel and metal engineering technology

Part 2 of the final examination encompasses such skills, knowledge and competences as are listed in Annexes 3 and 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) Part 2 of the final examination comprises the following examination areas.

1. Construction order
2. Building construction
3. Business and social studies

(3) The following stipulations apply to the examination area of the construction order.

1. Candidates should demonstrate the ability to perform the following tasks.
 - a) Produce technical drawings for the workshop and construction site with the necessary views, sections and details and dimension such technical drawings in line with workshop and assembly requirements
 - b) Draw up list of parts
2. One of the following areas should be selected for this purpose.
 - a) Steel engineering
 - b) Metal engineering technology
3. Candidates should create an examination product in the form of a technical drawing and take part in an order-related specialist oral examination.
4. The examination time for the examination product is seven hours. The period allowed for the specialist oral examination is 15 minutes.

(4) The following stipulations apply to the examination area of building construction.

1. Candidates should demonstrate the ability to perform the following tasks.
 - a) Use the results of static and construction physics calculations to inform the development of the drawing
 - b) Determine system measurements
 - c) Evaluate and select soluble and non-soluble connections
 - d) Produce developed views
2. Candidates should process practically oriented tasks in written form.
3. The total examination time is 180 minutes.

(5) The following stipulations are in place in respect of the examination area of business and social studies.

1. Candidates should demonstrate that they are in a position to present and evaluate general business

and societal correlations within the world of employment and work.

2. Candidates should complete written, practically related tasks.
3. The examination time is 60 minutes.

§ 23

Weighting and pass regulations in the specialism of steel and metal engineering technology

(1) The examination areas should be weighted as follows.

- | | |
|---|------------|
| 1. Examination area | |
| creation of technical documents | 25 percent |
| 2. Examination area construction order | 40 percent |
| 3. Examination area building construction | 25 percent |
| 4. Examination area business and social studies | 10 percent |

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

1. an overall result of at least "pass" is achieved in Part 1 and Part 2 of the final examination;
2. an overall result of at least "pass" is achieved in the examination area construction order;
3. a result of at least "pass" is achieved in Part 2 of the final examination;
4. a result of at least "pass" is achieved in at least one of the other examination areas of Part 2 of the final examination and
5. no mark of "fail" is recorded in any examination area of Part 2 of the final examination.

(3) At the request of the candidate, an examination in an examination area of Part 2 for which a mark of worse than "pass" has been awarded should be supplemented by an oral examination of approximately 15 minutes if this may be decisive for the passing of the examination. In calculating the result for this examination area, the previous result and the result of the supplementary oral examination should be accorded weighting in the ratio of 2:1.

§ 24

Final examination in the specialism of electro technical systems

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 essential to the vocational education and training to be imparted via teaching at vocational school. The training regulations shall constitute the basis of the examination. Skills, knowledge and competences 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.

(2) In determining the overall result, a weighting of 30 percent shall be accorded to Part 1 of the final examination and a weighting of 70 percent to Part 2 of the examination.

§ 25

Part 1 of the final examination in the specialism of electro technical systems

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

(2) Part 1 of the final examination encompasses such skills, knowledge and competences 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) Part 1 of the final examination comprises the examination area of creation of technical documents.

(4) The following stipulations are in place in respect of the examination area of creation of technical documents.

1. Candidates should demonstrate the ability to perform the following tasks.
 - a) Present views of basic structures
 - b) Present views and sections of construction components
 - c) Prepare sketches
 - d) Dimension and supplement technical drawings in accordance with standards
 - e) Differentiate materials and production and joining techniques
 - f) Select and present construction component details with the help of information regarding lists of parts and technical documentation
 - g) Design and alter technical documentation relating to installation technology
2. For this purpose, candidates should create an examination product in the form of a technical drawing and complete related written tasks.
3. Total examination time is seven hours. This comprises five hours for the creation of the examination product and 120 minutes for the written assignments.

§ 26

Part 2 of the final examination in the specialism of electro technical systems

Part 2 of the final examination encompasses such skills, knowledge and competences as are listed in Annexes 3 and 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) Part 2 of the final examination comprises the following examination areas.

1. A work order
2. System planning
3. Business and social studies

The following stipulations apply to the examination area of the work order.

1. Candidates should demonstrate the ability to perform the following tasks.
 - a) Analyse work orders, procure information, clarify technical and organisational interfaces
 - b) Prepare technical drawings with wiring and circuit diagrams according due consideration to standards and stipulations
 - c) Prepare functional correlations and data sheets
 - d) Carry out calculations, in particular cross-sectional and performance calculations
 - e) Identify parameters of plant components taking safety, noise and fire protection aspects into account, accord due consideration to legal stipulations
 - f) Draw up layout sketches and lists of selected materials
 - g) Draw up documentation

2. Examination option 1

- a) Candidates should execute a company order including provision of practical documentation, present the work order, the execution of the order and work results and take part in a specialist oral examination with regard to the order. The specialist oral examination will relate to the dataset, the documentation and the practically related written records. Prior to the conducting of the company-based order, the order must be submitted to the Examination Board for approval and information given regarding the planned time for completion.
- b) The total examination time for the completion of the company work order including documentation is 40 hours. The maximum time for the presentation is ten minutes, and the maximum period allowed for the order-related specialist oral examination is 20 minutes.

3. Examination option 2

- a) Candidates should create an examination product that corresponds to a company order. They should produce practically related accompanying documentation, present the work order, the implementation of the work order and the results of their work and take part in an

order-related specialist oral examination. The specialist oral examination will relate to the dataset and the practically related documentation.

- b) The total examination time for the creation of the examination product including documentation is 40 hours. The maximum time for the presentation is ten minutes, and the maximum period allowed for the order-related specialist oral examination is 20 minutes.

4. The company providing training should select the examination option in accordance with No. 2 or 3 above and should notify the candidate and the competent body of the selection at the same time as registration for the examination takes place.

(4) The following stipulations apply to the examination area of system planning.

1. Candidates should demonstrate the ability to perform the following tasks.
 - a) Calculate lighting levels
 - b) Carry out cross-sectional and performance calculations
 - c) Draw circuit diagrams and installation plans
 - d) Create wiring plans
 - e) Draw up sketches, functional layouts or lists of selected materials

2. Candidates should process practically oriented tasks in written form.

3. The total examination time is 180 minutes.

(5) The following stipulations are in place in respect of the examination area of business and social studies.

1. Candidates should demonstrate that they are in a position to present and evaluate general business and societal correlations within the world of employment and work.
2. Candidates should complete written, practically related tasks.
3. The examination time is 60 minutes.

§ 27

Weighting and pass regulations in the specialism of electro technical systems

(1) The examination areas should be weighted as follows.

- | | |
|---|------------|
| 1. Examination area creation of technical documents | 30 percent |
| 2. Examination area work order | 35 percent |
| 3. Examination area system planning | 25 percent |
| 4. Examination area business and social studies | 10 percent |

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

1. an overall result of at least "pass" is achieved in Part 1 and Part 2 of the final examination;
2. an overall result of at least "pass" is achieved in the examination area work order;
3. a result of at least "pass" is achieved in Part 2 of the final examination;
4. a result of at least "pass" is achieved in at least one of the other examination areas of Part 2 of the final examination and
5. no mark of "fail" is recorded in any examination area of Part 2 of the final examination.

(3) At the request of the candidate, an examination in an examination area of Part 2 for which a mark of worse than "pass" has been awarded should be supplemented by an oral examination of approximately 15 minutes if this may be decisive for the passing of the examination. In calculating the result for this examination area, the previous result and the result of the supplementary oral examination should be accorded weighting in the ratio of 2:1.

**Part 4
Final provisions**

§ 28

Existing vocational education and training contracts

Vocational education and training contracts in the training occupations of engineering

draughtsman/engineering draughtswoman and technical product designer which are already in existence at the time when the present Ordinance enters into force may be continued and credit may be awarded for the training period previously completed if the contractual parties so agree and if no interim examination has yet been completed.

§ 29

Entry into force, ceasing to be in force

(1) The present Ordinance enters into force on 1 August 2001. At the same time, the Ordinance on training in the occupation of engineering draughtsman/engineering draughtswoman of 17 December 1993 (Federal Law Gazette 1994 I p. 25), last amended by Article 2 of the Ordinance dated 19 June 2000 (Federal Law Gazette I p. 863), and the ordinance on vocational education and training in the occupation of technical product designer of 24 June 2005 (Federal Law Gazette I p. 1804, 2261) cease to be in force.

(2) The present Ordinance ceases to be in force on 31 July 2016. Vocational education and training contracts in existence at this time will be completed according to the provisions of the present Ordinance.

Berlin, 21 June 2011

The Federal Minister of Economics and Technology
per procuracionem
B. Heitzer

Annex 1

(to § 4 Paragraph 1 Clause 1)

General training plan
for vocational education and training in the occupation of technical product designer
– Content structure –

Section A: Joint skills, knowledge and competences making up the occupational profile

No.	Part of the training occupation profile	Skills, knowledge and competences to be imparted
1	2	3
1	Draw up and apply technical documents (§ 4 Paragraph 2 Section A No. 1)	<ul style="list-style-type: none"> a) Take standard specifications into account in creating technical drawings b) Differentiate geometric relations c) Present individual components and sub-assemblies in conformity with standards in views and sections d) Apply measurement entry rules e) Present workpieces spatially f) Prepare and dimension freehand sketches g) Prepare and manage technical support documentation, in particular lists of parts h) Prepare technical and presentation documentation i) Use lists of parts, tables, diagrams, manuals and operating instructions
2	Carry out computer-aided construction (§ 4 Paragraph 2 Section A No. 2)	<ul style="list-style-type: none"> a) Prepare datasets for individual components and sub-assemblies in accordance with technical stipulations and own draft designs b) Apply structuring methods c) Derive or prepare drawings d) Select and use symbols e) Select and use purchased and standard parts from libraries and catalogues
3	Differentiate materials (§ 4 Paragraph 2 Section A No. 3)	<ul style="list-style-type: none"> a) Obtain information on materials with regard to their properties and possible processing and uses b) Differentiate materials and semi-finished parts with regard to availability, cost-effectiveness and environmental sustainability c) Take materials standardisation into account d)
4	Differentiate production procedures and assembly techniques (§ 4 Paragraph 2 Section A No. 4)	<ul style="list-style-type: none"> a) Differentiate production and joining procedures typical to the branch b) Differentiate assembly techniques c)
5	Carry out calculations (§ 4 Paragraph 2 Section A No. 5)	<ul style="list-style-type: none"> a) Calculate lengths, angles, areas, volumes and masses b) Calculate expansion of lengths and volumes c)

Section B: Further skills, knowledge and competences making up the occupational profile

No.	Part of the training occupation profile	Skills, knowledge and competences to be imparted
1	2	3
1	Assess materials and auxiliary materials (§ 4 Paragraph 2 Section B No. 1)	<ul style="list-style-type: none"> a) Evaluate materials with regard to their properties and possible processing and uses b) Differentiate auxiliary materials and assign in accordance with use c) Evaluate materials and auxiliary materials with regard to availability, cost-effectiveness and environmental sustainability d) Use materials standardisation e) Describe materials properties in technical documents
2	Product development (§ 4 Paragraph 2 Section B No. 2)	
2.1	Product development process (§ 4 Paragraph 2 Section B No. 2.1)	<ul style="list-style-type: none"> a) Accord due consideration to the company product development process b) Align contents and tasks from within own field of work to the product development process c) Apply project and process management methods d) Differentiate stages of methodological construction e) Interpret and apply analytical and statistical tools for quality assurance f) Communicate with upstream and downstream areas, identify interfaces and effect coordination g) Comply with legal stipulations within the phases of the product life cycle, in particular development and construction, production and assembly, commissioning, maintenance and routine repair, service, disassembly and disposal
2.2	Plan and design components and sub-assemblies (§ 4 Paragraph 2 Section B No. 2.2)	<ul style="list-style-type: none"> a) Differentiate types of construction b) Define product requirements, differentiate user and functional specifications and requirements lists and take account of quality requirements c) Apply creative techniques to find solutions d) Develop, evaluate and select solutions according due consideration to technical, business and ecological criteria e) Visualise and present solutions

No.	Part of the training occupation profile	Skills, knowledge and competences to be imparted
1	2	3
2.3	Design, draw up and calculate components and sub-assemblies (§ 4 Paragraph 2 Section B No. 2.3)	<ul style="list-style-type: none"> a) Take account of functional, conditions of use, production, assembly and monitoring requirements with regard to constructions b) Take design stipulations into account from technical and functional perspectives c) Select components and semi-finished products in accordance with stipulations and technical documents d) Take account of the use of standardised and purchased parts e) Take account of materials requirements and properties f) Stipulate tolerances, matching and surfaces g) Prepare detailed constructions h) Undertake constructive changes i) Take account of joining and connection technologies j) Conduct mechanical calculations, in particular regarding speed, forces and resolution of forces, torque and friction k) Conduct stability calculations, in particular regarding contact pressure, tensile load, pressure load and shear load l) Calculate work, performance and degree of effectiveness m) Prepare datasets and secure data quality within the process n) Exchange and apply various data formats
3	Select production and joining procedures and assembly techniques (§ 4 Paragraph 2 Section B No. 3)	<ul style="list-style-type: none"> a) Select production procedures within the construction process b) Select assembly technique and joining procedures within the construction process
4	Conduct simulations (§ 4 Paragraph 2 Section B No. 4)	<ul style="list-style-type: none"> a) Develop virtual assemblies and check for collision b) Apply branch and company-specific simulation procedures

Annex 2
(to § 4 Paragraph 1 Clause1)

General training plan
for vocational education and training in the occupation of technical product designer

Section 1

No.	Part of the training occupation profile	Skills, knowledge and competences to be imparted	Time framework in months
1	2	3	4
1	VET, employment and collective wage agreement law (§ 4 Paragraph 2 Section E No. 1)	<ul style="list-style-type: none"> 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 (§ 4 Paragraph 2 Section E No. 2)	<ul style="list-style-type: none"> 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 (§ 4 Paragraph 2 Section E No. 3)	<ul style="list-style-type: none"> 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) Deploy regulations for preventative fire protection; describe behaviours in the event of fire and initiate fire fighting measures 	
4	Environmental protection (§ 4 Paragraph 2 Section E No. 4)	<p>Contribute to the avoidance of instances of environmental pollution caused by the company within the occupational sphere of influence, in particular</p> <ul style="list-style-type: none"> 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 2

1. Up until 3rd training semester

Time framework 1: Present simple components and sub-assemblies

No.	Part of the training occupation profile	Skills, knowledge and competences to be imparted (according to learning objectives of Annex 1)	Time framework in months
1	2	3	4
1	Draw up and apply technical documents (§ 4 Paragraph 2 Section A No. 1)	<ul style="list-style-type: none"> a) Take standard specifications into account in creating technical drawings b) Differentiate between geometric relations c) Present individual components and sub-assemblies in conformity with standards in views and sections d) Apply measurement entry rules e) Present workpieces spatially f) Prepare and dimension freehand sketches 	4 to 6
2	Carry out computer-aided construction (§ 4 Paragraph 2 Section A No. 2)	<ul style="list-style-type: none"> a) Prepare datasets for individual components and sub-assemblies in accordance with technical stipulations and own draft designs b) Apply structuring methods e) Select and use purchased and standard parts from libraries and catalogues 	
3	Differentiate materials (§ 4 Paragraph 2 Section A No. 3)	<ul style="list-style-type: none"> a) Obtain information on materials with regard to their properties and possible processing and uses 	
4	Carry out calculations (§ 4 Paragraph 2 Section A No. 5)	<ul style="list-style-type: none"> a) Calculate lengths, angles, areas, volumes and masses 	
5	Use information and communication technology systems (§ 4 Paragraph 2 Section E No. 5)	<ul style="list-style-type: none"> a) Use company communication and information systems for the transmission of data, images and language b) Use standard software, in particular spreadsheets, text processing and presentation c) Procure, evaluate and use information, also including English language information in particular d) Manage and secure data e) Comply with regulations regarding data security 	
6	Work planning and organisation (§ 4 Paragraph 2 Section E No. 6)	<ul style="list-style-type: none"> a) Check work orders and stipulations in terms of feasibility b) Procure, evaluate and use order-related information and data 	
7	Customer orientation (§ 4 Paragraph 2 Section E No. 8)	<ul style="list-style-type: none"> c) Communicate with customers in English d) Take cultural identities into account 	

Time framework 2: Prepare technical documents

No.	Part of the training occupation profile	Skills, knowledge and competences to be imparted (according to learning objectives of Annex 1)	Time framework in months
1	2	3	4
1	Draw up and apply technical documents (§ 4 Paragraph 2 Section A No. 1)	g) Prepare and manage technical support documentation, in particular lists of parts h) Prepare technical and presentation documentation i) Use lists of parts, tables, diagrams, manuals and operating instructions	4 to 6
2	Carry out computer-aided construction (§ 4 Paragraph 2 Section A No. 2)	c) Derive or prepare drawings d) Select and use symbols	
3	Differentiate materials (§ 4 Paragraph 2 Section A No. 3)	b) Differentiate materials and semi-finished parts with regard to availability, cost-effectiveness and environmental sustainability c) Take materials standardisation into account	
4	Assess materials and auxiliary materials (§ 4 Paragraph 2 Section B No. 1)	d) Use materials standardisation e) Describe materials properties in technical documents	
5	Design, draw up and calculate components and sub-assemblies (§ 4 Paragraph 2 Section B No. 2.3)	c) Select components and semi-finished products in accordance with stipulations and technical documents d) Take account of the use of standardised and purchased parts f) Stipulate tolerances, matching and surfaces i) Take account of joining and connection technologies m) Prepare datasets and secure data quality within the process	
6	Use information and communication technology systems (§ 4 Paragraph 2 Section E No. 5)	b) Use standard software, in particular spreadsheets, text processing and presentation c) Procure, evaluate and use information, also including English language information in particular d) Manage and secure data e) Comply with regulations regarding data security	
7	Work planning and organisation (§ 4 Paragraph 2 Section E No. 6)	c) Stipulate and secure work stages and processes in accordance with functional, organisational, production and business criteria d) Accord due consideration to legal, operational and technical regulations g) Collate work results, monitor work performed and evaluate and document work on the basis of stipulations	

Time framework 3: Design and prepare components in line with materials, production and assembly requirements

No.	Part of the training occupation profile	Skills, knowledge and competences to be imparted (according to learning objectives of Annex 1)	Time framework in months
1	2	3	4
1	Differentiate production procedures and assembly techniques (§ 4 Paragraph 2 Section A No. 4)	a) Differentiate production and joining procedures typical to the branch b) Differentiate assembly techniques	3 to 5
2	Carry out calculations (§ 4 Paragraph 2 Section A No. 5)	b) Calculate expansion of lengths and volumes	
3	Assess materials and auxiliary materials (§ 4 Paragraph 2 Section B No. 1)	a) Evaluate materials with regard to their properties and possible processing and uses b) Differentiate auxiliary materials and assign in accordance with use c) Evaluate materials and auxiliary materials with regard to availability, cost-effectiveness and environmental sustainability	
4	Product development process (§ 4 Paragraph 2 Section B No. 2.1)	a) Accord due consideration to the company product development process b) Align contents and tasks from within own field of work to the product development process f) Communicate with upstream and downstream areas, identify interfaces and effect coordination g) Comply with legal stipulations within the phases of the product life cycle, in particular development and construction, production and assembly, commissioning, maintenance and routine repair, service, disassembly and disposal	
5	Plan and design components and sub-assemblies (§ 4 Paragraph 2 Section B No. 2.2)	b) Define product requirements, differentiate user and functional specifications and requirements lists and take account of quality requirements c) Apply creative techniques to find solutions	
6	Design, draw up and calculate components and sub-assemblies (§ 4 Paragraph 2 Section B No. 2.3)	a) Take account of functional, conditions of use, production, assembly and monitoring requirements with regard to constructions e) Take account of materials requirements and properties	
7	Select production and joining procedures and assembly techniques (§ 4 Paragraph 2 Section B No. 3)	a) Select production procedures within the construction process b) Select assembly technique and joining procedures within the construction process	
8	Work planning and organisation (§ 4 Paragraph 2 Section E No. 6)	e) Plan work order and coordinate this with upstream and downstream areas	
9	Carry out quality assurance measures (§ 4 Paragraph 2 Section E No. 7)	b) Apply quality assurance measures in own work area, in particular check and evaluate interim and final results c) Recognise errors and quality defects and their causes and initiate and document measures for rectification	

Time framework 4: Implement construction process

No.	Part of the training occupation profile	Skills, knowledge and competences to be imparted (according to learning objectives of Annex 1)	Time framework in months
1	2	3	4
1	Product development processes (§ 4 Paragraph 2 Section B No. 2.1)	<ul style="list-style-type: none"> b) Align contents and tasks from within own field of work to the product development process c) Apply project and process management methods d) Differentiate stages of methodological construction e) Interpret and apply analytical and statistical tools for quality assurance f) Communicate with upstream and downstream areas, identify interfaces and effect coordination g) Comply with legal stipulations within the phases of the product life cycle, in particular development and construction, production and assembly, commissioning, maintenance and routine repair, service, disassembly and disposal 	3 to 5
2	Plan and design components and sub-assemblies (§ 4 Paragraph 2 Section B No. 2.2)	<ul style="list-style-type: none"> b) Define product requirements, differentiate user and functional specifications and requirements lists and take account of quality requirements e) Visualise and present solutions 	
3	Design, draw up and calculate components and sub-assemblies (§ 4 Paragraph 2 Section B No. 2.3)	<ul style="list-style-type: none"> n) Exchange and apply various data formats 	
4	Work planning and organisation (§ 4 Paragraph 2 Section E No. 6)	<ul style="list-style-type: none"> e) Plan work order and coordinate this with upstream and downstream areas f) Check and present possible solutions and compare their cost-effectiveness h) Plan and process tasks within a team; agree, evaluate and present team results 	
5	Carry out quality assurance measures (§ 4 Paragraph 2 Section E No. 7)	<ul style="list-style-type: none"> d) Contribute to the continuous improvement of work processes 	
6	Customer orientation (§ 4 Paragraph 2 Section E No. 8)	<ul style="list-style-type: none"> a) Receive customer-specific requirements and information, pass on such requirements and information within the company and take these requirements and this information into account 	

Section 3

4. Up until 7th training semester: Specialism of product design and construction

Time framework 5: Construct complex components and sub-assemblies

No.	Part of the training occupation profile	Skills, knowledge and competences to be imparted (according to learning objectives of Annex 1)	Time framework in months
1	2	3	4
1	Plan and design components and sub-assemblies (§ 4 Paragraph 2 Section B No. 2.2)	<ul style="list-style-type: none"> a) Differentiate types of construction b) Define product requirements, differentiate user and functional specifications and requirements lists and take account of quality requirements c) Apply creative techniques to find solutions d) Develop, evaluate and select solutions according due consideration to technical, business and ecological criteria e) Visualise and present solutions 	11 to 13
2	Design, draw up and calculate components and sub-assemblies (§ 4 Paragraph 2 Section B No. 2.3)	<ul style="list-style-type: none"> a) Take account of functional, conditions of use, production, assembly and monitoring requirements with regard to constructions b) Take design stipulations into account from technical and functional perspectives g) Prepare detailed constructions h) Undertake constructive changes j) Conduct mechanical calculations, in particular regarding speed, forces and resolution of forces, torque and friction k) Conduct stability calculations, in particular regarding contact pressure, tensile load, pressure load and shear load l) Calculate work, performance and degree of effectiveness 	
3	Select production and joining procedures and assembly technique (§ 4 Paragraph 2 Section B No. 3)	<ul style="list-style-type: none"> a) Select production procedures within the construction process b) Select assembly technique and joining procedures within the construction process 	
4	Conduct simulations (§ 4 Paragraph 2 Section B No. 4)	<ul style="list-style-type: none"> a) Develop virtual assemblies and check for collision b) Apply branch and company-specific simulation procedures 	
5	Design and develop objects (§ 4 Paragraph 2 Section C No. 1)	<ul style="list-style-type: none"> c) Apply basic principles of design d) Prepare draft sketches 	
6	Construct freeform surfaces (§ 4 Paragraph 2 Section C No. 2)	<ul style="list-style-type: none"> a) Differentiate types of curve b) Produce spatial curves c) Smooth curves d) Produce and evaluate curve transitions e) Produce and evaluate freeform surfaces 	
7	Construct objects (§ 4 Paragraph 2 Section C No. 3)	<ul style="list-style-type: none"> d) Construct objects taking production techniques into account, in particular deep drawing, injection moulding and bending e) Construct objects taking joining procedures and assembly techniques into account into account, in particular gluing, welding and clip and snap connections g) Construct objects taking materials into account, in particular sheet metals, plastic, wood, composite materials, glass, paper and cardboard 	
8	Use information and communication technology systems (§ 4 Paragraph 2 Section E No. 5)	<ul style="list-style-type: none"> c) Procure, evaluate and use information, also including English language information in particular d) Manage and secure data 	

No.	Part of the training occupation profile	Skills, knowledge and competences to be imparted (according to learning objectives of Annex 1)	Time framework in months
1	2	3	4
9	Work planning and organisation (§ 4 Paragraph 2 Section E No. 6)	c) Stipulate and secure work stages and processes in accordance with functional, organisational, production and business criteria e) Plan work order and coordinate this with upstream and downstream areas f) Check and present possible solutions and compare their cost-effectiveness g) Collate work results, monitor work performed and evaluate and document work on the basis of stipulations	
10	Carry out quality assurance measures (§ 4 Paragraph 2 Section E No. 7)	a) Take the objectives and tasks of quality assurance measures into account c) Recognise errors and quality defects and their causes and initiate and document measures for rectification	
11	Customer orientation (§ 4 Paragraph 2 Section E No. 8)	a) Receive customer-specific requirements and information, pass on such requirements and information within the company and take these requirements and this information into account	

Time framework 6: Develop, design and construct products

No.	Part of the training occupation profile	Skills, knowledge and competences to be imparted (according to learning objectives of Annex 1)	Time framework in months
1	2	3	4
1	Design and develop objects (§ 4 Paragraph 2 Section C No. 1)	a) Carry out product, competition and patent research b) Differentiate stages of the design process, in particular sketches, CAD models and physical models e) Design objects in a functional manner f) Design objects in accordance with ergonomic guidelines and legal stipulations g) Take material properties into account when designing objects	11 to 13
2	Construct freeform surfaces (§ 4 Paragraph 2 Section C No. 2)	f) Produce and evaluate surface transitions g) Produce and evaluate polysurfaces h) Create and evaluate objects with freeform surfaces	
3	Construct objects (§ 4 Paragraph 2 Section C No. 3)	a) Implement design stipulations in accordance with technical, functional and aesthetic perspectives b) Construct objects as surface, volume and hybrid models c) Construct objects in accordance with functionality and requirements f) Construct objects ergonomically h) Optimise objects, in particular taking calculation and test results into account	
4	Simulation and presentation (§ 4 Paragraph 2 Section C No. 4)	a) Create, use and evaluate simulations b) Check behaviour of components and sub-assemblies via virtual movement simulations c) Present and animate objects in a photorealistic manner d) Apply visualisation techniques	
5	Work planning and organisation (§ 4 Paragraph 2 Section E No. 6)	h) Plan and process tasks within a team; agree, evaluate and present team results	
6	Carry out quality assurance measures (§ 4 Paragraph 2 Section E No. 7)	c) Recognise errors and quality defects and their causes and initiate and document measures for rectification of causes d) Contribute to the continuous improvement of work processes	

No.	Part of the training occupation profile	Skills, knowledge and competences to be imparted (according to learning objectives of Annex 1)	Time framework in months
1	2	3	4
7	Customer orientation (§ 4 Paragraph 2 Section E No. 8)	<ul style="list-style-type: none"> b) Comply with company communication rules in informing and advising customers and take customer requirements into account c) Communicate with customers in English d) Take cultural identities into account 	

Section 4

4. 4th to 7th training semester: Specialism of in machinery and plant construction

Time framework 7: Construct complex components and sub-assemblies

No.	Part of the training occupation profile	Skills, knowledge and competences to be imparted (according to learning objectives of Annex 1)	Time framework in months
1	2	3	4
1	Assess materials and auxiliary materials (§ 4 Paragraph 2 Section B No. 1)	<ul style="list-style-type: none"> a) Evaluate materials with regard to their properties and possible processing and uses b) Differentiate auxiliary materials and assign in accordance with use 	11 to 13
2	Plan and design components and sub-assemblies (§ 4 Paragraph 2 Section B No. 2.2)	<ul style="list-style-type: none"> a) Differentiate types of construction b) Define product requirements, differentiate user and functional specifications and requirements lists and take account of quality requirements c) Apply creative techniques to find solutions d) Develop, evaluate and select solutions according due consideration to technical, business and ecological criteria e) Visualise and present solutions 	
3	Design, draw up and calculate components and sub-assemblies (§ 4 Paragraph 2 Section B No. 2.3)	<ul style="list-style-type: none"> a) Take account of functional, conditions of use, production, assembly and monitoring requirements with regard to constructions b) Take design stipulations into account from technical and functional perspectives g) Prepare detailed constructions h) Undertake constructive changes j) Conduct mechanical calculations, in particular regarding speed, forces and resolution of forces, torque and friction k) Conduct stability calculations, in particular regarding contact pressure, tensile load, pressure load and shear load l) Calculate work, performance and degree of effectiveness 	
4	Select production and joining procedures and assembly techniques (§ 4 Paragraph 2 Section B No. 3)	<ul style="list-style-type: none"> a) Select production procedures within the construction process b) Select assembly technique and joining procedures within the construction process 	
5	Conduct simulations (§ 4 Paragraph 2 Section B No. 4)	<ul style="list-style-type: none"> a) Develop virtual assemblies and check for collision b) Apply branch and company-specific simulation procedures 	
6	Alter and check material properties (§ 4 Paragraph 2 Section D No. 1)	<ul style="list-style-type: none"> a) Select procedures for the alteration of material properties b) Select test procedures for the identification of material properties 	

No.	Part of the training occupation profile	Skills, knowledge and competences to be imparted (according to learning objectives of Annex 1)	Time framework in months
1	2	3	4
7	Control and electrical engineering (§ 4 Paragraph 2 Section D No. 5)	<ul style="list-style-type: none"> a) Differentiate elements of control engineering b) Evaluate circuits with hydraulic and electro pneumatic elements c) Take account of the fundamental laws of electrical engineering and calculate basic values d) Calculate control engineering values, in particular pressures and forces e) Take account of risks in control and electrical engineering and comply with the requirements of relevant protective measures f) Integrate control and electrical engineering circuit diagrams into CAD datasets 	
8	Work planning and organisation (§ 4 Paragraph 2 Section E No. 6)	<ul style="list-style-type: none"> e) Plan work order and coordinate this with upstream and downstream areas f) Check and present possible solutions and compare their cost-effectiveness g) Collate work results, monitor work performed and evaluate and document work on the basis of stipulations h) Plan and process tasks within a team; agree, evaluate and present team results 	
9	Carry out quality assurance measures (§ 4 Paragraph 2 Section E No. 7)	<ul style="list-style-type: none"> b) Apply quality assurance measures in own work area, in particular check and evaluate interim and final results c) Recognise errors and quality defects and their causes and initiate and document measures for rectification d) Contribute to the continuous improvement of work processes 	
10	Customer orientation (§ 4 Paragraph 2 Section E No. 8)	<ul style="list-style-type: none"> c) Communicate with customers in English 	

Time framework 8: Conceptualise, design and develop technical products

No.	Part of the training occupation profile	Skills, knowledge and competences to be imparted (according to learning objectives of Annex 1)	Time framework in months
1	2	3	4
1	Design, draw up and calculate components and sub-assemblies (§ 4 Paragraph 2 Section B No. 2.3)	<ul style="list-style-type: none"> c) Select components and semi-finished products in accordance with stipulations and technical documents d) Take account of the use of standardised and purchased parts i) Take account of joining and connection technologies j) Conduct mechanical calculations, in particular regarding speed, forces and resolution of forces, torque and friction k) Conduct stability calculations, in particular regarding contact pressure, tensile load, pressure load and shear load l) Calculate work, performance and degree of effectiveness 	11 to 13
2	Conduct simulations (§ 4 Paragraph 2 Section B No. 4)	<ul style="list-style-type: none"> a) Develop virtual assemblies and check for collision b) Apply branch and company-specific simulation procedures 	
3	Create constructions (§ 4 Paragraph 2 Section D No. 2)	<ul style="list-style-type: none"> a) Select the structure, function and functionality of machine elements, in particular gears, couplings and mechanisms b) Develop constructions with function units, standard parts and connection elements c) Create injection constructions d) Create welded constructions 	

No.	Part of the training occupation profile	Skills, knowledge and competences to be imparted (according to learning objectives of Annex 1)	Time framework in months
1	2	3	4
4	Production engineering (§ 4 Paragraph 2 Section D No. 3)	<ul style="list-style-type: none"> a) Implement the effects of prototype forming on the dimensioning, design, surface characteristics and measurability of components in the construction b) Implement the effects of metal forming on the dimensioning, design, surface characteristics and measurability of components in the construction c) Implement the effects of milling machining on the dimensioning, design, surface characteristics and measurability of components in the construction d) Carry out technical production calculations 	
5	Joining and assembly engineering (§ 4 Paragraph 2 Section D No. 4)	<ul style="list-style-type: none"> a) Implement the effects of joining and assembly engineering on the dimensioning, design, surface characteristics and measurability of components in the construction b) Calculate tolerances and matching c) Use machine or connecting elements in constructions in a manner which meets load and functionality requirements 	
6	Work planning and organisation (§ 4 Paragraph 2 Section E No. 6)	<ul style="list-style-type: none"> c) Stipulate and secure work stages and processes in accordance with functional, organisational, production and business criteria d) Accord due consideration to legal, operational and technical regulations 	
8	Carry out quality assurance measures (§ 4 Paragraph 2 Section E No. 7)	<ul style="list-style-type: none"> a) Take the objectives and tasks of quality assurance measures into account 	
9	Customer orientation (§ 4 Paragraph 2 Section E No. 8)	<ul style="list-style-type: none"> b) Comply with company communication rules in informing and advising customers and take customer requirements into account c) Communicate with customers in English 	

S K E L E T O N C U R R I C U L U M

for the training occupation of

Technical product designer

(Resolution of the Standing Conference of the Ministers of Education and Cultural Affairs
of 27 May 2011)

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.

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

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

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

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

Part II: 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.

Part V Learning fields

Summary of the learning fields for the training occupation of technical product designer					
Learning fields		Suggested time allocations in teaching hours			
No.		1st year	2nd year	3rd year	4th year
1	Analyse and record technical systems	60			
2	Create components and subassemblies in a computer-aided way in accordance with stipulations	80			
3	Take account of effects of selected production procedures and materials on component construction	80			
4	Execute orders in a customer-oriented manner	60			
5	Develop components from metal materials in the context of subassemblies taking account of reforming procedures		60		
6	Develop components from plastics in the context of subassemblies taking account of forming and reforming procedures		80		
7	Develop components in the context of subassemblies taking account of production procedures involving separation		80		
8	Develop components from metal materials in the context of subassemblies taking account of forming procedures		60		
Specialism of machinery and plant construction (MPC)					
9	Create and modify 3D datasets of subassemblies taking joining procedures and assembly techniques into account			100	
10	Create and modify datasets and documentation for technical automated production systems			60	
11	Create and modify 3D datasets using machine elements and purchased parts			120	
12	Create and modify 3D datasets of components and subassemblies in accordance with technical design stipulations				60
13	Execute product development in a customer-oriented manner				80
Specialism of product design and construction (PDC)					
9	Create and modify 3D datasets of subassemblies taking joining procedures and assembly techniques into account			100	
10	Create and modify 3D datasets of components in accordance with design stipulations			120	
11	Create and modify 3D datasets of subassemblies using standardised and purchased parts			60	
12	Create and modify 3D datasets of complexly structured subassemblies from design ideas				60
13	Execute product development in a customer-oriented manner				80
Totals: overall time 980 hours		280	280	280	140

Learning field 1: Analyse and record technical systems	1st year of training Suggested time allocation: 60 hours
<p>Aim</p> <p>Pupils record and analyse technical systems. They evaluate technical documentation, including documentation in English, and use specialist terms to describe functional correlations of technical systems. For this purpose, they carry out application-related calculations, complete freehand technical sketches and draw up necessary technical documents.</p> <p>They apply the possibilities provided by technical documentation, in particular presentation in accordance with standards.</p>	
<p>Contents</p> <p>Spatial representation, representation in views</p> <p>Procurement of information: book of tables, catalogues, Internet lists of parts, standardised parts</p> <p>Dimensioning, tolerances</p> <p>Basic electro technology terms</p> <p>Calculations: length, surface area, volume, angle, masse, density</p>	

<p>Learning field 2: Create components and subassemblies in a computer-aided way in accordance with stipulations</p>	<p>1st year of training Suggested time allocation: 80 hours</p>
<p>Aim</p> <p>Pupils prepare datasets for components in accordance with hand drawn sketches and drawings. They generate and alter components in a computer-aided manner for this purpose. They particularly recognise geometric correlations and take these into account. They create simple subassemblies according due consideration to soluble connections and reflect upon their ease of assembly. They check their work results, carry out changes to the components and generate the necessary technical documents. Pupils manage and secure data in suitable structures whilst complying with data protection provisions. They address the risks of misuse of data and reflect upon the legal and economic consequences of this.</p>	
<p>Contents</p> <p>Views, sections, details Tolerance information Dataset structuring Purchased parts and standardised parts from libraries Lists of parts Computer-aided calculations: areas, volumes, masses, centres of gravitation Data formats</p>	

<p>Learning field 3: Take account of effects of selected production procedures and materials on component construction</p>	<p>1st year of training Suggested time allocation: 80 hours</p>
<p>Aim</p> <p>Pupils construct components and obtain information on production procedures in an order-related way. They take the structure, properties and possible uses of materials into consideration. They evaluate and structure information on production procedures and materials typical to the branch, carry out necessary calculations and recognise the influence on component construction. Pupils document and present their work and use standard software in its development. They reflect upon and evaluate their presentations including from design points of view.</p>	
<p>Contents</p> <p>Mechanical and physical materials properties Materials standardisation Surface characteristics, surface designation Expansion of lengths and volume Main groups of production procedures Copyright law Referencing sources</p>	

Learning field 4: Execute orders in a customer-oriented manner	1st year of training Suggested time allocation: 60 hours
<p>Aim</p> <p>Pupils process a customer order. For this purpose, they record and analyse fundamental operational sequences and processes, reflect upon their own experiences and take these into account in the execution of the order. They procure project-related information, including in English. In executing the order, pupils work in a team and apply suitable work strategies. They present, compare and evaluate their possible solutions. Following the completion of the customer order, pupils reflect upon the processes and procedures.</p>	
<p>Contents</p> <ul style="list-style-type: none"> Product development process User and functional specifications Creative techniques Quality assurance measures Time planning Cost management 	

<p>Learning field 5: Develop components from metal materials in taking account of reforming procedures</p>	<p>2nd year of training Suggested time allocation: 60 hours</p>
<p>Aim</p> <p>In the development process of metallic components, pupils take account of design rules for reforming procedures and deploy these in component design. They obtain information on reforming procedures and the cost-effectiveness of such procedures. They compare the properties of deployable materials and accord due consideration to the changes in property of such materials. They take account of ecological and economic aspects. They carry out application-related calculations.</p> <p>Pupils take account of order-specific requirements and plan their approach. They create and test 3D datasets and document the results.</p>	
<p>Contents</p> <p>Bending, deep drawing Steel, non-ferrous metals and their alloys, materials standardisation Bend raw lengths Recycling</p>	

<p>Learning field 6: Develop components from plastics in the context of subassemblies taking account of forming and reforming procedures</p>	<p>2nd year of training Suggested time allocation: 80 hours</p>
<p>Aim</p> <p>In development processes, pupils take account of design rules for plastic components depending on materials and production processes. They take account of order-specific requirements and plan their approach.</p> <p>They obtain information on production possibilities and evaluate these with regard to use and cost-effectiveness. They compare the properties of materials to be deployed including taking account of environmental sustainability and availability. For this purpose, they procure order-related information from technical documentation for the creation and alteration of components.</p> <p>They create and test 3D datasets and document the results.</p>	
<p>Contents</p> <p>Thermoplastics, duroplastics and elastomers Injection moulding, vacuum thermo forming, extrusion, blow forming, fibre composite technology Rapid prototyping</p>	

<p>Learning field 7: Develop components in the context of subassemblies taking account of production procedures involving separation</p>	<p>2nd year of training Suggested time allocation: 80 hours</p>
<p>Aim</p> <p>In the development process of components, pupils take account of design rules for separating and in particular machining production procedures and deploy these in component design. They obtain information on separating production procedures.</p> <p>Within the context of the subassembly and taking cost-effectiveness into account, they derive requirements regarding form and precision from the function of a component. They take into account the properties of the materials and auxiliary materials used. They also use English-language specialist terms for components, materials and procedures. They obtain information on CNC and CAM appropriate data provision and draw up derived drawings with information on measurements, form and surfaces that are suitable for production purposes.</p>	
<p>Contents</p> <p>Lathe turning, milling, drilling, precision machining, stamping, cutting, eroding</p>	

<p>Learning field 8: Develop components from metal materials in the context of subassemblies taking account of forming procedures</p>	<p>2nd year of training Suggested time allocation: 60 hours</p>
<p>Aim</p> <p>In the development process of metallic components, pupils take account of design rules for forming procedures and deploy these in component design. They obtain information on forming procedures and the cost-effectiveness of such procedures. They compare the properties of deployable materials and accord due consideration to the changes in property of such materials. They take account of ecological and economic aspects. They carry out application-related calculations.</p> <p>Pupils take account of order-specific requirements and plan their approach. They create and test 3D datasets and document the results.</p>	
<p>Contents</p> <p>Moulding, sintering Cast iron, cast steel, non-ferrous metals and their alloys, materials standardisation Heat expansion Recycling</p>	

Specialism of machinery and plant construction (MPC)

Learning field 9 MPC: Create and modify 3D datasets of subassemblies taking joining procedures and assembly techniques into account	3rd year of training Suggested time allocation: 100 hours
Aim Pupils create and amend datasets of subassemblies according due consideration to technical joining and assembly requirements. They recognise the technical relations necessary for assembly and identify the required tolerances. They procure information on joining techniques and assembly strategies and select suitable techniques and strategies. Pupils develop strategies for the positioning of components in the CAD system. They create subassemblies including the use of libraries of standardised parts and components. Pupils supplement necessary component information and generate lists of parts. They derive technical documents. They secure their datasets in accordance with company stipulations.	
Contents Function analysis Force, form-fit and bonded joinings Spindle and hub connections Collision controls Form and positional tolerances, matching Views, details, sections, explosion representations Assembly and disassembly plans Calculations: forces, torques, pressure loads Data import and export	

<p>Learning field 10 MPC: Create and modify datasets and documentation for technical automated production systems</p>	<p>3rd year of training Suggested time allocation: 60 hours</p>
<p>Aim</p> <p>Pupils analyse technical documentation relating to automated production systems, in particular circuit diagrams for pneumatic and hydraulic control systems. They obtain information on functional correlations of simple connection and programmable control systems. Within the context of a subassembly, they create circuit diagrams, allocation lists and other documentation for technical automated production systems in accordance with stipulations. They also use manufacturer documentation for this purpose.</p>	
<p>Contents</p> <p>Sensors, actuators Electro pneumatic and electro hydraulic functional Forces, pressures Representation of functional processes</p>	

**Learning field 11 MPC: Create and modify 3D datasets
using machine elements and
purchased parts**

**3rd year of training
Suggested time allocation: 120 hours**

Aim

Pupils create 3D datasets of subassemblies. They also use machine elements and purchased parts and take economic and technical assembly aspects into account.

They obtain information on methods for the construction of subassemblies and select suitable methods in an order-related way.

They select necessary procedures for the alteration of material properties and for testing procedures and document their results.

They accord due consideration to the possibilities of adapted construction and variants. They use quality management methods to evaluate their work results. Pupils apply possibilities for collision control and simulate and present installation, movement and assembly processes. They carry out stability calculations to test the dimensioning of components. They derive necessary technical documents from the datasets of the subassemblies. Pupils secure and archive data relating to the components and subassemblies.

Contents

Product development process

Construction methods: bottom up, top down storage

Belt, chain and gear wheel drives

Couplings

Heat treatment procedures, hardness testing procedures

Application-related calculations:

Friction load, tensile load, pressure load, shear load,
transmission ratio, work, performance, degree of effectiveness, speed

Product data management

Learning field 12 MPC: Create and modify 3D datasets of components and subassemblies in accordance with technical design stipulations

**4nd year of training
Suggested time allocation: 60 hours**

Aim

Pupils create complex components and subassemblies in accordance with technical design stipulations. They implement the stipulations according to technical, functional, ergonomic and aesthetic points of view and represent these stipulations in technical hand drawn sketches.

They conduct a comparison of variants in order to select the optimum solution concept and model components using surface and volume modelling functions. They take account of design and ergonomic requirements and of the effects of component forms, materials and surface structures and transfer the results to the models.

Pupils check datasets for completeness, precision and suitability for production. They evaluate work results and document and present these results with the help of visualisation techniques.

Contents

2D, 3D curves, consistency

Surface analysis

Structuring of models

Criteria of product design

Colours and textures as design characteristics

<p>Learning field 13 MPC: Execute product development in a customer-oriented manner</p>	<p>4nd year of training Suggested time allocation: 80 hours</p>
<p>Aim</p> <p>Pupils execute a project in a customer-oriented way. They take project management and quality assurance methods into account. They identify the necessary requirements in agreement with the customers. They analyse the amount of work needed and plan deadlines and tools. They stipulate and distribute the stages of work.</p> <p>Pupils coordinate their team work and document this in a suitable form.</p> <p>In the development of components, they take account of functional, economic and ecological points of view and compare alternative solutions. They hold meetings with customers including in English.</p> <p>They take account of suitable production procedures in the product development process. They accord due consideration to the cost-effectiveness of the procedures. They evaluate properties and possible uses of the materials and auxiliary materials to be deployed.</p> <p>Pupils draw up detailed documentation for the project. They present and reflect upon work results.</p>	
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Specialism of product design and construction (PDC)

Learning field 9 PDC: Create and modify 3D datasets of subassemblies taking joining procedures and assembly techniques into account	3rd year of training Suggested time allocation: 100 hours
Aim Pupils create and amend datasets of subassemblies according due consideration to technical joining and assembly requirements. They recognise the technical relations necessary for assembly and identify the required tolerances. They procure information on joining techniques and assembly strategies and select suitable techniques and strategies. Pupils develop strategies for the positioning of components in the CAD system. They create subassemblies including the use of libraries of standardised parts and components. Pupils supplement necessary component information and generate lists of parts. They derive technical documents. They secure their datasets in accordance with company stipulations.	
Contents Function analysis Materials: metals, plastics, composite materials, glass, paper, cardboard, wood Force, form-fit and bonded joinings Clip connections Snap connections, film hinges Integrated or differentiated type of construction Collision controls Form and positional tolerances, matching Views, details, sections, explosion representations Data import and export	

<p>Learning field 10 PDC: Create and modify 3D datasets of components in accordance with design stipulations</p>	<p>3rd year of training Suggested time allocation: 120 hours</p>
<p>Aim</p> <p>Pupils create 3D datasets in accordance with design stipulations. For this purpose, they obtain information about the product and carry out necessary competition and patent researches including in English. They develop their dexterity in sketching technique.</p> <p>Pupils use modelling strategies, in particular surface modelling, for components within the subassembly context. They take account of assembly aspects that have been optimised in design and economic terms. They accord due consideration to ergonomic requirements and to the effects of colour, touch and feel and materials in terms of perception. They evaluate their work results.</p> <p>Pupils secure and archive data relating to the components and subassemblies.</p>	
<p>Contents</p> <p>Design stipulations: formal/aesthetic, constructive/functional, touch and feel of material</p> <p>Product graphics</p> <p>Hand drawn sketches in perspective</p> <p>Curves, curve transitions, free form surfaces, surface analysis</p> <p>Surface, volume and hybrid models</p> <p>Proportions, contrast, light, shadow, perspective, colour</p>	