



DRAFT TRAINING STANDARD
PROFESSIONAL QUALIFICATION
General Mechanic

Version **V 0.3**

Maputo, 10.2.2008

Preliminary remarks

This product is in line with the resolutions COREP/PIREP No 02/2007 and COREP/PIREP No 03/2007 and the National Catalogue for Professional Qualifications. It includes

- **a detailed description of the professional qualification, including the professional field of action, the required competencies of the respective occupation and assessment procedures.**
- **the associated training qualifications, structured in training modules.**

This work is the result of a comprehensive study and analysis of the related productive system, particularly of the Metal Working infrastructure in Mozambique. Furthermore, the result considers international standards which include beside other countries especially concepts of

- Southern Africa,
- Germany,
- Australia and
- Spain

The first draft has been discussed and revised in a workshop in January 2008 with representatives of

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This draft will be circulated to relevant Industries, Authorities, Training Providers and interested persons on national and provincial level in order to provide recommendations.

Furthermore the draft training standard will be discussed and if necessary revised in three regional workshops on provincial level.

PROFESSIONAL QUALIFICATION

General Mechanic

Code		Title	General Mechanic
Level		Professional Field	Metal Working
General Competency			
Qualification competence units	<ol style="list-style-type: none"> 1. Security and health protection at the work, 2. Environmental protection, 3. read and draw up of technical communication documents 4. plan and control the work sequences; control and judge the work results, 5. Quality management, 6. verifying and measuring 7. joining, separating and reforming 8. manual cutting and forming, 9. working with machine-tools, 10. setting up machines and installations, 11. dismantling and installing of prefabricated parts and elements, 12. repairing and maintaining equipment, 13. performing welding, thermal cutting, 14. producing metal- or steel constructions, 15. manual and mechanical forming of sheet metals and profiles, 16. treat and protect surfaces 17. installing, troubleshooting and testing pneumatic and hydraulic circuits 		

Professional field of action	<p>Industrial Mechanics</p> <ul style="list-style-type: none"> - plan and control work sequences and assess work results, - apply norms and guidelines for the assurance of the product quality and contribute to the continuous improvement of work procedures, - measure and verify mechanical and physical dimensions, - produce parts and elements as well as install and dismantle pneumatic and hydraulic components, - produce temporary and fixed joints, - produce work-pieces and prefabricated parts with different manual and mechanical production procedures, - treat and protect surfaces, - dismantle and install prefabricated parts and elements
Associated Training: Training Modules	<p>1st year</p> <p>M 01 Basic Training Metal Works</p> <p>M 02 Machining (Turning, Tool grinding)</p> <p>M 03 Arc-Welding and Gas Welding</p> <p>M 04 Sheet-Metal Work and Pipe Fitting</p> <p>M 05 Basic Electrical Engineering</p> <p>M 06 Measurement and Verification I</p> <p>M 07 Internship 1</p> <p>2nd year</p> <p>M 08-M Machining II</p> <p>M 09-M Mounting and Dismounting</p> <p>M 10-M CNC-Machining (Introduction)</p> <p>M 11-M Heat Treatment and Material Testing</p> <p>M 12-M Pneumatics and Hydraulics</p> <p>M 13-M Welding II (MIG/MAG & TIG)</p> <p>M 14-M Measuring and Verification II</p> <p>M 15-M Internship 2</p>

Target Group:

This training directs to all school graduates with at least one good graduation from the 12. Class. Interest in electro technology, mathematics and physics is an advantage.

Prerequisites of the Applicants:

1. Basic craftsmanship and skills.
2. Ability to work independently and as a member of a team.
3. Organise and manage oneself and one's activities responsibly and effectively.
4. Effective and responsible decision making.
5. Logical thinking and ingenuity.
6. High tolerance to stress.
7. Effective communication using visual, mathematical and language skills in the modes of oral and/or written persuasion.
8. Willingness to further education.
9. Flexibility and mobility.

Assessment (proposal):**A. Integrated Assessment:**

Continuous assessment in the form of self-assessment is carried out by the learner. This is done using activities and self-evaluations exercises. Continuous assessment is also carried out by the facilitators in the form of assignments that the learner must submit upon completion of each module of the learning programme.

Formative and summative assessment are integrated in a final portfolio assessment. The learner builds up a portfolio of activities, self-evaluation exercises, assignments and projects which are assessed in order to determine whether the learner has achieved the exit level outcomes of the qualification.

B. Final Examination (proposal):

Composition of examination board:

- Representatives of the related industries (2)
- Representatives of the Ministry (1)
- Representatives of the related Union (1)
- Representatives of the training centres (2, cross-centre)

Part 1 (FE Part 1)

After the 1st year the success of the training program will be assessed in a

- Written test (theory, modules M 00 to M 07, 180 min = 3h) and a
- Practical Test (two working days)

The result of part 1 will be taken into consideration in the final result of the training program (30%).

Part 2 (FE Part 2)

At the end of the 2nd year the success of the training program will be assessed in a

- Written test (theory, modules M 09 to M 15, 180 min = 3h) and a
- Practical Project (preferably a real task from an external customer, internship company), including practical work, project documentation, project presentation and expert talk.

Technical Structure and Distribution of Training Time

	Module	Duration hours	Duration weeks
1st year			
M 01	Basic Training Metal Works	256	8
M 02	Machining (Turning, Tool grinding)	256	8
M 03	Arc-Welding and Gas Welding	128	4
M 04	Sheet-Metal Work and Pipe Fitting	128	4
M 05	Basic Electrical Engineering	128	4
M 06	Measurement and Verification I	128	4
M 07	Internship 1	360	9
2nd year			
M 08-M	Machining II	256	8
M 09-M	Mounting and Dismounting	256	8
M 10-M	CNC-Machining (Introduction)	128	4
M 11-M	Heat Treatment and Material Testing	64	2
M 12-M	Pneumatics and Hydraulics	128	4
M 13-M	Welding II (MIG/MAG & TIG)	128	4
M 14-M	Measuring and Verification II	64	2
M 15-M	Internship 2	360	9
	FirstYear Examination (Part 1 FE)	40	1
	Final Examination (Part 2 FE)	80	2
	Total (1st & 2nd):	2888	85

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Training Module	M 01 Basic Training Metal Works		
Associated to CU	1, 5, 7	Duration: 256 hours	8 weeks
Evaluation criteria	Trainees are able to read and interpret technical drawings as per ISO Trainees manufacture workpieces according to technical drawings within the required tolerances and the allowed time		
Requirements for training	Workbench with standard set of hand tools and benchvise technical tables drawing instruments PC - laboratory	Applied Theory: 6 hrs/week Computer applications: 2 hrs/week General Education: 6 hrs/week Workshop Practice: 26 hrs/week	

Capacities M 01	Contents	hours
1 Reading and interpreting technical drawings	3-view technical drawings, sectional views isometric and dimetric views	12

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Capacities M 01	Contents	hours
2 Manufacturing metal workpieces according to technical drawings by manual working techniques	marking out, chiseling, filing, centre punching, drilling	180
3 Producing technical drawings and lists of standard items	use of drawing instruments use of mini drawing board	16
4 Planning the work sequence for given jobs	Production plan	8
5 Selecting the suitable measuring instruments for various jobs	Steel rule, vernier caliper, micrometer, bevel protractor, measuring tape	8
6 Calculating lengths of workpieces, surface areas, volumes and mass	Units of length, metric system and imperial system, cross-sections	8
7 Presenting the project results	Visualisation techniques such as mind maps, posters...	4
8 Documenting work sequence and results of jobs	Elaboration of assessment sheets	4
9 Realizing the significance of national and international standards	Use of technical tables	4
10 Calculating the cost of manual jobs	Material costs and labour costs per job	4
11 Working in a team to reach agreement and optimum results	Communication methods	8

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Training Module	M 02 Machining (Turning, Tool grinding)		
Associated to CU	1, 2, 3, 4, 8	Duration: 256 hours	8 weeks
Evaluation criteria	Trainees are able to produce cylindrical items on the lathe according to technical drawings within the required tolerances and the allowed time Trainees adhere to safety regulations and care for cleanliness and maintenance of machines and equipment		
Requirements for training	Pedestal grinders; Conventional lathe with lathe tools and clamping devices Technical tables and text books	Applied Theory: 6 hrs/week Computer applications: 2 hrs/week General Education: 6 hrs/week Workshop Practice: 26 hrs/week	

Capacities M 02		Contents	hours
1	Identifying main cutting tool angles of the cutting tool wedge	Angles on the cutting tool wedge and its relation to cutting conditions	8
2	Off-hand grinding of cutting tools such as chisels, twist drills and turning tools	Pedestal grinder and accessories; tool grinding practice	12
3	Observing the safety precautions in tool grinding	Safety regulations in tool grinding	4

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Capacities M 02		Contents	hours
4	Identifying important cutting tool materials linking it with the cutting conditions	High speed steels, carbide tipped tools, ceramics, indexable inserts	8
5	Selecting the suitable cutting tools for a given job		8
6	Describing the construction and the main components of the conventional lathe	Types of lathes, construction and specification	8
7	Selecting the cutting speed and calculating spindle speed (rpm) and the feed for turning jobs	Determination of cutting data by calculation and by reading diagrams	8
8	Maintaining the safety precautions during turning	Safety regulations of the trade	8
9	Planning the lathe work and selecting the appropriate turning tools and clamping devices	Elaboration of the production plan	24
10	Selecting the suitable cooling lubricants	Use of different types of cooling lubricants; Mixing water soluble coolants according to instructions	4
11	Turning cylindrical items on the lathe as per technical drawing, according to required dimensions and tolerances	Longitudinal turning, facing, grooving, cutting	136
12	Inspecting and self-assessing the work		12

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Capacities M 02	Contents	hours
13 Observing the preventive maintenance instructions, lubrication, care and cleanliness on the lathe	Maintenance plans and manuals; Types of lubricants and its uses; Disposal of chips and lubricants	16

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Training Module	M 03 Arc-Welding and Gas Welding		
Associated to CU	1, 3, 4, 12	Duration: 128 hours	4 weeks
Evaluation criteria	Trainees are able to produce welds by oxy-acetylene and manual electric arc welding according to technical drawings Trainees adhere to safety regulations		
Requirements for training	Welding workshop with oxy-acetylene welding equipment and manual electric arc welding equipment	Applied Theory:	6 hrs/week
		Computer applications:	2 hrs/week
		General Education:	6 hrs/week
		Workshop Practice:	26 hrs/week

Capacities M 03		Contents	hours
1	Classifying welding methods according to material used and welding positions	Welding processes according to international standards	2
2	Determining the equipment required for oxyacetylene welding	Oxygen and acetylene cylinders and ist construction; welding torches, its construction and use	4
3	Identifying the symbols for the types of welds and welding positions in technical drawings	ISO standards for technical drawings	2

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Capacities M 03	Contents	hours
4 Making sketches and technical drawings of welded construction using the standardised symbols		8
5 Calculating the consumption of welding gases and determining the cost of welding jobs	Calculation according to technical tables	2
6 Identifying sources of dangers in oxyacetylene welding and observing the safety precautions	International standards on safety regulations in gas welding	2
7 Producing of welds in the leftward welding method, thickness of steel sheets 1...3mm; butt welds and fillet welds in flat welding positions	Welding practice; Defects in welding and inspection methods	48
8 Explaining the working principle of manual electric arc welding	AC- welding / DC welding; Properties of the electric arc	2
9 Classifying welding electrodes according to the required job	ISO standards for welding electrodes; Construction of the welding electrode	2
10 Identifying the equipment required for electric arc welding	Welding transformer, welding rectifier and welding generator	4
11 Producing of build-up welds, butt welds and fillet welds in horizontal position and downward position; material thickness 2..3 mm	Welding practice	48

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Capacities M 03	Contents	hours
12 Maintaining the safety precautions in electric arc-welding, care and maintenance of the equipment	ISO standards on safety in electric arc welding	4

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Training Module	M 04 Sheet-Metal Work and Pipe Fitting		
Associated to CU	1, 3, 4, 6, 7, 9, 13	Duration: 128 hours	4 weeks
Evaluation criteria	Trainees are able to produce sheetmetal components according to the technical drawing within given tolerances and allowed time Trainees are able to install pipe systems according to layout plan		
Requirements for training	Sheet metals in different sizes, pipes and pipe connectors, special sheet metal tools, sheet metal working machines, pipe bending equipment, technical tables and textbok	Applied Theory:	6 hrs/week
		Computer applications:	2 hrs/week
		General Education:	6 hrs/week
		Workshop Practice:	26 hrs/week

Capacities M 04		Contents	hours
1	Explaining the standards and the classification of sheet metals and pipes	ISO standards on sheet metals and pipes	2
2	Distinguishing various sheet metal working processes such as cutting, bending, seaming, beading and crimping	Processing of sheet metals, manually and with the help of machines	8
3	Designing and drawing of sheet metal developments	Sheet metal developments of boxes, tubes, cones and funnels	8

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Capacities M 04		Contents	hours
4	Planning of the work sequence for the manufacture of sheet metal objects	Elaboration of the production plan for sheet metal objects	4
5	Producing of sheet metal items according to technical drawing such as hollow bodies (containers, boxes, funnels, oil can) and sheathings		48
6	Maintaining the safety precautions during sheet metal work	ISO standards on safety in sheet metal work	4
7	Classifying and explaining different pipe connections	Pipe connections such as flanges, cutting ring, pipe threads	4
8	Explaining methods of cold- and hot pipe bending	Manual bending of pipes and pipe bending using mechanical and hydraulic devices	8
9	Designing the pipe layouts using the standard pipe work symbols	Technical drawing of pipe layout systems according to ISO	12
10	Calculating of the pipe sizes		2
11	Manufacturing of pipe systems according to the layout using standard items and applying various pipe joining methods	Pipelines for compressed air and for liquids	24
12	Inspecting the pipe system for leaks and assessing the quality of the work	Leak test with handpump	4

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Training Module	M 05 Basic Electrical Engineering		
Associated to CU	1, 3, 17	Duration: 128 hours	4 weeks
Evaluation criteria	The trainee is able to read and interpret electric circuit plans and realises the circuits on the plug board. The trainee tests, measures and evaluates simple electric circuits.		
Requirements for training	Basic electrical training laboratory with measuring instruments, plugboards and electrical components	Applied Theory:	6 hrs/week
		Computer applications:	2 hrs/week
		General Education:	6 hrs/week
		Workshop Practice:	26 hrs/week

Capacities M 05		Contents	hours
1	Explaining the nature of electricity – fundamentals of electrical engineering	Bor's atomic model	4
2	Classifying the effects of electric current	Thermal effects, magnetic effects, chemical effects of electric current	4
3	Realising the dangers of electric current, sources of accidents and first aid	Regulations on safety in electric installations; First aid measures	4

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Capacities M 05		Contents	hours
4	Distinguishing between the electric current, the resistance and electric tension	Analogy with water current; units for current, tension and resistance; Ohm's law in DC circuits	8
5	Explaining the generation of electric tension		4
6	Developing simple electric circuits (DC)	Simple electric DC circuits	36
7	Measuring electric current and voltage for given resistors with the help of the multimeter on the plugboard	Use of analog and digital multimeters	16
8	Drawing the current-voltage diagram by measuring different resistors and deriving Ohm's law from it	Design of the current-voltage diagram with the help of the PC	8
9	Calculating electric circuits with electric consumers in parallel and in series		4
10	Calculating of electric work and electrical power		8
11	Explaining the protective measures in electrical engineering such as insulation, fusing, low-voltage systems, grounding methods and fault voltage circuit breakers		12
12	Developing low voltage circuits on the plugboard, using resistors, light-bulbs,	Design and try-out of low voltage circuits on the plugboard	20

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Capacities M 05	Contents	hours
13 Switches, relays and carrying out the necessary measurements		20
14 Documenting the results in worksheets		4
0		0

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Training Module	M 06 Measurement and Verification I		
Associated to CU	3, 6	Duration: 128 hours	4 weeks
Evaluation criteria	The trainee is able to select the appropriate measuring instruments for given jobs, measures and verifies dimensions and tolerances		
Requirements for training	Set of measuring instruments for linear and angular measurements Set of limit gauges	Applied Theory:	6 hrs/week
		Computer applications:	2 hrs/week
		General Education:	6 hrs/week
		Workshop Practice:	26 hrs/week

Capacities M 06		Contents	hours
1	Realising the relevance of inspection and quality control in metal working		4
2	Classifying of inspection methods according to type and shape of job and the required accuracy	Terminology and definitions in inspection and metrology	8
3	Distinguishing linear- and angular measurement and measurement of surfaces	Units in measurements	8

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Capacities M 06	Contents	hours
4 Using simple gauges and limit gauges	Form gauges, slip gauges, plug gauges and snap gauges	8
5 Determining measuring faults: systematic and random faults		4
6 Using of different measuring instruments: steel rule, vernier calliper, micrometer, dial gauge, plug gages, ring gauges, slip gauges		48
7 Documenting and assessing the results of measuring	Inspection sheets	4
8 Explaining the standardised tolerance system	ISO tolerance system	8
9 Calculating of fits for the basic hole and the basic shaft system	Designation of tolerances in technical drawings	8
10 Applying suitable inspection methods for given jobs	Inspection of various machine elements	24
11 Caring for measuring instruments	Inspection of measuring instruments and assessment of current condition	4

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Training Module	M 07 Internship 1		
Associated to CU	1, 3, 4, 7, 8, 9, 12, 13	Duration: 360 hours	9 weeks
Evaluation criteria			
Requirements for training	Enterprise in the metal working sector which offers internships to trainees	Applied Theory:	6 hrs/week
		Computer applications:	2 hrs/week
		General Education:	6 hrs/week
		Workshop Practice:	26 hrs/week

Capacities M 07	Contents	hours
1 Observing and participating in the typical working routine of professional mechanics.		0
2 Accomplishing typical basic tasks of professional mechanics.		0
3 Keeping records of work assignments.		0
4 Describing technical applications of the working environment.		0

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Capacities M 07	Contents	hours
5 Applying safety and health measures.		0
6 Exercising team work, responsibility and reliability.		0

Training Module	M 08-M Machining II		
Associated to CU	Duration: 256 hours		8 weeks
Evaluation criteria	Trainee is able to machine components by turning, milling and surface grinding according to the technical drawing within the tolerances and the required time		
Requirements for training	Machine shop with universal lathe, universal milling machines and a surface grinding machine Necessary cutting tools, tool holders, vices and cabinets	Applied Theory:	6 hrs/week
		Computer applications:	2 hrs/week
		General Education:	6 hrs/week
		Workshop Practice:	26 hrs/week

Capacities M 08-M	Contents	hours
1 Classifying different types of lathes	Difference between conventional lathe and CNC lathe Universal lathe, turret lathe, vertical lathe	12
2 Turning of tapers by different methods	Compound slide method, taper turning attachment and set over of the tailstock	8
3 Turning of threads with engagement of the lead screw	Turning of metric threads and inch threads	8

Capacities M 08-M		Contents	hours
4	Doing the necessary calculations for taper turning and threading	Calculation of taper angle and slope applying the trigonometric functions	12
5	Planning the work sequence for given jobs		16
6	Measuring of the tapers and the threads	Use of the sine bar for inspection Use of thread gauges	8
7	Classifying the different types of milling machines	Difference between universal milling machine and CNC milling machine	12
8	Using the indexing head and the turntable for indexing work	Calculation of gear ratios for indexing	24
9	Machining of gears	Machining of gears by means of indexing head and gear milling cutters	12
10	Designing of workpieces in 3D CAD and deriving of the technical drawing	Practising design with 3D-CAD e.g. Inventor or SolidWorks	24
11	Describing of the construction and the main components of the surface grinder		12
12	Identifying various grinding agents and designs of grinding wheels	ISO standards for grinding wheels Grinding agents: Al ₂ O ₃ , SiC, BN, C	8
13	Trimming and balancing the grinding wheel	Use of the grinding wheel balancing unit Balancing of grinding wheels	4

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Capacities M 08-M	Contents	hours
14 Carrying out various surface grinding jobs		24
15 Using the appropriate cooling lubricants for machining	Classification of cooling lubricants	8
16 Observing the preventive maintenance instructions, lubrication, care and cleanliness on the machine tools	Classification of lubricants, inspection of machines and equipment for wear and tear	24
17 Presenting the project results		8
18 Documenting work sequence and results of jobs		8
19 Calculating the cost of machining jobs		8
20 Working in a team to reach agreement and optimum results		12

Training Module	M 09-M Mounting and Dismounting		
Associated to CU	Duration: 256 hours		8 weeks
Evaluation criteria	The trainee is able to inspect machinery and equipment according to inspection plan. He suggests remedies for defective machines and exchanges machine elements		
Requirements for training	Tools and equipment for assembly work. Assemblies and sub-assemblies with bearings, shafts, hubs, key jopints, belts and chains for assembly practice	Applied Theory:	6 hrs/week
		Computer applications:	2 hrs/week
		General Education:	6 hrs/week
		Workshop Practice:	26 hrs/week

Capacities M 09-M		Contents	hours
1	Identifying different shaft-hub connections and calculating the strength	Key-hub connections, splines, shear strength	24
2	Classifying the different types of rolling bearings and friction bearings	Ball bearings, roller bearings, needle bearings, tapered roller bearings and bearing bushes	36
3	Fitting and dismantling of various types of bearings	Different mounting methods	24

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Capacities M 09-M		Contents	hours
4	Identifying of seals, bolts, shaft lockings and fitting key joints as per national or international standards		12
5	Fitting of belt drives, flat belt, V-belt, toothed belt.....		12
6	Planning the work sequence for the fitting of sub-assemblies and machines	Elaboration of assembly plans	24
7	Inspecting machine parts for wear and tear and identifying of the causes and proposing remedies	Causes of wear, exchange of worn machine elements, rigging of machinery	12
8	Realising the seriousness and consequences of downtime because of breakdown of machinery	Preventive maintenance	16
9	Calculating the cost of maintenance and of downtime		8
10	Designing of inspection and maintenance plans and concepts		16
11	Simulating the assembly of machine parts in 3D-CAD	Design practice with 3D CAD-system e.g. Inventor, SolidWorks	16
12	Maintaining the safety precautions during assembly		8

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Capacities M 09-M		Contents	hours
13	Classifying lubricants as per national and international standards	ISO Standards of lubricants; Properties of lubricants	12
14	Inspecting and self-assessing the assembly work	Elaboration of assembly- and repairwork records	20
15	Documenting assembly or machine repair work and presenting it to listeners		16

Training Module	M 10-M CNC-Machining (Introduction)		
Associated to CU	Duration: 128 hours		4 weeks
Evaluation criteria	The trainee is able to write the CNC program for given jobs The trainee is able to pre-set tools, set up the CNC machine and machine the job		
Requirements for training	PC-lab with CNC software for programming, testing and simulation Preferable: One CNC milling machine with necessary tools and equipment	Applied Theory:	6 hrs/week
		Computer applications:	2 hrs/week
		General Education:	6 hrs/week
		Workshop Practice:	26 hrs/week

Capacities M 10-M		Contents	hours
1	Comparing conventional machine tools and CNC machines identifying strengths and advantages	Advantages and range of application of CNC machines	8
2	Describing the special CNC machine sub-assemblies, spindle drives, sensors, measuring systems and feedback control systems		8

Capacities M 10-M	Contents	hours
3 Distinguishing 2D, 2 ½ D, 3D controls and multi axes machines describing the coordinate systems in CNC machining	Machine zero point, reference points and workpiece zero point	12
4 Identifying the special tools and equipment required for CNC machining		16
5 Preparing and setting the cutting tools prior to the job	Zero setting of tools with the help of presetting equipment	16
6 Distinguishing absolute and incremental dimensions	CNC-oriented dimensioning of jobs	12
7 Programming as per ISO	Elaboration of programmes according to technical drawings	24
8 Writing of CNC programs for various jobs (turning and milling) and simulating and testing it on the PC with CNC software		24
9 Explaining and describing CAD/CAM systems		8

Training Module	M 11-M Heat Treatment and Material Testing		
Associated to CU	Duration: 64 hours		2 weeks
Evaluation criteria	The trainee selects materials suitable for heat treatment He hardens or anneals steels according to specifications		
Requirements for training	Various types of steels Heat treatment furnace Material testing equipment Hydraulic press	Applied Theory:	6 hrs/week
		Computer applications:	2 hrs/week
		General Education:	6 hrs/week
		Workshop Practice:	26 hrs/week

Capacities M 11-M		Contents	hours
1	Describing the effects of carbon content in steels on their properties	Hardness, brittleness, hardenability and technological properties depending on carbon content in steels	4
2	Explaining the iron-carbon diagram for non-alloy steels	Microstructure of steel: ferrite, austenite, martensite, cementite and eutectic point	8
3	Classifying the different methods of heat treatment for steels	Annealing, through hardening, surface hardening and quenching	4

Capacities M 11-M	Contents	hours
4 Describing the structural changes in steel on heating and quenching		4
5 Drawing the time-temperature diagram for hardening and tempering, through hardening and surface hardening of various types of steels		4
6 Classifying the different types of material testing methods	Overview on material testing methods	8
7 Carrying out hardness tests (Brinell, Vickers, Rockwell)		8
8 Carrying out the tensile test for various types of ferrous and non-ferrous metals	Tensile test with the hydraulic press and elaboration of the stress-strain diagram	8
9 Interpreting the stress-strain diagram		8
10 Calculating tensile strength, yield point and elongation for machine elements		8

Training Module	M 12-M Pneumatics and Hydraulics		
Associated to CU	Duration: 128 hours		4 weeks
Evaluation criteria	The trainee is able to design and install pneumatic and hydraulic circuits on the plug board The trainee tests, finds faults and rectifies trouble in pneumatic and hydraulic circuits		
Requirements for training	Pneumatic and hydraulic lab with plugboards and necessary equipment PC software for the design and the simulation of pneumatic and hydraulic circuits	Applied Theory:	6 hrs/week
		Computer applications:	2 hrs/week
		General Education:	6 hrs/week
		Workshop Practice:	26 hrs/week

Capacities M 12-M		Contents	hours
1	Describing automatic control and signal flow with the help of signal flow diagram distinguishing between open loop and closed loop	Block diagrams and step diagrams	8
2	Explaining the provision of compressed air with different types of compressors	Physics of gases, piston compressor, vane compressor and Roots compressor	8

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Capacities M 12-M	Contents	hours
3 Identifying the equipment required for compressed air systems used in pneumatic circuits		8
4 Explaining the control elements, cylinder, valves, switches and its symbols as per ISO		4
5 Designing of various pneumatic control circuits on the PC using suitable software e.g. FluidSim and testing it	Control of single acting cylinder, double acting cylinder AND-relations, OR-relations and distance rules on cylinders	24
6 Testing various pneumatic control circuits on the plug board, trouble shooting self-assessing and documenting the work		24
7 Replacing the pneumatic control circuits with electrical control circuits	Fundamentals of electric circuits, relays and solenoid valves	12
8 Explaining the physical principals of hydraulic systems		4
9 Identifying the equipment required for hydraulic circuits	Types of hydraulic pumps, oil tanks, pipes, cylinders and control valves	4
10 Calculating pressure, volume of flow, transmission of forces in hydraulic circuits		4

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Capacities M 12-M	Contents	hours
0 Designing various different circuit diagrams, trying them out on the plug-board documenting and self-assessing the work		20
0 Replacing the hydraulic control circuits with electrical control circuits		4
0 Identifying sources of accidents in hydraulics and pneumatics, observing the safety rules and taking the precautionary steps to avoid accidents	Safety regulations as per ISO	4

Training Module	M 13-M Welding II (MIG/MAG & TIG)		
Associated to CU	Duration: 128 hours		4 weeks
Evaluation criteria	The trainee is able to produce different types of welds with the MIG/MAG and the TIG welding technology		
Requirements for training	Welding workshop with MIG/MAG welding and TIG welding equipment	Applied Theory: 6 hrs/week Computer applications: 2 hrs/week General Education: 6 hrs/week Workshop Practice: 26 hrs/week	

Capacities M 13-M		Contents	hours
1	Classifying the welding methods as per ISO, pointing out its application	Overview on welding methods	4
2	Describing the advantages of MIG/MAG and TIG welding and its range of application		4
3	Identifying the equipment required for MIG/MAG welding, the shielding gases and the filler material	Electrode coil materials, electrode feed unit, welding torch, electric arc and shielding gases	4

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Capacities M 13-M		Contents	hours
4	Planning the work sequence for the welding jobs and making drawings of the welded constructions as per ISO or national standards	Elaboration of the welding plan and the technical drawing	8
5	Calculating the cost of welding		2
6	Carrying out MIG/MAG welding for different types of joints in different welding positions	Butt joint, lap joint, corner joint, fillet weld. Horizontal, vertical and rotated welding position	36
7	Welding of different types of materials such as mild steel and aluminium		24
8	Taking precautionary measures to avoid accidents and observing the safety regulations	Safety regulation as per ISO	8
9	Identifying the equipment used for TIG - welding	Welding machine, tungsten electrode, electric arc and shielding gases	4
10	Planning the work sequence for the TIG welding jobs making drawings of the welded constructions as per ISO or national standards	Elaboration of the welding plan and the technical drawing	8
11	TIG – welding of materials such as mild steel, stainless steel and aluminium in different welding positions and for different types of joints and for thin sheets		18

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Capacities M 13-M	Contents	hours
12 Identifying of faulty welds and applying various testing measures	Inspection, types of defects and corrective action Throat size, liquid penetrant test	8

Training Module	M 14-M Measuring and Verification II		
Associated to CU	Duration: 64 hours		2 weeks
Evaluation criteria	The trainee is able to assess the quality of jobs using necessary measuring instruments and gauges The Trainee documents the results of inspection in protocol sheets		
Requirements for training	Inspection equipment, measuring instruments and gauges as per contents M14	Applied Theory:	6 hrs/week
		Computer applications:	2 hrs/week
		General Education:	6 hrs/week
		Workshop Practice:	26 hrs/week

Capacities M 14-M		Contents	hours
1	Describing the tolerances of form and using the appropriate testing methods to determine the quality of work	Straightness, flatness, parallelism, perpendicularity, angularity and concentricity	12
2	Identifying the standardised symbols of form tolerance and inserting them in technical drawings	Symbols for tolerances of form according to ISO	12

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Capacities M 14-M	Contents	hours
3 Inspecting of tapers and threads using the appropriate testing methods	Thread gauge and sine bar	8
4 Documenting and analysing the results of measurements	Elaboration of inspection sheets	12
5 Realizing the relevance of quality control in production	Elements of quality, 100% inspection and random inspection, standard deviation and frequency distribution	8
6 Introducing the statistical process control method using quality control cards		12

Training Module	M 15-M Internship 2		
Associated to CU	Duration: 360 hours		9 weeks
Evaluation criteria	Satisfactory reports from the company where the internship took place Quality of the record books		
Requirements for training	Enterprise in the metal working sector which offers internships to trainees	Applied Theory:	6 hrs/week
		Computer applications:	2 hrs/week
		General Education:	6 hrs/week
		Workshop Practice:	26 hrs/week

Capacities M 15-M	Contents	hours
1 Observing and supporting the typical working routine of professional mechanical production		0
2 Accomplishing typical tasks of professional mechanical production work.		0
3 Keeping records of work assignments.		0
4 Describing technical applications of the working environment.		0

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Capacities M 15-M	Contents	hours
5 Applying safety and health measures.		0
6 Exercising team work, responsibility and reliability.		0

