GOVERNMENT NOTICES

SOUTH AFRICAN QUALIFICATIONS AUTHORITY

No. 352 **14 May 2010**

SOUTH AFRICAN QUALIFICATIONS AUTHORITY (SAQA)

In accordance with Regulation 24(c) of the National Standards Bodies Regulations of 28 March 1998, the Standards Generating Body (SGB) for

Manufacturing and Assembly Processes

registered by Organising Field 06 – Manufacturing Engineering and Technology, publishes the following Qualifications and Unit Standards for public comment.

This notice contains the titles, fields, sub-fields, NQF levels, credits, and purpose of the Qualifications and Unit Standards. The full Qualifications and Unit Standards can be accessed via the SAQA web-site at **www.saqa.org.za**. Copies may also be obtained from the Directorate of Standards Setting and Development at the SAQA offices, SAQA House, 1067 Arcadia Street, Hatfield, Pretoria.

Comment on the Qualifications and Unit Standards should reach SAQA at the address below and ***no later than*** 14 June 2010. All correspondence should be marked **Standards Setting – SGB for Manufacturing and Assembly Process** and addressed to

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SOUTH AFRICAN QUALIFICATIONS AUTHORITY

QUALIFICATION:
Further Education and Training Certificate: Autotronics

SAQA QUAL ID	***QUALIFICATION TITLE***		
78883	Further Education and Training Certificate: Autotronics		
ORIGINATOR		***PROVIDER***	
SGB Manufacturing and Assembly Processes			
QUALIFICATION TYPE	***FIELD***	***SUBFIELD***	
Further Ed and Training Cert	6 - Manufacturing, Engineering and Technology	Manufacturing and Assembly	
ABET BAND	***MINIMUM CREDITS***	***NQF LEVEL***	***QUAL CLASS***
Undefined	134	Level 4	Regular-Unit Stds Based

New NQF Level: NQF Level 04

This qualification does not replace any other qualification and is not replaced by another qualification.

PURPOSE AND RATIONALE OF THE QUALIFICATION
Purpose:

This Qualification is for any individual who is, or wishes to be, involved in an autotronics environment. The Qualification contains all the skills, knowledge, values and attitudes required by a learner who needs mainly to be able to perform a range of activities and thereby meet the challenges within a specific autotronics environment at this level. An individual acquiring this Qualification will be able to contribute towards the efficient operation of a number of processes within this sector as described in the Core component of the qualification.

The main competencies in this qualification are communication and mathematical literacy competencies at this level, diagnosing, servicing and maintaining automobile air conditioning systems, fitting and wiring-up auto-electrical equipment, diagnosing and repairing faults on advanced auto-electrical circuits, diagnosing and repairing networking and communications systems and diagnosing and repairing engine management systems.

These competencies will enable the learner to work in different industries within the diverse autotronics sector.

The Qualification ensures progression of learning, enabling the learner to perform optimally within the autotronics field of learning and provide access to a higher Qualification within the same or a related sector. The Qualification will facilitate access to, and mobility within, education and training for learners who:

- Would like to achieve this Qualification through the process of Recognition of Prior Learning (RPL) and/or formal study.
- Wish to extend their range of skills and knowledge and hence their competencies in the autotronics environment.

The Qualification also intends to:

- Release the potential of people.
- Provide opportunities for people to explore related activities within the autotronics sector.

Rationale:

This is the third Qualification in a series of four autotronics qualifications that range from NQF Levels 2 to 5. These qualifications constitute a learning pathway that takes the learners from basic/simple competencies in autotronics at NQF Level 2 to high level autotronics competencies at NQF Level 5. Typical learners will be persons who have completed the National Certificate Autotronics at NQF Level 3 who wish to further their career in autotronics.

The automobile is subject to ever increasing technological advances. These advances are continuously being incorporated into the electrical systems of automobiles. They represent the integration of mechanical, hydraulic, pneumatic, electronic and electrical systems and are managed by microelectronic control known as Computer Integrated Auto Management (CIAM) Systems. Consequently, the auto-electrical skills required to maintain such automobiles are changing to incorporate more electronic skills.

The field of autotronics deals with the installation, diagnosis and repair of CIAM systems. People working in the field of autotronics require specialised technical skills and knowledge and well as highly developed analytical skills to enable them to install, diagnose and repair CIAM systems.

This series will reflect the skills, knowledge and understanding required to perform effectively in industry, whether in micro, small, medium or large enterprises.

For those who have been in the work place for a long time, this qualification represents part of the RPL process that acknowledges workplace skills acquired without the benefit of formal education and training.

This qualification forms the basis for further learning in the field of autotronics at NQF Level 5.

The autotronics sector falls within the ambit of South Africa's large motor industry. There are huge motor assembly plants in several parts of the country, primarily in the Eastern Cape, Gauteng and Kwa Zulu Natal provinces. There are also many automotive related sectors like the automotive components manufacturing and assembly industries, automotive sales and service sector, repairs (including panel beating and spray painting) industries. It's a sector that employs a large number of people. Companies and/or industries within this sector operate in a global competitive and challenging environment.

The highly developed autotronics sector is well-established and economically powerful. In terms of transformation in the country, learners will require skills and competencies to gain access to positions within management structures by completing other qualifications and training. It will be in the interest of the country and the sector to ensure that those who operate in the autotronics environment are trained according to this Qualification to improve productivity and efficiency.

This national Qualification and its related Unit Standards were developed to standardize the accreditation of learning programmes, resulting in improved quality management in terms of programme delivery.

RECOGNIZE PREVIOUS LEARNING?
Y

LEARNING ASSUMED IN PLACE
Learners wishing to study towards this Qualification are assumed to have:

- Mathematical Literacy at NQF Level 3.

- Communication at NQF Level 3.

Recognition of Prior Learning:

This Qualification may be achieved in part (or whole) through the recognition of relevant prior knowledge and/or experience. The learner must be able to demonstrate competence in the knowledge, skills, values and attitudes implicit in this Qualification. As part of the provision of recognition of prior learning providers are required to develop a structured means for the assessment of individual learners against the Unit Standards of the Qualification on a case-by-case basis. A range of assessment tools and techniques during formative and summative assessment procedures should be used which have been jointly decided upon by the learner and the assessor. Such procedures, and the assessment of individual cases, are subject to moderation by independent assessors. The same principles that apply to assessment of this Qualification also apply to Recognition of Prior Learning.

Learners may provide evidence of prior learning for which they may receive credit towards the Unit Standards and/or the Qualification by means of portfolios or other forms of appropriate evidence as agreed to between the relevant provider and relevant ETQA or ETQA that has a Memorandum of Understanding in place with the relevant ETQA.

Recognition of Prior Learning is particularly important, as there are people in the autotronics sector with a variety of skills and competencies of differing quality and scope. It is important that Recognition of Prior Learning process be available to assist in making sense of existing competencies and skills, and helping to standardize these competencies and skills towards a common standard.

Access to the Qualification:

There is an open access to this Qualification. However learners should first have completed the National Certificate: Autotronics, NQF Level 3.

QUALIFICATION RULES

The Qualification consists of a Fundamental, a Core and an Elective Component.

To be awarded the Qualification learners are required to obtain a minimum of 134 Credits as detailed below.

Fundamental Component: 56 Credits.

The Fundamental Component consists of Unit Standards in:

- Mathematical Literacy at NQF Level 4 to the value of 16 Credits.
- Communication at NQF Level 4 to the value of 20 Credits.
- Communication at NQF Level 3 to the value of 20 Credits.

It is compulsory therefore for learners to do Communication in two different South African languages, one at NQF Level 4 and the other at NQF Level 3.

All Unit Standards in the Fundamental Component are compulsory.

Core Component: 58 Credits.

The Core Component consists of Unit Standards to the value of 58 Credits, all of which are compulsory.

Elective Component.

Learners are to choose Elective Unit Standards totaling a minimum of 20 Credits to attain a minimum of 134 Credits for this Qualification.

EXIT LEVEL OUTCOMES

1. Diagnose and repair faults on advanced auto electrical circuits.

2. Fit and wire-up auxiliary auto-electrical equipment.

3. Diagnose and repair networking/data transfer systems on automobiles.

4. Diagnose, service and maintain automobile air-conditioning systems.

5. Test and repair integrated fuel injection and engine control systems.

6. Implement occupational health and safety requirements.

Critical Cross-Field Outcomes

Identify and solve problems in which responses display that responsible decisions using critical and creative thinking have been made when:

- Recognizing situations that require action and correct when necessary.
- Testing and diagnosing problems in the air-conditioning system, networking/data transfer systems and with fitted auto-electrical equipment.
- Reading and interpreting electrical circuit diagrams for air-conditioning and networking/data transfer diagrams.
- Problem solving is developed when human error and medical emergencies unrelated to the facility have been considered and are adequately catered for.
- Differentiating between the main types of injection systems.
- Testing and repairing common rail fuel injection/combined ignition and engine control systems on petrol and diesel vehicles.

Work effectively with others as a member of a team, group, organization, community to:

- Trace and repair faults.
- Repair automobile air-conditioning and networking/data transfer system.
- Test and repair common rail fuel injection/combined ignition and engine control systems on petrol and diesel vehicles.

Organize and manage oneself and one's activities responsively and effectively when:

- Applying the correct procedures for using, storing and looking after equipment, tools, test equipment, components and chemicals.
- Explaining the basic operating principles of the refrigeration cycle and the operation of auxiliary auto-electrical equipment and harnesses of an automobile.
- Reading and interpreting electrical circuit diagrams.
- Servicing and maintaining automobile air-conditioning systems.
- Investigating the handling of the incident within a relevant time frame and authority.
- Fitting, wiring-up and commissioning auto-electrical component.
- Sourcing information from manufacturer's manuals.
- Explaining the purpose, variants and common causes of failure with networking/data transfer systems.
- Using wiring and technical diagrams/information to obtain information on these systems.
- Explaining the purpose/functions of sub-systems of combined fuel injection/ ignition systems.

Collect, analyze, organize and critically evaluate information to:

- Diagnose and repair automobile air conditioner problems.
- Diagnose problems related to fitted auto-electrical equipment.
- Interpret an automobile networking/data transfer block diagram.
- Determine the cause of a fault or system failure.
- Differentiate between the main types of injection systems.

Communicate effectively using visual, mathematical and/or language skills in the modes of oral and/or written presentation to:

- Use common names for tools and equipment.
- Fill in and use fault reports, requisition forms and job cards.
- Prepare reports on the air-conditioning system, the auxiliary auto-electrical equipment and harnesses of an automobile and on the failure of networking systems, as per company procedure.

Use science and technology effectively and critically, showing responsibility towards the environment and the health of others by:

- Using tools and equipment according to manufacturer's instructions and Workplace procedure.
- Using electrical technology wit care.
- Applying Kirchhoff's current and voltage laws.

Demonstrate an understanding of the world as a set of related systems by recognising that problem-solving contexts do not exist in isolation when:

- Relating the functioning of automobile electric systems to that of other related electrical systems.
- engaging with problems to do with the air-conditioning system, the auxiliary auto-electrical equipment and harnesses of an automobile and the networking/data transfer system.
- explaining that faults on other vehicle systems can affect the functioning of the engine management system.

ASSOCIATED ASSESSMENT CRITERIA

Associated Assessment Criteria for Exit Level Outcome 1:

- Advanced auto electric circuit diagrams are interpreted using symbols to determine structure and sequence of circuit.
- Test equipment is selected and used to locate and identify faults on auto electric circuits.
- Components are removed and fitted according to procedure and manufacturer's specifications and with due regard to safety practices of the workplace.
- Fault finding reports are completed in accordance with workplace procedures.

Associated Assessment Criteria for Exit Level Outcome 2:

- The operation of auxiliary auto-electrical equipment and harnesses of an automobile is explained in terms of their functions and components.
- Auxiliary auto-electrical equipment is fitted, wired-up and commissioned according to manufacturer's specifications and workplace procedures.
- Auxiliary auto-electrical equipment is tested and problems are diagnosed as per manufacturer's specifications.
- Repairs to auxiliary auto-electrical equipment are performed as per workplace procedure.

Associated Assessment Criteria for Exit Level Outcome 3:

• Automobile networking/data transfer diagram is interpreted using its key components, symbols and terminology.
• Faults on networking/data transfer systems are located and diagnosed using appropriate test equipment.
• Faulty networking components/wiring is repaired or replaced using the appropriate tools and procedures.
• The purpose and variants of networking/data transfer systems are explained in terms of their types and the common causes of failure with these systems are discussed using examples.

Associated Assessment Criteria for Exit Level Outcome 4:

• The basic operating principles of the refrigeration cycle is explained using scientific terminology.
• The components of the automobile air-conditioning system are described in terms of their functions.
• Air-conditioning electrical circuit diagrams are read and interpreted using circuit symbols and standard procedure.
• Automobile air-conditioning systems are serviced and maintained according to manufacturer's specifications.
• Automobile air conditioner problems are diagnosed and repaired as per manufacturer's specifications and workplace procedures.

Associated Assessment Criteria for Exit Level Outcome 5:

• The main types of injection systems including combined ignition and injection systems/diesel/petrol common rail systems are identified in terms of their differences.
• Wiring and technical diagrams/information are used to obtain information on injection systems.
• Common components for combined ignition and injection systems are identified and explained in terms of their purpose and functions.
• The sub-systems of combined fuel injection/ignition systems are explained in terms of their purpose/functions.
• Common rail fuel injection/combined ignition and engine control systems on petrol and diesel vehicles are tested and repaired as per procedure.

Associated Assessment Criteria for Exit Level Outcome 6:

• A safe environment is maintained for team members to work.
• Policy is implemented to promote the prevention of safety and emergency incidents.
• Incidents (including emergency incidents) which affect the safety of an individual, group or crowd are managed according to procedure.
• The reaction of an individual, group or crowd to a safety or emergency incident is managed according to procedure including crowd control.

Integrated Assessment:

The importance of integrated assessment is to confirm that the learner is able to demonstrate applied competence (practical, foundational and reflexive) and ensure that the purpose of this Qualification is achieved. Both formative and summative assessment methods and strategies are used to ensure that the Exit Level Outcomes and the purpose of the Qualification are achieved through achieving the Unit Standards. Learning, teaching and assessment are inextricably linked.

Learning and assessment should be integrated and assessment practices must be fair, transparent, valid and reliable. A variety of assessment strategies and approaches must be used. This could include tests, assignments, projects, demonstrations and/or any applicable

method. Evidence of the acquisition of competencies must be demonstrated through the Unit Standards, which enhance the integration of theory and practice as deemed appropriate at this level.

Formative assessment is an on-going process which is used to assess the efficacy of the teaching and learning process. It is used to plan appropriate learning experiences to meet the learner's needs. Formative assessments can include a mix of simulated and actual (real) practice or authentic settings. Feedback from assessment informs both teaching and learning. If the learner has met the assessment criteria of all the Unit Standards then s/he has achieved the Exit Level Outcomes of the Qualification.

Summative assessment is concerned with the judgement of the learning in relation to the Exit Level Outcomes of the Qualification. Such judgement must include integrated assessment(s) which test the learners' ability to integrate the larger body of knowledge, skills and attitudes, which are represented by the Exit Level Outcomes. Summative assessment can take the form of oral, written and practical examinations as agreed to by the relevant ETQA.

Integrated assessment must be designed to achieve the following:

- An integration of the achievement of the Exit Level Outcomes in a way that reflects a comprehensive approach to learning and shows that the purpose of the Qualification has been achieved.
- Judgement of learner performance to provide evidence of applied competence or capability.

Assessors and moderators should make use of a range of formative and summative assessment methods. Assessors should assess and give credit for the evidence of learning that has already been acquired through formal, informal and non-formal learning and work experience.

Assessment should ensure that all specific outcomes, embedded knowledge and critical cross-field outcomes are assessed. The assessment of the critical cross-field outcomes should be integrated with the assessment of specific outcomes and embedded knowledge.

INTERNATIONAL COMPARABILITY

This qualification is part of a series of qualifications in the field of Autotronics and was compared to similar qualifications-some outcomes-based-in various countries. The following countries were used to compare this qualification with:

- United States - The US has one of the most extensive and very highly-developed car manufacturing industries in the world.
- United Kingdom - The UK also has a highly-developed car manufacturing industry. It also has a number of institutions that offer training courses in the automotive/autotronics field.
- New Zealand and Australia - They have qualification frameworks similar to the South African NQF; this facilitates comparison.
- Malaysia-Malaysia works closely with training partners in the automotive industry. These include vehicle brands such as BMW, Mercedes Benz, Nissan, Mazda, Ssangyong, Citroen, Fiat, Honda, Hyundai, Toyota, Audi and Volvo.
- India - India has a thriving car manufacturing industry.
- Northern Ireland - A relevant qualification in this country was found.

International comparability with the following car manufacturing countries was attempted, with little success, as there was very little or no information available:

- Japan.
- Korea.
- Sweden.

- France.
- Germany.
- Italy.
- China.

There was also a paucity of information on training offered by car manufacturers to their employees; in other words, vehicle or company-specific training. Some information is available on training by car manufacturers, namely, Volvo. This is described later.

Comparability with the following countries was possible and the comparisons are listed below:

New Zealand:

Within New Zealand any programme leads to a qualification such as a degree, diploma or certificate and usually consists of a number of courses/unit standards. When a course/unit standard in the programme is completed, the credits for that course/unit standards count towards the total credits one requires to complete the programme. A course/unit standard is a module of study within a programme, and is therefore usually taken over one semester. In some qualifications all courses/unit standards are compulsory, while in others there may be elective courses/unit standards.

Current certificates which are presented in New Zealand include the following:

Certificate: Applied Technology (Autotronics) Level 4, 120 credits:

The Certificate: Applied Technology (Autotronics) provides learners with an in-depth understanding of electronic control systems and componentry in motor vehicle sub-systems. They gain an insight into motor vehicle mechanical systems and sub-systems, along with electrical and electronic principles. They learn to find faults and diagnose automotive electronic problems, and develop a sound knowledge of engine management, fuel injection, electronics, transmission and ABS controls. Topics covered by this qualification include but are not limited to automotive electronics, electrical and electronic fuel injection and emission controls. Learners who completed this qualification can follow careers in ignition and engine management systems, mechanical, transmission, brakes and suspension controls, apprentice auto electrician, auto electronics technician or vehicle service technician.

Certificate: Applied Technology (Automotive Engineering) Level 4, 120 credits:

The Certificate: Applied Technology (Automotive Engineering) provides learners with a solid grounding for any career in the automotive industry. Topics covered by these qualifications are but not limited to general repairs on engines, transmissions, brakes, steering and suspension, and fuel and electronic control systems. Learners gain an understanding of basic principles and concepts in automotive ignition systems, the function and operation of a vehicle braking system, security, and the identification and repair of transmissions, drivelines and final drives. They develop the skills to interpret general servicing schedules, and carry out customer and administrative services. The qualification also includes critical thinking skills and problem-solving ability. Other topics include chassis, electrical, engine and drive as well as mechanical.

The following competencies/unit standards are addressed in this qualification:

- Electrical.
- Mechanical.
- Chassis.
- Engine and drives.

Once a learner completes the Certificate: Applied Technology (Automotive Engineering) they can apply for cross-credits for unit standards from the National Certificate: Motor Industry (Automotive Engineering) and become an apprentice mechanic working alongside an industry employer, to complete all remaining unit standards. Learners can also choose to continue to the Bachelor of Applied Technology, specializing in Automotive Engineering.

National Certificate: Motor Industry (Automotive Electrical Engineering) Level 4, 244 credits.

This qualification is a progression from the National Certificate: Motor Industry (Entry Skills). This qualification include topics such as testing auto-electrical circuits, overhauling automotive starter motors, testing and rectifying faults within electronic ignition systems.

The following competencies/unit standards are addressed in this qualification:

- Pick up and deliver a customer's vehicle, machine, or equipment.
- Demonstrate knowledge of safe working practices in an automotive workshop.
- Attend to customer inquiries.
- Carry out general engineering tasks to repair, manufacture or modify components.
- Select and use hand tools and equipment.
- Identify locations/functions of motor vehicle systems/components.
- Two and Four stroke petrol and diesel engines.
- Test an automotive electrical unit.

National Certificate: Motor Industry (Automotive Engineering) Level 4: 271 credits:

This certificate is a progression from the National Certificate: Motor Industry (Entry Skills). Topics within this certificate include but are not limited to the diagnosis and repair of emission system fault, servicing automotive cooling systems, identifying wiring diagrams and circuits, rectifying faults in clutch systems, servicing automatic transmission, inspecting and overhauling brakes and replacing engine cam belts. Learners can combine these certificates with their apprenticeship. Learners who achieved this certificate can be employed as an automotive engineer. Automotive technician, heavy equipment technician, powerboat engineer or small engine technician.

The following competencies/unit standards are addressed in this qualification:

- Attend to customer inquiries.
- Demonstrate knowledge of safe working practices in an automotive workshop.
- Carry out general engineering tasks to repair, manufacture or modify components.
- Select and use hand tools and equipment.
- Identify locations/functions of motor vehicle systems/components.
- Two and Four stroke petrol and diesel engines.
- Service automotive battery.
- Test an automotive electrical unit.

Various automotive engineering skills programmes (short courses) also exist and are based on unit standards. These programmes include automotive Air Conditioning (Installation and Servicing), Basic Car Maintenance, Introduction to Multiplexing and CAN Bus, Oscilloscope for Automotive Diagnosis, Vehicle Emission Testing, Vehicle Inspector's Preparatory Course or Vehicle Wheel Alignment.

Malaysia:

The following qualifications exist in Malaysia and compared with the South African Qualification it is clear that the content is similar to the South African Qualifications.

Although it was difficult to determine and compare the levels of these qualifications it is clear that the content and progression are similar as the South African Qualifications.

Malaysia works closely with partners in the automotive industry to expose students to real-life conditions in the automotive industry. Their training partners include companies involved in the distribution and servicing of vehicle brand such as BMW, Mercedes Benz, Nissan, Mazda, Ssangyong, Citroen, Fiat, Honda, Hyundai, Toyota, Audi and Volvo.

The Otomotif College (TOC) offers the following qualification, some of whose competencies resonate with this Qualification:

- Diploma: Modern Automotive Technology:

TOC offers the Technician Apprenticeship Programme or TAP over a period of 2.5 years to develop the learner into a competent automotive technician to handle demands of increasingly sophisticated vehicles.

TAP is a comprehensive programme where students work towards a Diploma: Modern Automotive Technology awarded by TOC. In addition, students will acquire the necessary skills and knowledge to fulfill the requirements of City and Guilds International Diploma in Motor Vehicle Engineering 3905 as well as the MLVK certification Level 1 and 2 under the Ministry of Human Resources.

The programme combines basic principles of automotive technology with extensive hands-on-training both at the college and on-job-training at designated service centres. The ratio of theory to practical training is 30:70. The backbone of the training is electrics and electronics so students are given a very strong foundation to master their fault diagnosis and troubleshooting skills.

The programme also incorporates Communication, Mathematics and Science so that students can further their studies upon completion of the Diploma.

Areas covered in the programme.

Health and Safety practices.

Construction, operating principles, maintenance, diagnosis and repair of the following vehicle systems:

- Petrol/Diesel Engines and Fuel Systems.
- Ignition and Electrical Systems.
- Cooling and Lubrication Systems.
- Braking, Steering and Suspension Systems.
- Gearbox and Transmission Systems.
- Spark Ignition and Electrical/ Electronic Systems.
- Vehicle Bodywork.
- Engine Auxiliary Systems.
- Air-conditioning Systems.

Associated studies include measurements, calculations, properties and materials in automotive engineering and technical drawing. Other subjects include Communication, Mathematics and Science.

As a graduate of TOC, the learner can secure job placements with reputable companies in the automotive industry. As a fresh graduate, the learner can start off as a service technician with the dealership of a particular brand. As the learner masters the skills, s/he could advance to

become a senior technician or master technician with a number of years of working experience and continuous professional development.

Students will be able to immediately adapt to the working environment thanks to the unique concept of closely monitored and extensive on-the-job-training as well as familiarization with the latest automobile models in the market.

Students can be employed as:

- Automotive Service Technician.
- Diagnostic Technician/ Specialist.
- Technical Advisor.
- Motorsport Technician.
- Service Adviser/Consultant.
- Service Manager.
- Spare Parts Executive/Manager.
- Workshop Owner/Operator.
- After-sales Manager.
- Insurance Claim Assessor.
- Collision Estimator.
- Warranty Executive/Manager.
- Vehicle Accessories.
- Vehicle Component Supplier/Manufacturer.

Internships are a unique feature of this qualification and are built in as a compulsory requirement for students to gain working experience within exciting automotive industry. It gives students the competitive edge in post-qualification employment. Students will also gain a strong foundation in business management and up-to-date knowledge on automotive retail operations. They will also be familiarized with the latest technologies associated with modern automobiles.

It is clear that the Malaysian qualification compares well with the South African Level 4 Autotronics qualification to Level 5 articulates well with the qualification in Malaysia. Although South Africa presented four qualifications from Level 2 to Level 5, the Malaysia qualification is presented over 2.5 years and 2.5 years in management. The learners in South Africa, after completing all these qualifications will acquire the same competencies as included in the Malaysia qualifications.

United States:

Within Dallas, Texas programmes/courses lead towards credits for a certificate and usually consist of a number of courses/programmes. When a course/programme is completed, the credits for that course/programme count towards the total credits one requires to complete the certificate. A course/unit standard is a module of study within a programme, and is therefore usually taken over one or two semesters depending on the credit value of the programme. In some qualifications all courses/unit standards are compulsory, while in others there may be elective courses/unit standards. The following courses/programmes are offered in Texas.

Advanced Certificate: Electrical System Troubleshooting:

This certificate covers competencies such as generator (alternator) circuits, generator interfaces with the electrical system, computer control of generators (alternators), analysis of the charging voltage value, systematic troubleshooting procedures, testing the charging system on the vehicle, troubleshooting a vehicle's complete primary 14V electrical system, systematic troubleshooting procedure, ignition key-off battery drain, troubleshoot key-off battery drain problems, multiple battery systems and troubleshooting techniques to find battery problems in multiple battery systems.

Advanced Certificate: Auto/truck: Electrical Troubleshooting Training:

This qualification covers competencies such as troubleshoot auto/truck electrical circuits, troubleshoot electrical problems and Auto/truck/heavy equipment electrical - electronics troubleshooting.

Certificate: Electric Motor and Switch Assemblers and Repairers:

Competencies which are addressed in this certificate: Lifts units or parts, such as motors or generators, using crane or chain hoist; Measures velocity, horsepower, r.p.m., amperage, circuitry, and voltage of unit or parts, using electrical meters and mechanical testing devices; Repairs and rebuilds defective mechanical parts in electric motors, generators, and related equipment, using hand tools and power tools; Replaces defective parts, such as coil leads, carbon brushes, and connecting wires, using soldering equipment, Rewinds coils on core while core is in slots, or makes replacement coils, using coil-winding machine, Cuts and forms insulation and inserts insulation into armature, rotor, or stator slots; Records repairs required, parts used, and labor time; Tests charges and replaces batteries; Refaces, reams, and polishes commutators and machine parts to specified tolerances, using machine tools; Installs, secures, and aligns parts, using hand tools, welding equipment, and electrical meters; Assembles electrical parts, such as alternators, generators, starting devices, and switches, following schematic drawings, using hand, machine, and power tools; Rewires electrical systems and repairs or replaces electrical accessories; Adjusts working parts, such as fan-belt tension, voltage output, contacts and springs, using hand tools, and verifies corrections, using gauges; Scrapes and cleans units or parts, using cleaning solvent, and lubricates moving parts; Inspects parts for wear or damage, or reads work order or schematic drawings to determine required repairs; Cuts and removes parts, such as defective coils and insulation; Tests for overheating, using speed gauges and thermometers; Disassembles defective unit, using hand tools; Reassembles repaired electric motors to specified requirements and ratings, using hand tools and electrical meters.

Certificate: Electro-Mechanical Technicians:

Competencies which are addressed in this certificate include: Operates metalworking machines to fabricate housings, jigs, fittings, and fixtures; Aligns, fits, and assembles component parts, using hand tools, power tools, fixtures, templates, and microscope; Installs electrical and electronic parts and hardware in housing or assembly, using soldering equipment and hand tools; Tests performance of electromechanical assembly, using test instruments such as oscilloscope, electronic voltmeter, and bridge; Analyzes and records test results and prepares written documentation; Reads blueprints, schematics, diagrams, and technical orders to determine method and sequence of assembly; Inspects parts for surface defects; Verifies dimensions and clearances of parts to ensure conformance to specifications, using precision measuring instruments; Repairs, reworks, and calibrates assemblies to meet operational specifications and tolerances.

Certificate: Electrical and Electronics Installers and Repairers, Transportation Equipment:

Competencies which are addressed in this certificate include: Adjusts, repairs, or replaces defective wiring and relays in ignition, lighting, air-conditioning, and safety control systems, using electrician's tools; Installs electrical equipment, such as air-conditioning, heating, or ignition systems, generator brushes, and commutators, using hand tools; Measures, cuts, and installs framework and conduit to support and connect wiring, control panels, and junction boxes, using hand tools; Cuts openings and drills holes for fixtures, outlet boxes, and fuse holders, using electric drill and router; Visually inspects and tests electrical system or equipment, using testing devices such as oscilloscope, voltmeter, and ammeter, to determine malfunctions; Confers with customer to determine nature of malfunction; Repairs or rebuilds starters, generators, distributors, or door controls, using electrician's tools; Installs fixtures,

outlets, terminal boards, switches, and wall boxes, using hand tools; Estimates cost of repairs based on parts and labor charges; Splices wires with knife or cutting pliers, and solders connections to fixtures, outlets, and equipment.

Autotronics at the Arizona Automotive Institute:

The Arizona Automotive Institute not only offers high-quality career training to help prepare their students for successful careers in Automotive Technology; Autotronics; Diesel Technology; and Heating, Ventilation, Air Conditioning and Refrigeration (HVAC), AAI also provides students with added services.

Automotive Technology Program in Exton, PA:

Today's cars are complex machines run by sophisticated computer systems. And the people who fix those cars are highly paid automotive technicians.

The Automotive Technology program provides the knowledge and skills a learner needs to become a successful entry-level automotive technician. The learner will learn: how to diagnose, service, and repair domestic and foreign cars; troubleshoot problems using the latest equipment; build high-performance engines; essential business skills that will make his/her careers a long and successful one.

Plus, the learner can choose from among the following programmes:

- BMW Fast Track.
- Ford Accelerated Credential Training (FACT).
- Nissan Advanced Technician Training (NATT).
- Toyota Professional Automotive Training (TPAT) elective programs to make him/her even more sought after in the workforce.

Program Length:

- Automotive Technology core program 51 weeks.
- Automotive Technology with BMW Fast Track 63 weeks.
- Automotive Technology with Ford FACT 66 weeks.
- Automotive Technology with Toyota TPAT 60 weeks.
- Automotive Technology with Nissan NATT 60 weeks.

Northern Ireland:

Various certificate courses are offered. To become automotive electrician learners need to complete an apprenticeship and gain a National Certificate in Automotive Electrical Engineering.

Certificate: Automotive Electrical Engineering:

The qualification covers: Electrical values, Multimeters and electrical measurement; Identification of typical circuit symbols and use of wiring diagrams; Test methods for circuit continuity, insulation and resistance; The electrical properties and testing of series and parallel circuits; Battery, starting, charging and body electrical systems operation, testing and diagnosis; Test methods volt drop measurement.

United Kingdom:

Various courses/programmes and qualifications are presented in the United Kingdom. Some of these qualifications are also presented in New Zealand. The City of Guilds qualifications are presented and accepted in some African countries and are presented to their students in

Autotronics. Many of the Level 3 NVQ qualifications contain the competencies taught in the South African Level 4 qualification.

These qualifications may include:

Diploma: Vehicle Maintenance and Repairs - Auto Electrical Level 3 (The Manchester College, Manchester):

• This Level 3 qualification covers the technical needs for today's motor vehicle repair industry, including the diagnosis of complex system faults and advanced systems operation. It provides essential knowledge for service technicians working on heavy commercial vehicles in all types of garages, dealerships and maintenance depots. It is a learning programme which involves students studying both the theory and practical aspects of the diagnosis and rectification of a range of faults. Students also gain a broad knowledge and understanding of health and safety in the workplace and other skills associated with working in a garage.
• The course covers the following: Engine and component faults - Chassis system faults - Auxiliary equipment electrical faults.

Certificate: Motor - Fundamental of Electricity (Paragon Skills for Industry, Bournemouth and Paragon Skills for Industry, Bangor):

This course is aimed at helping experienced technicians who need to update their skills or who have identified areas of weakness. It covers the knowledge that will enable participants to consider other topics such as engine management, ignition systems and diagnostics. Participants should be qualified to NVQ level 3 or above or have a minimum of 4 years' experience of working with vehicle electrical or electronic systems.

This Qualification is aimed at helping experienced technicians who need to update their skills or who have identified areas of weakness.

Certificate: Refrigerant Handling for Mobile Air Conditioner - Vehicle Level 3 (HTC Business and Enterprise, Huddersfield):

This is a City and Guilds' certificate. It is a short intensive course covering competencies around motor vehicle air-conditioning which is an integral part of this Qualification. The certificate has been designed specifically to provide the essential practical knowledge in air conditioning fundamentals and Refrigerant handling. This enables technicians to carry out servicing procedures, component identification, leak checking and refrigerant handling in a professional, safe and legal manner. It also ensures technicians; employers and employees meet their duty of care under COSHH regulations.

Senior MET Technician Automotive Technician Accreditation (ATA) (Training 2000 Limited, Blackpool and Training 2000 Limited, Lancashire):

With the increasing complexity and sophistication of vehicles and a shortage of skilled individuals, there has never been a greater need for competent technicians. Properly trained technicians are highly skilled professionals. Automotive Technician Accreditation has been developed to enable identification of them. ATA is a voluntary assessment programme for technicians working in the retail motor industry.
For MET technicians there are two competency levels:

• MET Technician.
• Senior MET Technician.

MET Technician:

The six practical assessments at Technician level will measure competence in the following:

- Mechanical Electrical and Trim (remove and refit).
- Cosmetic panel alignment.
- Cooling systems.
- Supplementary Restraint Systems (SRS).
- Mechanical components (non structural components).
- Vehicle electrical - simple diagnosis.

Senior MET Technician:

The eight practical assessments at Senior Technician level will measure competence in the following:

- Mechanical Electrical and Trim (remove and refit).
- Cosmetic panel alignment.
- Cooling systems.
- Supplementary Restraint Systems (SRS).
- Mechanical components (structural components).
- Vehicle electrical - complex diagnosis.
- Wheel alignment and steering.
- Air Conditioning (ATA Refrigerant Handler).

The Air Conditioning assessment meets the minimum requirements set out in EC Regulation (EC) No. 307/2008.

NVQ Level 3 Vehicle Mechanics.

This course is offered by Greenwich Community College. It is a one year part-time course.

The course is designed to enable students to become competent in a variety of skills. There is an increasing use of IT in motor vehicles and an IT session is included each week as well as tutorial technology sessions. The course leads to Qualified Vehicle Mechanic status.

Certificate: Vehicle Electrical/Electronic in Leeds:

The aim of this course is to provide the technician with the necessary knowledge to test and repair electrical circuits in modern vehicles. It also includes the use of equipment such as multi-meters and oscilloscopes. The competencies covered in this certificate include but is not limited to: Electricity, Tools and Equipment, Type of circuit, Electrical and Electronic Components and Introduction to complex electronic systems.

Vehicle Maintenance and Repair - Auto Electrical Level 3 Diploma (IMI Awards Ltd):

This one-year full-time course provides the essential knowledge for auto-electricians working on vehicles in all types of garages, dealerships and maintenance depots. It focuses on faults involving the interaction of more than one auto-electrical system and accurate diagnosis.

Motor Vehicle - Auto Electrical - Level 3:

This Level 3 qualification provides the essential knowledge for auto-electricians working on vehicles in all types of garages, dealerships and maintenance depots. It focuses on faults involving the interaction of more than one auto-electrical system and accurate diagnosis.

The learner will learn about diagnosis and rectification of:

- Engine Electrical Faults.
- Transmission and Chassis Electrical Faults.
- Auxilliary Equipment Electrical Faults.

The learner will also gain a broad knowledge and understanding of health and safety in the workplace and other skills associated with working in a garage.

The learner's time will be split between classroom sessions where s/he will learn the underpinning theory and practical workshop sessions where you will apply the theory and develop your skills.

Australia:

Certificate IV: Automotive Technology is offered by the South Western Sydney Institute, TAFE NSW:

The following subjects are part of the qualification:

Core: Carry out diagnosis of complex system faults. Electives: Implement and monitor environmental regulations in the marine repair industry; Plan and manage compliance with environmental regulations in the mechanical repair industry; Provide technical guidance; Repair instruments and warning systems; Repair starting systems; Service and repair electronic spark ignition engine management systems; Test and service 240V portable generators; Water test vessels; Recondition cylinder heads; Install hydraulic systems to specific applications; plus more.

India:

School: EmbiTech India in Chennai, Tamil Nadu:

This school offers a course entitled Automotive Embedded Systems. It offers the following courses:

- Controller Area Network(CAN).
- Transport protocol.
- MISRA C.
- UDS protocol (Diagnostic).
- KWP200 protocol (Diagnostic).

Some of these competencies are in line with the networking data competencies of this Qualification.

School: The Hindustan Group of Institutions in Chennai:

This school offers a course entitled Automotive Engineering. However, details about the course are sketchy.

Training at Volvo:

I-CAR Training for Volvo Level 4:

20% (or a minimum of 1 technician for small body shops):

- Wheel Alignment and Diagnostic Angles (STE04).
- Electrical Circuits and DVOM Usage (ELE01).

- Diagnosis, Testing, and Repair Of Common Electrical Loads (ELE02).
- Volvo Damage Analysis and Electromechanical Repair (VLV04).
- Frontal Impact Analysis (DAM02).
- Mechanical Systems Analysis (DAM03).
- Restraints, Interior, Glass, Side and Rear Impact Analysis (DAM04).
- Air Conditioning (AIR01).
- Restraints (RES01).
- Advanced Restraints Systems (RES02).
- Brakes (BRA01).
- Anti-Lock Brakes and Traction Control Systems (ABR01).
- Fault Code Retrieval, Diagnosis, and Testing Electronic Systems (ELE03).
- Lighting, Starting, and Charging Systems (LSC01).

SADC:

None of the SADC countries have their own qualifications relating to Autotronics, but use the British City and Guilds Standards for training learners in the automotive field. Namibia has indicated interest in the South African qualifications and may implement this qualification once it has been registered. Namibia is currently in the process of developing vocational certificates for registration on the Namibia Qualifications Framework. Various initiatives are in place to ensure that their qualifications are inline with the South African Qualifications.

Conclusion:

The competencies covered in the Further Education and Training Certificate: Autotronics: Autotronics, NQF Level 4 are either similar to or have some or substantial overlap with some of the qualifications that are offered in countries investigated here. While direct and complete comparisons are rarely possible-given the very different contexts in the countries investigated-there are overlaps between this qualification and those internationally. Because it is difficult to figure out the levels of the international qualifications and courses, the comparison was made on the basis of the competencies in this Qualification.

While this Qualification enjoys significant similarity with the New Zealand qualifications cited here, it is closest to the Certificate: Applied Technology (Autotronics) Level 4, 120 credits. This Qualification also shares many competencies with the Malaysian qualification even though that qualification is taught over a period of 2.5 years.

The qualifications from the USA cited here focus on troubleshooting of auto-electrical problems at a higher level. A number of auto-electrical related qualifications are also discussed. There is some similarity between this qualification and those from the USA even though the qualifications from the USA go into very specific detail regarding auto-electrical competencies. Perhaps the qualification offered by the Arizona Automotive Institute comes closest to this qualification.

The Northern Ireland qualification focuses heavily on auto-electrical circuits and circuitry and the competencies therein coincide with those of this Qualification.

A variety of qualifications from the UK has been cited here. Each one contains some competencies that resonate with this Qualification. The same applies to the Australian qualification cited in this comparability exercise.

On the whole this qualification compares very favourably with international qualifications/courses or aspects contained therein.

ARTICULATION OPTIONS

This Qualification lends itself to both vertical and horizontal articulation possibilities.

Horizontal articulation is possible with the following Qualifications:

• ID 71949: Further Education and Training Certificate: Automotive Components: Manufacturing and Assembly, NQF Level 4, 138 Credits.
• ID 78525: Further Education and Training Certificate: Automotive Repair and Maintenance, NQF Level 4, 159 Credits.
• ID 64549: Further Education and Training Certificate: Automotive Body Repair, NQF Level 4, 135 Credits.
• ID 64411: Further Education and Training Certificate: Automotive Spray Painting, NQF Level 4, 140 Credits.

Vertical articulation is possible with the following Qualifications:

• ID 71969: National Certificate: Automotive components: Manufacturing and Assembly, NQF Level 5, 125 Credits.
• National Certificate: Automotive Repair and Maintenance, NQF Level 5, 144 Credits.

MODERATION OPTIONS
• Anyone assessing a learner or moderating the assessment of a learner against this Qualification must be registered as an assessor with the relevant Education, Training, Quality, and Assurance (ETQA) Body.

• Any institution offering learning that will enable the achievement of this Qualification must be accredited as a provider with the relevant ETQA.

• Assessment and moderation of assessment will be overseen by the relevant ETQA according to the ETQA's policies and guidelines for assessment and moderation; in terms of agreements reached around assessment and moderation between ETQA's (including professional bodies); and in terms of the moderation guideline detailed immediately below.

• Moderation must include both internal and external moderation of assessments at exit points of the Qualification, unless ETQA policies specify otherwise. Moderation should also encompass achievement of the competence described both in individual Unit Standards, the integrated competence described in the Qualification and will include competence within core sales and the elective standards relevant to the economic sector.

• Anyone wishing to be assessed against this Qualification may apply to be assessed by any assessment agency, assessor or provider institution that is accredited by the relevant ETQA.

CRITERIA FOR THE REGISTRATION OF ASSESSORS
For an applicant to register as an assessor, the applicant needs:

• A minimum of 4 (four) years' practical, relevant occupational experience.
• A relevant Qualification at NQF Level 5 or higher.
• To be registered as an assessor with the relevant ETQA.

NOTES
N/A

UNIT STANDARDS

	ID	UNIT STANDARD TITLE	LEVEL	CREDITS
Fundamental	119472	Accommodate audience and context needs in oral/signed communication	Level 3	5
Fundamental	119457	Interpret and use information from texts	Level 3	5
Fundamental	119467	Use language and communication in occupational learning programmes	Level 3	5

	ID	UNIT STANDARD TITLE	LEVEL	CREDITS
Fundamental	119465	Write/present/sign texts for a range of communicative contexts	Level 3	5
Fundamental	9015	Apply knowledge of statistics and probability to critically interrogate and effectively communicate findings on life related problems	Level 4	6
Fundamental	119462	Engage in sustained oral/signed communication and evaluate spoken/signed texts	Level 4	5
Fundamental	119469	Read/view, analyse and respond to a variety of texts	Level 4	5
Fundamental	9016	Represent analyse and calculate shape and motion in 2- and 3-dimensional space in different contexts	Level 4	4
Fundamental	119471	Use language and communication in occupational learning programmes	Level 4	5
Fundamental	7468	Use mathematics to investigate and monitor the financial aspects of personal, business, national and international issues	Level 4	6
Fundamental	119459	Write/present/sign for a wide range of contexts	Level 4	5
Core	260677	Diagnose and repair faults on advanced auto electrical circuits	Level 4	8
Core	376622	Diagnose and repair networking/data transfer systems in automobiles	Level 4	8
Core	376605	Fit and wire-up auxiliary auto-electrical equipment	Level 4	12
Core	243301	Manage safety and emergency incidences	Level 4	6
Core	244140	Repair and maintain vehicle air conditioning systems	Level 4	8
Core	376640	Test and repair integrated fuel injection and engine control	Level 5	16
Elective	376604	Construct simple electro-pneumatic/hydraulic circuits	Level 3	12
Elective	123258	Foster and maintain customer relations	Level 3	10
Elective	116714	Lead a team, plan, allocate and assess their work	Level 3	4
Elective	117877	Perform one-to-one training on the job	Level 3	4
Elective	242816	Conduct a structured meeting	Level 4	5
Elective	12225	Construct and test advanced electronic circuits	Level 4	16
Elective	260639	Diagnose and repair fuel system components	Level 4	8
Elective	260737	Diagnose and repair vehicle ignition systems	Level 4	6
Elective	242813	Explain the contribution made by own area of responsibility to the overall organisational strategy	Level 4	5
Elective	114877	Formulate and implement an action plan to improve productivity within an organisational unit	Level 4	8
Elective	335875	Implement and maintain business processes	Level 4	8
Elective	114589	Manage time productively	Level 4	4
Elective	242819	Motivate and Build a Team	Level 4	10
Elective	116389	Write a technical report	Level 4	4
Elective	376620	Diagnose and repair climate control systems	Level 5	10
Elective	376660	Diagnose and repair supplementary restraint systems (SRS)	Level 5	10
Elective	376642	Diagnose and repair vehicle convenience systems	Level 5	16
Elective	376623	Diagnose and repair vehicle stability, traction and drive control (VSTDC) systems	Level 5	16

LEARNING PROGRAMMES RECORDED AGAINST THIS QUALIFICATION
None

SOUTH AFRICAN QUALIFICATIONS AUTHORITY

UNIT STANDARD:

Construct simple electro-pneumatic/hydraulic circuits

SAQA US ID	*UNIT STANDARD TITLE*		
376604	Construct simple electro-pneumatic/hydraulic circuits		
ORIGINATOR		*PROVIDER*	
SGB Manufacturing and Assembly Processes			
FIELD		*SUBFIELD*	
6 - Manufacturing, Engineering and Technology		Manufacturing and Assembly	
ABET BAND	*UNIT STANDARD TYPE*	*NQF LEVEL*	*CREDITS*
Undefined	Regular	Level 3	12

New NQF Level: NQF Level 03

This unit standard replaces:

US ID	Unit Standard Title	NQF Level	Credits	Replacement Status
12224	Construct simple electro-pneumatic/hydraulic circuits	Level 3	12	Will occur as soon as 376604 is registered

SPECIFIC OUTCOME 1
Discuss the principles of pneumatics.

SPECIFIC OUTCOME 2
Explain the use of pneumatic components.

SPECIFIC OUTCOME 3
Discuss the principles of hydraulics.

SPECIFIC OUTCOME 4
Explain the use and functions of components for hydraulics.

SPECIFIC OUTCOME 5
Troubleshoot the hydraulic system.

SPECIFIC OUTCOME 6
Troubleshoot the pneumatic system.

SPECIFIC OUTCOME 7
Explain the design and construction of basic pneumatic circuitry.

SPECIFIC OUTCOME 8
Explain the design and construction of basic hydraulic circuitry.

QUALIFICATIONS UTILISING THIS UNIT STANDARD

ID	QUALIFICATION TITLE	LEVEL

	ID	QUALIFICATION TITLE	LEVEL
Elective	78883	Further Education and Training Certificate: Autotronics	Level 4

SOUTH AFRICAN QUALIFICATIONS AUTHORITY

UNIT STANDARD:

Fit and wire-up auxillary auto-electrical equipment

SAQA US ID	*UNIT STANDARD TITLE*		
376605	Fit and wire-up auxiliary auto-electrical equipment		
ORIGINATOR		*PROVIDER*	
SGB Manufacturing and Assembly Processes			
FIELD		*SUBFIELD*	
6 - Manufacturing, Engineering and Technology		Manufacturing and Assembly	
ABET BAND	*UNIT STANDARD TYPE*	*NQF LEVEL*	*CREDITS*
Undefined	Regular	Level 4	12

New NQF Level: NQF Level 04

This unit standard replaces:

US ID	Unit Standard Title	NQF Level	Credits	Replacement Status
12229	Fit and wire up auxiliary auto-electrical equipment	Level 4	12	Will occur as soon as 376605 is registered

SPECIFIC OUTCOME 1
Explain the operation of auxiliary auto-electrical equipment and harnesses of an automobile.

SPECIFIC OUTCOME 2
Plan and prepare for fitting and wiring of auto-electrical equipment.

SPECIFIC OUTCOME 3
Fit, wire-up and commission auto-electrical component.

SPECIFIC OUTCOME 4
Test fitted auto-electrical equipment and diagnose problems.

QUALIFICATIONS UTILISING THIS UNIT STANDARD

	ID	QUALIFICATION TITLE	LEVEL
Core	78883	Further Education and Training Certificate: Autotronics	Level 4

SOUTH AFRICAN QUALIFICATIONS AUTHORITY

UNIT STANDARD:

Diagnose and repair climate control systems

SAQA US ID	***UNIT STANDARD TITLE***		
376620	Diagnose and repair climate control systems		
ORIGINATOR		***PROVIDER***	
SGB Manufacturing and Assembly Processes			
FIELD		***SUBFIELD***	
6 - Manufacturing, Engineering and Technology		Manufacturing and Assembly	
ABET BAND	***UNIT STANDARD TYPE***	***NQF LEVEL***	***CREDITS***
Undefined	Regular	Level 5	10

New NQF Level: NQF Level 05

This unit standard replaces:

US ID	Unit Standard Title	NQF Level	Credits	Replacement Status
12235	Diagnose and repair climate control systems	Level 5	10	Will occur as soon as 376620 is registered

SPECIFIC OUTCOME 1
Discuss the operation of vehicle climate control systems.

SPECIFIC OUTCOME 2
Discuss the climate control related input and output devices.

SPECIFIC OUTCOME 3
Test and diagnose climate control systems.

SPECIFIC OUTCOME 4
Replace or repair components in the climate control system.

QUALIFICATIONS UTILISING THIS UNIT STANDARD

	ID	QUALIFICATION TITLE	LEVEL
Elective	78883	Further Education and Training Certificate: Autotronics	Level 4
Core	78943	National Certificate: Autotronics	Level 5

SOUTH AFRICAN QUALIFICATIONS AUTHORITY

UNIT STANDARD:

Diagnose and repair networking/data transfer systems in automobiles

SAQA US ID	*UNIT STANDARD TITLE*		
376622	Diagnose and repair networking/data transfer systems in automobiles		
ORIGINATOR		*PROVIDER*	
SGB Manufacturing and Assembly Processes			
FIELD		*SUBFIELD*	
6 - Manufacturing, Engineering and Technology		Manufacturing and Assembly	
ABET BAND	*UNIT STANDARD TYPE*	*NQF LEVEL*	*CREDITS*
Undefined	Regular	Level 4	8

New NQF Level: NQF Level 04

This unit standard does not replace any other unit standard and is not replaced by another unit standard.

SPECIFIC OUTCOME 1
Interpret automobile networking/data transfer diagrams.

SPECIFIC OUTCOME 2
Locate, interpret and diagnose faults on networking/data transfer systems.

SPECIFIC OUTCOME 3
Repair/replace faulty networking components/wiring.

SPECIFIC OUTCOME 4
Explain the purpose, variants and common causes of failure with networking/data transfer systems.

QUALIFICATIONS UTILISING THIS UNIT STANDARD

	ID	QUALIFICATION TITLE	LEVEL
Core	78883	Further Education and Training Certificate: Autotronics	Level 4

SOUTH AFRICAN QUALIFICATIONS AUTHORITY

UNIT STANDARD:

Diagnose and repair vehicle stability, traction and drive control (VSTDC) systems

SAQA US ID	*UNIT STANDARD TITLE*		
376623	Diagnose and repair vehicle stability, traction and drive control (VSTDC) systems		
ORIGINATOR		*PROVIDER*	
SGB Manufacturing and Assembly Processes			
FIELD		*SUBFIELD*	
6 - Manufacturing, Engineering and Technology		Manufacturing and Assembly	
ABET BAND	*UNIT STANDARD TYPE*	*NQF LEVEL*	*CREDITS*
Undefined	Regular	Level 5	16

New NQF Level: NQF Level 05

This unit standard replaces:

US ID	Unit Standard Title	NQF Level	Credits	Replacement Status
12232	Diagnose and repair vehicle stability, traction and drive control (VSTDC) systems	Level 5	20	Will occur as soon as 376623 is registered

SPECIFIC OUTCOME 1
Discuss the operation of vehicle stability, traction and drive control system.

SPECIFIC OUTCOME 2
Discuss the components of and the equipment used in the VSTDC system.

SPECIFIC OUTCOME 3
Test and diagnose VSTDC systems.

SPECIFIC OUTCOME 4
Replace or repair components in the VSTDC system.

QUALIFICATIONS UTILISING THIS UNIT STANDARD

	ID	QUALIFICATION TITLE	LEVEL
Elective	78883	Further Education and Training Certificate: Autotronics	Level 4
Core	78943	National Certificate: Autotronics	Level 5

SOUTH AFRICAN QUALIFICATIONS AUTHORITY

UNIT STANDARD:

Test and repair integrated fuel injection and engine control

SAQA US ID	*UNIT STANDARD TITLE*		
376640	Test and repair integrated fuel injection and engine control		
ORIGINATOR		*PROVIDER*	
SGB Manufacturing and Assembly Processes			
FIELD		*SUBFIELD*	
6 - Manufacturing, Engineering and Technology		Manufacturing and Assembly	
ABET BAND	*UNIT STANDARD TYPE*	*NQF LEVEL*	*CREDITS*
Undefined	Regular	Level 5	16

New NQF Level: NQF Level 05

This unit standard does not replace any other unit standard and is not replaced by another unit standard.

SPECIFIC OUTCOME 1
Differentiate between the main types of injection systems.

SPECIFIC OUTCOME 2
Use wiring and technical diagrams/information to obtain information on these systems.

SPECIFIC OUTCOME 3
Identify and explain the purpose/functions of all common components for combined ignition and injection systems.

SPECIFIC OUTCOME 4
Explain the purpose/functions of sub-systems of combined fuel injection/ignition systems.

SPECIFIC OUTCOME 5
Test and repair common rail fuel injection/combined ignition and engine control systems on petrol and diesel vehicles.

QUALIFICATIONS UTILISING THIS UNIT STANDARD

	ID	QUALIFICATION TITLE	LEVEL
Core	78883	Further Education and Training Certificate: Autotronics	Level 4

SOUTH AFRICAN QUALIFICATIONS AUTHORITY

UNIT STANDARD:

Diagnose and repair vehicle convenience systems

SAQA US ID	*UNIT STANDARD TITLE*		
376642	Diagnose and repair vehicle convenience systems		
ORIGINATOR		*PROVIDER*	
SGB Manufacturing and Assembly Processes			
FIELD		*SUBFIELD*	
6 - Manufacturing, Engineering and Technology		Manufacturing and Assembly	
ABET BAND	*UNIT STANDARD TYPE*	*NQF LEVEL*	*CREDITS*
Undefined	Regular	Level 5	16

New NQF Level: NQF Level 05

This unit standard replaces:

US ID	Unit Standard Title	NQF Level	Credits	Replacement Status
12236	Diagnose and repair automobile convenience systems	Level 5	16	Will occur as soon as 376642 is registered

SPECIFIC OUTCOME 1
Discuss the operation of vehicle convenience systems.

SPECIFIC OUTCOME 2
Discuss the components of and equipment used in the convenience system.

SPECIFIC OUTCOME 3
Test and diagnose convenience systems.

SPECIFIC OUTCOME 4
Replace or repair components in the convenience system.

QUALIFICATIONS UTILISING THIS UNIT STANDARD

	ID	QUALIFICATION TITLE	LEVEL
Elective	78883	Further Education and Training Certificate: Autotronics	Level 4
Core	78943	National Certificate: Autotronics	Level 5

SOUTH AFRICAN QUALIFICATIONS AUTHORITY

UNIT STANDARD:

Diagnose and repair supplementary restraint systems (SRS)

SAQA US ID	*UNIT STANDARD TITLE*		
376660	Diagnose and repair supplementary restraint systems (SRS)		
ORIGINATOR		*PROVIDER*	
SGB Manufacturing and Assembly Processes			
FIELD		*SUBFIELD*	
6 - Manufacturing, Engineering and Technology		Manufacturing and Assembly	
ABET BAND	*UNIT STANDARD TYPE*	*NQF LEVEL*	*CREDITS*
Undefined	Regular	Level 5	10

New NQF Level: NQF Level 05

This unit standard replaces:

US ID	Unit Standard Title	NQF Level	Credits	Replacement Status
12234	Diagnose and repair supplementary restraint systems (SRS)	Level 5	12	Will occur as soon as 376660 is registered

SPECIFIC OUTCOME 1
Discuss the operation of vehicle supplementary restraint systems

SPECIFIC OUTCOME 2
Discuss the components and equipment used in supplementary restraint systems.

SPECIFIC OUTCOME 3
Test and diagnose supplementary restraint systems.

SPECIFIC OUTCOME 4
Replace or repair components in the supplementary restraint system.

QUALIFICATIONS UTILISING THIS UNIT STANDARD

	ID	QUALIFICATION TITLE	LEVEL
Elective	78883	Further Education and Training Certificate: Autotronics	Level 4
Core	78943	National Certificate: Autotronics	Level 5

SOUTH AFRICAN QUALIFICATIONS AUTHORITY

QUALIFICATION:
National Certificate: Autotronics

SAQA QUAL ID	*QUALIFICATION TITLE*		
78944	National Certificate: Autotronics		
ORIGINATOR		*PROVIDER*	
SGB Manufacturing and Assembly Processes			
QUALIFICATION TYPE	*FIELD*	*SUBFIELD*	
National Certificate	6 - Manufacturing, Engineering and Technology	Manufacturing and Assembly	
ABET BAND	*MINIMUM CREDITS*	*NQF LEVEL*	*QUAL CLASS*
Undefined	127	Level 2	Regular-Unit Stds Based

This qualification replaces:

Qual ID	Qualification Title	NQF Level	Min Credits	Replacement Status
22858	National Certificate: Autotronics	Level 2	128	Will occur as soon as 78944 is registered

PURPOSE AND RATIONALE OF THE QUALIFICATION
Purpose:

This Qualification is for any individual who is, or wishes to be, involved in an autotronics environment. An individual acquiring this Qualification will be able to contribute towards the efficient operation of a number of processes within this sector as described in the core component of the qualification.

The core component covers the following competencies:

- Assembling, fitting and repairing automobile auxiliary harnesses.
- Building auto-electrical circuits.
- Performing basic welding/joining of metals.
- Removing and fitting automobile components.
- Selecting and using vehicle lifting equipment.
- Diagnosing and servicing automobile batteries and battery system components.
- Selecting, using and caring for engineering hand and power tools.
- Complying with safety, health and environmental requirements in the workplace.
- Understanding and applying the fundamentals of engine technology.

These competencies are supported by a range of related and supportive competencies as encapsulated in the Core component of the qualification. The competencies will enable the learner to work in different industries within the diverse autotronics sector.

The Qualification ensures progression of learning, enabling the learner to perform optimally within the autotronics field of learning and provides learning that could lead to further learning at a higher level within the same or a related sector. The Qualification also intends to:

• Assist learners who wish to extend their range of skills and knowledge and hence their competencies in the autotronics environment.
• Provide opportunities for people to explore different but related activities within the autotronics sector.

Rationale:

This is an entry level Qualification in a series of four autotronics qualifications that range from NQF Level 2 to NQF Level 5. These qualifications constitute a learning pathway that takes the learners from basic/simple competencies in autotronics at NQF Level 2 to high level autotronics competencies at NQF Level 5.

The automobile is subject to ever increasing technological advances. These advances are continuously being incorporated into the electrical systems of automobiles. They represent the integration of mechanical, hydraulic, pneumatic, electronic and electrical systems and are managed by microelectronic control known as Computer Integrated Auto Management (CIAM) Systems. Consequently, the auto-electrical skills required to maintain such automobiles are changing to incorporate more electronic skills.

The field of autotronics deals with the installation, diagnosis and repair of CIAM systems. People working in the field of autotronics require specialised technical skills and knowledge and well as highly developed analytical skills to enable them to install, diagnose and repair CIAM systems.

The autotronics sector falls within the ambit of South Africa's large motor industry. There are huge motor assembly plants in several parts of the country, primarily in the Eastern Cape, Gauteng and Kwa Zulu Natal provinces. There are also many automotive related sectors like the automotive components manufacturing and assembly industries, automotive sales and service sector, repairs (including panel beating and spray painting) industries. It's a sector that employs a large number of people. Companies and/or industries within this sector operate in a global competitive and challenging environment.

The highly developed autotronics sector is well-established and economically powerful. In terms of transformation in the country, learners will require skills and competencies to gain access to positions within management structures by completing other qualifications and training. It will be in the interest of the country and the sector to ensure that those who operate in the autotronics environment are trained according to this Qualification to improve productivity and efficiency.

This series of autotronics qualifications reflects the skills, knowledge and understanding required to perform effectively in industry, whether in micro, small, medium or large enterprises.

RECOGNIZE PREVIOUS LEARNING?
Y

LEARNING ASSUMED IN PLACE
Learners wishing to study towards this Qualification are assumed to be competent in:

• Mathematical Literacy at NQF Level 1.
• Communication at NQF Level 1.

Recognition of Prior Learning:

This Qualification may be achieved in part (or whole) through the recognition of relevant prior knowledge and/or experience. The learner must be able to demonstrate competence in the knowledge, skills, values and attitudes implicit in this Qualification. As part of the provision of recognition of prior learning providers are required to develop a structured means for the assessment of individual learners against the Unit Standards of the Qualification on a case-by-

case basis. A range of assessment tools and techniques during formative and summative assessment procedures should be used which have been jointly decided upon by the learner and the assessor. Such procedures, and the assessment of individual cases, are subject to moderation by independent assessors. The same principles that apply to assessment of this Qualification also apply to recognition of prior learning.

Learners may provide evidence of prior learning for which they may receive credit towards the Unit Standards and/or the Qualification by means of portfolios or other forms of appropriate evidence as agreed to between the relevant provider and relevant ETQA or ETQA that has a Memorandum of Understanding in place with the relevant ETQA.

Recognition of Prior Learning is particularly important, as there are people in the autotronics sector with a variety of skills and competencies of differing quality and scope. It is important that a Recognition of Prior Learning process be available to assist in making sense of existing competencies and skills, and helping to standardise these competencies and skills towards a common standard.

Access to the Qualification:

There is an open access to this Qualification, keeping in mind the "Learning Assumed to be in Place".

QUALIFICATION RULES
The Qualification consists of a Fundamental, a Core and an Elective Component.

To be awarded the Qualification learners are required to obtain a minimum of 127 credits as detailed below.

Fundamental Component: 36 credits.

The Fundamental Component consists of Unit Standards in:

- Mathematical Literacy at NQF Level 2 to the value of 16 credits.
- Communication at NQF Level 2 to the value of 20 credits.

All Unit Standards in the Fundamental Component are compulsory.

Core Component:

- The Core Component consists of Unit Standards to the value of 81 credits, all of which are compulsory.

Elective Component:

- The Elective Component consists of Unit Standards that will impart a variety of competencies to the learner. Learners are to choose Elective Unit Standards totalling a minimum of 10 credits to attain a minimum of 127 credits for this Qualification.

EXIT LEVEL OUTCOMES
Qualifying learners will be able to:

1. Build auto-electrical circuits and work with automobile auxiliary harnesses.

2. Diagnose and service automobile batteries and battery systems components.

3. Demonstrate an understanding of the fundamentals of engine technology and remove and fit electronic/electric automobile components.

4. Select and use vehicle lifting equipment and engineering tools.

5. Explain the importance of occupational health and safety.

Critical Cross-Field Outcomes:

Identify and solve problems in which responses display that responsible decisions using critical and creative thinking have been made when:

- Interpreting testing equipment results and diagnosing problems.
- Engaging with problems related to battery and battery system and the removal and fitting of automotive components.
- Perform cable testing.
- Recognising and responding to problems/defects.
- Identifying and solving problems related to the application and controlling of compliance to safety, health and environmental requirements in the workplace.

Work effectively with others as a member of a team, group, organisation and community to:

- Interact with team members and colleagues to obtain fluids, parts, tools and equipment.
- Contribute to the workgroup's efforts to maintain cleanliness, safety and quality.
- Work effectively with others in the process of monitoring, evaluating and remedying workplace safety, health and environmental practices in the workplace.

Organise and manage oneself and one's activities responsively and effectively when:

- Building, and maintaining auto-electrical circuits.
- Using tools and equipment perform tests on and repairs to automobile auxiliary harnesses, circuits, fitted automotive battery, battery cables and battery system.
- Interpreting automobile auxiliary circuit diagrams.
- Removing, fitting, routing, assembling and repairing automobile auxiliary harnesses.
- Removing and refitting battery in accordance with battery and vehicle manufacturer's specifications and instructions.
- Performing service operations on battery/battery systems.
- Applying the correct procedures for using, storing and looking after engineering hand and power tools.
- Ensuring that all safety, health and environmental activities are in accordance with specific requirements.

Collect, analyse, organise and critically evaluate information to:

- Interpret and build circuit diagrams.
- Interpret results from test equipment.
- Perform repairs.
- Solve problems pertaining to the battery and battery system.
- Classify the information and identify deviations from the norm.
- Ensure application and control of compliance to safety, health and environmental requirements in the workplace.

Communicate effectively using visual, mathematical and/or language skills in the modes of oral and/or written presentation to:

- Prepare documentation for work carried out on vehicle.
- Prepare report on battery condition for customer.
- Report faulty lifting equipment.
- Report on faulty or unsafe power tools.
- Record and report deviations from specified requirements and when providing feedback on the progress and results of the safety, health and environmental management programmes.

Use science and technology effectively and critically, showing responsibility towards the environment and the health of others by:

- Using tools and equipment according to manufacturer's instructions and/or specifications.

Demonstrate an understanding of the world as a set of related systems by recognising that problem-solving contexts do not exist in isolation when:

- Engaging with problems that occur while building, maintaining and repairing auto-electrical circuits.
- Assembling, fitting and removing automobile auxiliary harnesses.
- Engaging with problems associated with the battery and battery systems.
- Identifying and responding to quality problems as part of the quality chain from manufacturing to customer.
- Dealing with the failure to monitor and control the requirements for safety, health and environmental.

ASSOCIATED ASSESSMENT CRITERIA

Associated Assessment Criteria for Exit Level Outcome 1:

- The theory of auto-electricity is explained in terms of auto-electrical related activities.
- Calculations are performed using scientific formulae.
- Components of auto-electrical circuits and auxiliary harnesses are identified and described in terms of their uses and functions.
- Auto-electrical circuit diagrams are interpreted and circuits are constructed based on the diagrams.
  - Range: These also include auto electrical auxiliary circuit diagrams.
- Auto-electrical circuits are built, tested and repaired using theoretical knowledge of circuits and auto-electricity.
- Automobile auxiliary harnesses are tested, removed, assembled and repaired according to standard procedure.

Associated Assessment Criteria for Exit Level Outcome 2:

- Vehicle tests on a fitted automotive battery are performed as per standard procedure.
- Cable related to the battery are tested for condition as per standard procedure.
- The battery is removed and refitted in accordance with procedure.
- Batteries are tested according to standard procedures.
- Service operations on battery/battery system components and repair operations on battery system components are performed according to standard procedures.
- 12/24 volt battery systems are configured and tested according to manufacturer's requirements.
- Jump-starting procedures are explained and conducted as per standard procedure.

Associated Assessment Criteria for Exit Level Outcome 3:

- The various types of automotive engines and engine operation are identified in terms of their differences.

• The major parts of a typical automotive engine are identified and described in terms of their functions.
• Engine design classifications are explained and the various automotive engine systems are described in terms of their functions and associated components.
• Electronic/electric automobile components are remove, fitted, inspected and tested according to standard procedure.
• Welding activity is performed where necessary according to procedure.
• Safety procedures and practices are applied during the performance of all operations.
• Work areas are restored and process documentation is completed as per procedure.

Associated Assessment Criteria for Exit Level Outcome 4:

• The basic operation of automobile lifting equipment is discussed and the function of various components related to hoists are explained.
• Various types of lifting equipment are operated in order to complete the auto electrical tasks on a vehicle.
• Hand and power engineering tools are selected and used according to manufacturer's specifications.
• Hand and power engineering tools are cared for and maintained according to workplace procedure.
• Automobile lifting equipment and hand and power engineering tools are used with due care for self, fellow workers, machines, equipment, materials and environment.

Associated Assessment Criteria for Exit Level Outcome 5:

• The safety, health and environmental requirements applicable in a specific workplace are explained.
• Workplace compliance to safety, health and environmental requirements are monitored against specified requirements.
• The performance of workplace safety activities is evaluated as required by safety, health and environmental management programmes.
• Recommendations to remediate workplace non-compliance to and non-performance of safety, health and environmental requirements and programmes are made to ensure the safety of all in the workplace.

Integrated Assessment:

The importance of integrated assessment is to confirm that the learner is able to demonstrate applied competence (practical, foundational and reflexive) and ensure that the purpose of this Qualification is achieved. Both formative and summative assessment methods and strategies are used to ensure that the Exit Level Outcomes and the purpose of the Qualification are achieved through achieving the Unit Standards. Learning, teaching and assessment are inextricably linked.

Learning and assessment should be integrated and assessment practices must be fair, transparent, valid and reliable. A variety of assessment strategies and approaches must be used. This could include tests, assignments, projects, demonstrations and/or any applicable method. Evidence of the acquisition of competencies must be demonstrated through the Unit Standards, which enhance the integration of theory and practice as deemed appropriate at this NQF Level.

Formative assessment is an on-going process which is used to assess the efficacy of the teaching and learning process. It is used to plan appropriate learning experiences to meet the learner's needs. Formative assessments can include a mix of simulated and actual (real) practice or authentic settings. Feedback from assessment informs both teaching and learning. If

the learner has met the assessment criteria of all the Unit Standards then s/he has achieved the Exit Level Outcomes of the Qualification.

Summative assessment is concerned with the judgement of the learning in relation to the Exit Level Outcomes of the Qualification. Such judgement must include integrated assessment(s) which test the learners' ability to integrate the larger body of knowledge, skills and attitudes, which are represented by the Exit Level Outcomes. Summative assessment can take the form of oral, written and practical examinations as agreed to by the relevant ETQA.

Integrated assessment must be designed to achieve the following:

- An integration of the achievement of the Exit Level Outcomes in a way that reflects a comprehensive approach to learning and shows that the purpose of the Qualification has been achieved.
- Judgement of learner performance to provide evidence of applied competence or capability.

Assessors and moderators should make use of a range of formative and summative assessment methods. Assessors should assess and give credit for the evidence of learning that has already been acquired through formal, informal and non-formal learning and work experience.

Assessment should ensure that all specific outcomes, embedded knowledge and critical cross-field outcomes are assessed. The assessment of the critical cross-field outcomes should be integrated with the assessment of specific outcomes and embedded knowledge.

INTERNATIONAL COMPARABILITY

This qualification is part of a series of qualifications in the field of Autotronics and was compared to similar qualifications, some outcomes-based, in various countries. International comparability with the following car manufacturing countries was attempted, with little success, as there was very little or no information available:

- Japan.
- Korea.
- Sweden.
- France.
- Germany.
- Italy.
- China.

There was also a paucity of information on training offered by car manufacturers to their employees; in other words, vehicle or company-specific training.

Comparability with the following countries was possible and the comparisons are listed below:

New Zealand:

Within New Zealand a qualification such as a degree, diploma or certificate usually consists of a number of courses/unit standards. When a course/unit standard in the programme or qualification is completed, the credits for that course/unit standards count towards the total credits one requires to complete the programme or qualification. In some qualifications all courses/unit standards are compulsory, while in others there may be elective courses/unit standards.

Current certificates which are presented in New Zealand include the following:

- National Certificate in Motor Industry (Entry Skills) Level 2: 80 credits.

The National Certificate in Motor Industry (Entry Skills) is an entry-level programme that gives a learner the fundamental skills for a career in the automotive repair industry. Learners develop a basic knowledge of motor vehicle technology, engines, transmissions, electrical aspects, safety and workshop engineering. Once learners have completed the National Certificate in Motor Industry (Entry Skills), they can access the National Certificate in Motor Industry (Automotive Engineering) or the National Certificate in Motor Industry (Automotive Electrical Engineering). Once all unit standards (both practical and theoretical) are completed the learners are considered to have finished their apprenticeship in the automotive industry.

The following competencies/unit standards are addressed in this qualification:

- Remove and replace road wheels in the motor industry.
- Hand tools and workshop equipment for motor industry applications.
- Good work habits and performing safe work practices in motor industry.
- Select/use hand tools and workshop equipment in motor industry.
- Identify locations/functions of motor vehicle systems/components.
- Attend to customer inquiries.
- Select and use hand tools and equipment.
- Carry out general engineering tasks to repair, manufacture or modify components.

Following this qualification a learner can proceed to the Certificate in Automotive and Mechanical Engineering at Level 3, 120 credits.

National Certificate in Motor Industry (Automotive Electrical Engineering) at Level 2:

- Demonstrate knowledge of safe working practices in an automotive workshop.
- Carry out general engineering tasks to repair, manufacture or modify components.
- Select and use hand tools and equipment.
- Identify locations/functions of motor vehicle systems/components.
- Two and four stroke petrol and diesel engines.
- Inspect and test an ignition distributor, and rectify faults.
- Service automotive battery.
- Automotive starting and charging systems and their operation.
- Automotive ignition systems and their operation Service automotive cooling systems.
- Identify types of brake, steering and suspension systems.
- Identify types of manual transmission and adjust a clutch.
- Establish the operation of a petrol fuel system and adjust a carburettor.
- Establish the operation of a diesel fuel system and perform minor servicing tasks.
- Change the fluid and adjust a brake and clutch hydraulic system.
- Carry out basic engine tuning on a petrol engine.
- Select and apply lubricants and sealants.
- Prepare a vehicle or a machine for use and shutdown.
- Provide customer service in a given situation.

The Certificate in Automotive and Mechanical Engineering is also an entry level programme designed to give learners a solid introductory grounding for their careers in the automotive and mechanical engineering industry. Learners will learn about the principles of general automotive systems, develop the skills to interpret general servicing schedules, and carry out customer and administrative services. They learn about general engineering principles, processes and workshop practices. This qualification also helps learners increase their communication, literacy, mathematics and computer skills.

Topics covered in this certificate include but are not limited to electrical technology, engine technology, engineering technology, industry practice, internal combustion engines and vehicle technology. Once learners acquire the Certificate in Automotive and Mechanical Engineering

learners they can apply for cross-credits for unit standards from the National Certificate in Motor Industry (Entry Skills) and National Certificate in Mechanical Engineering (Level 2), and become apprentices working alongside an industry employer and continue studying industry-based unit standards. Learners can also choose to continue their qualifications in the Certificate in Applied Technology, specializing in automotive engineering, marine engineering systems, Autotronics, or welding and fabrication.

In comparing these qualifications to the qualifications in South Africa it is clear that many of the qualifications in New Zealand and South Africa are similar, with a few differences. Both the qualifications (New Zealand and South Africa) are streamlined for the needs of that country and therefore there are, quite understandably, some differences between the qualifications of these two countries.

United Kingdom:

Within the United Kingdom there are various qualifications in the Autotronics environment. The level of qualifications in the United Kingdom is higher than the South African qualifications. The UK Level 2 qualifications cover various aspects including some competencies in the South African qualifications at levels 3 and 4.

Certain aspects of the Institute of Motor Industry and City of Guilds in the United Kingdom have been used in benchmarking best practice procedures in some of the unit standards used in this qualification. The NVQ qualifications offered in the UK cover all the same objectives of this series of qualifications, which are at various levels of complexity. The qualifications in the UK are offered as an internship wherein the learner enrols with a college or training centre for the theoretical component, and achieves the practical component in-house. The qualifications are all based on specific levels of performance, and lead to progressive levels of complexity, but are identified as separate qualifications. The learning towards these qualifications is offered through long-term learner-employer relationships, with short-term stints at a training centre.

Qualification titles in the United Kingdom include:

- City and Guilds: Certificate in Vehicle Maintenance and Repair (Auto-electrical) Level 2.
- City and Guilds: Certificate in Vehicle Maintenance and Repair (Mobile Electrics and Security) Level 2.
- IMI Certificate in Vehicle Maintenance and Repair (Auto-electrical) Level 2.
- IMI National Certificate in Vehicle Maintenance and Repair (Auto-electrical) Level 2.

Competencies covered within these qualifications include unit standards such as health and safety, customer relations, use of tools, repairing, servicing and testing all the elements of electrical systems. The electives include: Apply Safe Working Practices, Service and Charge Batteries, Carry out Repairs to Single Electrical Circuits, Install, Install Ancillary Electrical Components, Repair Starting Systems, Repair Ignition Systems, Service and Repair Electronically Controlled Steering Systems, Service and Repair Electronically Controlled Suspension Systems, Repair Electronic Systems and Service and Repair Electronic Spark Ignition Engine Management Systems.

Other qualifications in the United Kingdom were also used to compare the South African Qualifications. Some of the qualifications include:

- The Motor-Fundamentals of Electricity Certificate level 2 aimed at helping experienced technicians who need to update their skills or who have identified areas of weakness.
- Auto Electricians Apprenticeships at level 2 cover the interpretation of data from system symptoms and diagnosis of non-complex faults.

• Mobile Electronics-Advanced Installation Level 2, Mobile Electronics and Security Federation (MESF Certificate), IMI Mobile Electronic and Security Federation, United Kingdom involves the learning the installation of in-car entertainment electronic devices and electronic gadgets.
• Vehicle Maintenance and Repair Level 2 aims to locate basic electrical faults, remove, rectify and replace electrical components.

After learners complete this qualification they may progress to the next level of qualifications such as:

• Auto Electrical Technical Diploma which will provide learners with the knowledge and skills for a career within the motor vehicle industry.

In comparing these qualifications to the qualifications in South Africa it is clear that many of the qualifications in the United Kingdom and South Africa are similar, with a few differences. Both the qualifications (United Kingdom and South Africa) are streamlined for the needs of that country and therefore there are, quite understandably, some differences between the qualifications of these two countries.

Australia:

In Australia to become an Automotive Electrician usually requires the completion of a Certificate III Apprenticeship in Automotive Electrical Technology. The length of training varies and involves both on-the-job and off-the-job components. The off-the-job training is provided through Registered Training Organizations to Certificate III level.

Qualifications presented in Australia which were used to compare the South African Qualifications include:

• Certificate in Entry to Automotive Engineering (Level 2).

The NMIT Certificate in Entry to Automotive Engineering (Level 2) is 120 credits in value and involves a combination of study at NMIT, work-based training and self-directed study. The programme includes assessment of unit standards that qualify students for the National Certificate in Motor Industry (Entry to Automotive Trades) (Level 2).

Students can complete courses in one of two ways:

• Complete eight 15-credit pre-trade courses in one year full-time. These courses cover the principles and theory needed for automotive engineering, alongside essential practical skills of the trade.
• Six weeks (240 hours) of work-based training in an approved workshop or other approved automotive site are required during the pre-trade programme.

OR

• Complete eight 15-credit beginner apprentice courses over two or more years in block and evening classes at NMIT while employed as an automotive apprentice. These courses apply the theory elements of automotive engineering to skills being learned in the workplace, along with refining skills and abilities practiced in the apprenticeship. The courses are timetabled as a series of 5 one-week block courses during the year, and a series of evening classes over the year.

Normally, an apprentice would study up to four of these block courses in a year and complete the evening class series.

Pre-Trade/Beginner Apprentice Courses Level NMIT Credits:

- Automotive Industry Knowledge.
- Workshop Engineering.
- Preventative Maintenance.
- Engine Repairs.
- Electrical and Electronics.
- Automotive Systems.
- General.
- Cooling and Electrical.

Total NMIT Credits: 120.

All courses in the programme are compulsory and are detailed in the course descriptors. The order of completing each block course is not important.

Certificate II in Automotive Electrical Technology offered by Holmesglen:

Description:

This qualification is part of the Automotive Retail Service and Repair Training Package, Electrical Stream. It is designed for trainee automotive electrical/electronic accessory fitters. Participants will learn how to install, connect and test automotive sound, communications and security systems. Participants will also learn how to fit electronic accessories such as cruise control and central locking systems.

Subjects:

Apply safe working practices; Apply environmental regulations and best practice in a workplace or business; Carry out soldering of electrical wiring/circuits; plus Technical Inventory units including Electrical Ancillary Systems and Accessories cluster-Electrical group units; plus Retail, service and repair or other relevant units.

Course Structure:

To successfully achieve Certificate II in Automotive Electrical Technology, students will be required to complete all modules. Through completing this program, students will also achieve Certificate I in Automotive.

Unit Hours:

- Apply safe working practices.
- Communicate effectively in the workplace.
- Remove and replace electrical/electronic units/assemblies.
- Carry out repairs to single electrical circuits.
- Install, test and repair electrical security systems/components.
- Carry out soldering of electrical wiring/circuits.
- Perform computations.

Unit Hours:

- Identify, clarify and resolve problems.
- Establish relations with customers.
- Apply Environment Regulations And Best Practice In A Workplace Or Business.
- Test, service and charge batteries.
- Install, test and repair low voltage wiring/lighting systems.
- Install ancillary electrical components.

- Read and interpret engineering drawings.
- Interact with computing technology.

Other similar qualifications are:

- Certificate Automotive Electrics and Electronics Level 2.
- Certificate: Automotive (Electrical-Accessory Fitting) Level 2.
- Certificate: Automotive (Electrical) Level 3.
- Certificate Automotive (Mechanical-Air Conditioning) Level 2.
- Certificate II awarded by TAFE NSW-Sydney Institute.

Duration: 1 year.
Study mode: Part time day.

Course description:

This nationally recognised course is for people working in the automotive after market accessory fitting industry who want a career as an accessory fitter and have entered into a training agreement. In this course students will learn how to install automotive mechanical and electrical accessory components to motor vehicles. It is a pathway to a traineeship in the accessory fitting industry. This course is for people seeking to become an accessory fitter in the automotive industry.

Certificate II in Automotive Mechanical (Air Conditioning):

- Duration: 18 months part time.

Course Description:

This course provides the training component required to obtain registration from the Australian Refrigeration Council to work as an automotive air conditioning fitter or repairer. This course can be studied in the workplace as a traineeship or qualification achieved via the Recognition of Prior Learning (RPL) process.

Major specialisation:

- Major Study Areas.
- OHS.
- Repair electric circuits.
- Workplace tools and equipment.
- Service, repair and diagnose.
- Air-conditioning systems.

Units of Study:

Compulsory units:

- Apply safe working practices-20 hours.
- Implement and monitor environmental regulations in the automotive mechanical industry-20 hours.

Elective units:

- Carry out repairs to single electrical circuits-40 hours.
- Install air conditioning systems-30 hours.

- Service air conditioning systems-20 hours.
- Repair/retrofit air conditioning systems-30 hours.
- Carry out diagnostic procedures-20 hours.
- Service, maintain or replace batteries-15 hours.
- Carry out servicing operations-20 hours.
- Inspect and service engines-20 hours.
- Inspect and service cooling systems-10 hours.
- Service petrol fuel systems-15 hours.
- Use and maintain workplace tooling and equipment-20 hours.

These qualifications/certificates provide automotive electrical apprentices with the knowledge and skills required to perform on-vehicle faultfinding procedures and electrical system repairs. Competencies in these qualifications include but are not limited to testing of electrical systems that incorporate various control devices and loads, locating faults and identifying their causes, repairing faults in electrical systems that incorporate various control devices and loads, using electric and gas heated devices to perform soldering procedures associated with the repair of automotive electrical systems and components.

In comparing this Qualification to these offered in Australia, it is clear that the same competencies are covered by both countries, within their qualifications. Although the implementation and use of these qualifications in each country may be different, the same principles of apprenticeship and/or learnerships are applied. The qualifications of both countries are streamlined for the needs of that country and this points to the differences between the qualifications of the two countries.

Germany-Ceylon:

The Ceylon German Technical Training Institute was a body affiliated to the Sri Lanka Central Transport Board, which was an autonomous body incorporated under an act of Parliament. This Institute was established with a grant from the Federal Republic of Germany. The Institute offers, inter alia, the following autotronics-related courses. However, the NQF levels of these courses cannot be determined. The institute offers both full-time and part-time courses. The full-time courses are of lengthy duration (most are of 3 years or more) and this indicates that the full time courses are probably post schooling. The part-time course that coincide with the competencies of this qualification are listed here.

Part-Time Courses [Weekend/Evening]:

- Preliminary Training Course Engineering Hand Tools & Measuring Tools Operation. Preparation Course before entering Automobile, Power Electrical.
  - Workshop Practice.
- Automobile Courses.
  - Motor Vehicle Technology-1.
- Auto Electrical Courses.
  - Auto Electricity.
- Electricity and Electronics in Automobiles.
- Tool Machinery Courses.

Another German initiative in the autotronics field is the Jamaican-German Automotive School. It is a technical cooperation project between the Governments of Germany and Jamaica and provides training for persons in the automotive industry as well as for those wishing to join the industry. Programmes are offered in the evening and daily on a full-time or part-time basis. The full-time programme is for three years. The major objective of the School is to provide continually a cadre of highly trained personnel for the Automotive Sector. Skills upgrading is offered to persons working in the Automotive Industry. It provides professional advisory service to automotive workshops, training institutions and individuals. The courses offered include:

- Automotive Mechanic.
- Automotive Electronics.
- Automotive Electrician.

United States:

In Dallas, Texas various qualifications exists but it was not clear on which levels these qualifications are presented. The competencies and skills covered in these qualifications are similar to the South African Qualifications.

Certificate in Electric Troubleshooting:

- Aspects covered in this qualification cover: how electrical circuits work; testing electrical circuits; electrical circuits failure and troubleshooting electrical circuits; DC Motor circuit electrical problems; introduction to the various types of ohmmeters, their parameters, capabilities and limitations for testing solid-state components; introduction to key-off battery drain problems relating to DC motor circuit cooling fans; troubleshooting relay circuits; relays causing key-off drain problems.

Certificate: Wire Harness Troubleshooting:

- This qualification covers unique electrical circuit problems relating to: troubleshooting an electrical system; troubleshooting batteries; unusual battery failures; troubleshoot a battery failure on the vehicle simply using a DMM and a DC Current Clamp; cranking circuits and practical cranking circuit; systematic troubleshooting procedures, testing voltage drops, troubleshooting charging systems, systematic troubleshooting procedure, troubleshooting key-off battery drain problems, discussion on key-off drain issues (on-board computers are the primary cause of key-off drain problems); troubleshooting multiple battery systems; principles of operation and troubleshooting concepts of batteries, parallel combinations with emphasis on battery voltage analysis versus battery current analysis.

India:

Autotronics training in India takes places by private providers such as the TechnoLabs. This is a student assistance Technological Company offering its services in the field of hands-on practical training on emerging technologies, development tools and components for self project development and involves assistance in major project development to engineering students. Most of the training information available is at a higher level.

SADC:

None of the SADC countries has its own qualifications relating to Autotronics, but use the British City and Guilds Standards for training learners in the automotive field. Namibia has indicated interest in the South African qualification and may implement this qualification once it has been registered. Namibia is currently in the process of developing vocational certificates for registration on the Namibia Qualifications Framework. Various initiatives are in place to ensure that their qualifications are in line with the South African Qualifications.

Conclusion:

The competencies covered in the National Certificate: Autotronics, level 2 are similar to those in the qualifications that have been looked at in other countries. While direct and complete comparisons are rarely possible - given the very different contexts in the countries investigated, there are significant (and sometimes not-so-significant) overlaps between this qualification and those internationally. In some cases, it is difficult to figure out the levels of the international

courses and qualifications but the overlap in competencies helped to benchmark this Qualification.

This Qualification enjoys close similarity with the qualifications from Australia, New Zealand and England in terms of the competencies contained therein. The comparison with these three countries is enhanced by the fact that the qualifications available there are in an outcomes-based format. An advantage was that a fair amount of information is available and this promotes a more comprehensive comparability.

There is also some overlap of this qualification with the Germany-Ceylon project described above. This Qualification also shares competencies with the qualifications from the United States.

There is not much information available from India but it must be assumed that the TechnoLabs do provide basic training on the competencies listed in this Qualification before embarking on higher levels of training.

On the whole this qualification compares very favourably with international qualifications or aspects thereof.

This qualification will develop the competencies required by the entry level workers who wish to access the autotronics industry. It will also equip them to be able to perform entry level tasks similar to tasks in other countries.

ARTICULATION OPTIONS

This Qualification lends itself to both vertical and horizontal articulation possibilities.

Horizontal articulation is possible with the following Qualifications:

- ID 71950: National Certificate: Automotive Components: Manufacturing and Assembly at NQF Level 2.
- National Certificate: Automotive Repair and Maintenance at NQF Level 2.
- ID 65809: National Certificate: Automotive Manufacturing and Assembly at NQF Level 2.

Vertical articulation is possible with the following Qualifications:

- ID 71989: National Certificate: Automotive Components: Manufacturing and Assembly at NQF Level 3.
- ID 78923: National certificate: Autotronics at NQF Level 3.

MODERATION OPTIONS

- Anyone assessing a learner or moderating the assessment of a learner against this Qualification must be registered as an assessor with the relevant Education, Training, Quality, and Assurance (ETQA) Body.

- Any institution offering learning that will enable the achievement of this Qualification must be accredited as a provider with the relevant ETQA.

- Assessment and moderation of assessment will be overseen by the relevant ETQA according to the ETQA's policies and guidelines for assessment and moderation; in terms of agreements reached around assessment and moderation between ETQA's (including professional bodies); and in terms of the moderation guideline detailed immediately below.

- Moderation must include both internal and external moderation of assessments at exit points of the Qualification, unless ETQA policies specify otherwise. Moderation should also encompass achievement of the competence described both in individual Unit Standards, the

integrated competence described in the Qualification and will include competence within core sales and the elective standards relevant to the economic sector.

• Anyone wishing to be assessed against this Qualification may apply to be assessed by any assessment agency, assessor or provider institution that is accredited by the relevant ETQA.

CRITERIA FOR THE REGISTRATION OF ASSESSORS

For an applicant to register as an assessor, the applicant needs:

• A minimum of 4 (four) years' practical, relevant occupational experience.
• A relevant Qualification at NQF Level 3 or higher.
• To be registered as an assessor with the relevant ETQA.

NOTES

This qualification replaces qualification 22858, "National Certificate: Autotronics", Level 2, 128 credits.

UNIT STANDARDS

	ID	UNIT STANDARD TITLE	LEVEL	CREDITS
Fundamental	119463	Access and use information from texts	Level 2	5
Fundamental	9009	Apply basic knowledge of statistics and probability to influence the use of data and procedures in order to investigate life related problems	Level 2	3
Fundamental	7480	Demonstrate understanding of rational and irrational numbers and number systems	Level 2	3
Fundamental	119454	Maintain and adapt oral/signed communication	Level 2	5
Fundamental	12444	Measure, estimate and calculate physical quantities and explore, describe and represent geometrical relationships in 2-dimensions in different life or workplace contexts	Level 2	3
Fundamental	119460	Use language and communication in occupational learning programmes	Level 2	5
Fundamental	7469	Use mathematics to investigate and monitor the financial aspects of personal and community life	Level 2	2
Fundamental	9007	Work with a range of patterns and functions and solve problems	Level 2	5
Fundamental	119456	Write/present for a defined context	Level 2	5
Core	376621	Build auto-electrical circuits	Level 2	16
Core	376600	Diagnose and service automobile batteries and battery system components	Level 2	8
Core	119753	Perform basic welding/joining of metals	Level 2	8
Core	260717	Remove and fit automobile components	Level 2	12
Core	376641	Remove, fit, assemble and repair automobile auxiliary harnesses	Level 2	12
Core	15123	Select and use vehicle lifting equipment	Level 2	3
Core	119744	Select, use and care for engineering hand tools	Level 2	8
Core	12219	Select, use and care for engineering power tools	Level 2	6
Core	259604	Verify compliance to safety, health and environmental requirements in the workplace	Level 2	4
Core	244056	Understand the fundamentals of engine technology	Level 3	4
Elective	252250	Apply fire fighting techniques	Level 1	3
Elective	116932	Operate a personal computer system	Level 1	3
Elective	119567	Perform basic life support and first aid procedures	Level 1	5
Elective	115101	Address workplace hazards and risks	Level 2	4
Elective	259762	Demonstrate an understanding of HIV/AIDS and its impact on the workplace	Level 2	12
Elective	244365	Lift and move material and equipment by means of a forklift	Level 2	3
Elective	9268	Manage basic personal finance	Level 2	6
Elective	116235	Operate a pendant controlled overhead crane	Level 2	5
Elective	120496	Provide risk-based primary emergency care/first aid in the workplace	Level 2	5
Elective	335860	Read and interpret engineering drawings	Level 2	8

	ID	UNIT STANDARD TITLE	LEVEL	CREDITS
Elective	260637	Test and report on condition of vehicle starting and charging system	Level 2	4
Elective	9322	Work in a team	Level 2	3

LEARNING PROGRAMMES RECORDED AGAINST THIS QUALIFICATION
None

SOUTH AFRICAN QUALIFICATIONS AUTHORITY

UNIT STANDARD:

Diagnose and service automobile batteries and battery system components

SAQA US ID	*UNIT STANDARD TITLE*		
376600	Diagnose and service automobile batteries and battery system components		
ORIGINATOR		*PROVIDER*	
SGB Manufacturing and Assembly Processes			
FIELD		*SUBFIELD*	
6 - Manufacturing, Engineering and Technology		Manufacturing and Assembly	
ABET BAND	*UNIT STANDARD TYPE*	*NQF LEVEL*	*CREDITS*
Undefined	Regular	Level 2	8

New NQF Level: NQF Level 02

This unit standard does not replace any other unit standard and is not replaced by another unit standard.

SPECIFIC OUTCOME 1
Perform vehicle tests on a fitted automotive battery.

SPECIFIC OUTCOME 2
Perform cable testing related to the battery.

SPECIFIC OUTCOME 3
Remove and refit a battery.

SPECIFIC OUTCOME 4
Test batteries.

SPECIFIC OUTCOME 5
Perform service operations on battery/battery system associated components.

SPECIFIC OUTCOME 6
Perform repair operations on battery system associated components.

SPECIFIC OUTCOME 7
Configure and test 12/24 volt battery systems.

SPECIFIC OUTCOME 8
Explain and conduct jump-starting procedures.

SPECIFIC OUTCOME 9
Restore work area and complete and process documentation.

QUALIFICATIONS UTILISING THIS UNIT STANDARD

	ID	QUALIFICATION TITLE	LEVEL
Core	78944	National Certificate: Autotronics	Level 2

SOUTH AFRICAN QUALIFICATIONS AUTHORITY

UNIT STANDARD:

Build auto-electrical circuits

SAQA US ID	*UNIT STANDARD TITLE*		
376621	Build auto-electrical circuits		
ORIGINATOR		*PROVIDER*	
SGB Manufacturing and Assembly Processes			
FIELD		*SUBFIELD*	
6 - Manufacturing, Engineering and Technology		Manufacturing and Assembly	
ABET BAND	*UNIT STANDARD TYPE*	*NQF LEVEL*	*CREDITS*
Undefined	Regular	Level 2	16

New NQF Level: NQF Level 02

This unit standard replaces:

US ID	Unit Standard Title	NQF Level	Credits	Replacement Status
12211	Build basic auto electrical circuits	Level 2	16	Will occur as soon as 376621 is registered

SPECIFIC OUTCOME 1
Demonstrate an understanding of the basic principles of auto-electricity.

SPECIFIC OUTCOME 2
Explain the uses and functions of components used when building basic auto electrical circuits.

SPECIFIC OUTCOME 3
Interpret circuit diagrams.

SPECIFIC OUTCOME 4
Build auto-electrical circuits.

SPECIFIC OUTCOME 5
Test and repair auto-electrical circuits.

QUALIFICATIONS UTILISING THIS UNIT STANDARD

	ID	QUALIFICATION TITLE	LEVEL
Core	78944	National Certificate: Autotronics	Level 2

SOUTH AFRICAN QUALIFICATIONS AUTHORITY

UNIT STANDARD:

Remove, fit, assemble and repair automobile auxiliary harnesses

SAQA US ID	*UNIT STANDARD TITLE*		
376641	Remove, fit, assemble and repair automobile auxiliary harnesses		
ORIGINATOR		*PROVIDER*	
SGB Manufacturing and Assembly Processes			
FIELD		*SUBFIELD*	
6 - Manufacturing, Engineering and Technology		Manufacturing and Assembly	
ABET BAND	*UNIT STANDARD TYPE*	*NQF LEVEL*	*CREDITS*
Undefined	Regular	Level 2	12

New NQF Level: NQF Level 02

This unit standard replaces:

US ID	Unit Standard Title	NQF Level	Credits	Replacement Status
12212	Assemble, fit and repair automobile auxiliary harnesses	Level 2	12	Will occur as soon as 376641 is registered

SPECIFIC OUTCOME 1
Demonstrate an understanding of aspects related to auxiliary harnesses.

SPECIFIC OUTCOME 2
Read and interpret auto electrical auxiliary circuit diagrams and construct circuits.

SPECIFIC OUTCOME 3
Test automobile auxiliary harnesses.

SPECIFIC OUTCOME 4
Remove and fit automobile auxiliary harnesses.

SPECIFIC OUTCOME 5
Assemble automobile auxiliary harnesses.

SPECIFIC OUTCOME 6
Repair automobile auxiliary harnesses.

QUALIFICATIONS UTILISING THIS UNIT STANDARD

	ID	QUALIFICATION TITLE	LEVEL
Core	78944	National Certificate: Autotronics	Level 2

SOUTH AFRICAN QUALIFICATIONS AUTHORITY

QUALIFICATION:
National Certificate: Autotronics

SAQA QUAL ID	***QUALIFICATION TITLE***		
78923	National Certificate: Autotronics		
ORIGINATOR		***PROVIDER***	
SGB Manufacturing and Assembly Processes			
QUALIFICATION TYPE	***FIELD***	***SUBFIELD***	
National Certificate	6 - Manufacturing, Engineering and Technology	Manufacturing and Assembly	
ABET BAND	***MINIMUM CREDITS***	***NQF LEVEL***	***QUAL CLASS***
Undefined	132	Level 3	Regular-Unit Stds Based

New NQF Level: NQF Level 03

This qualification replaces:

Qual ID	Qualification Title	NQF Level	Min Credits	Replacement Status
22859	National Certificate: Autotronics	Level 3	141	Will occur as soon as 78923 is registered

PURPOSE AND RATIONALE OF THE QUALIFICATION
Purpose:

This Qualification is for any individual who is, or wishes to be, involved in an autotronics environment. The Qualification contains all the skills, knowledge, values and attitudes required by a learner who needs mainly to be able to perform a range of activities and thereby meet the challenges within a specific autotronics environment. An individual acquiring this Qualification will be able to contribute towards the efficient operation of a number of processes within this sector and at this level as described in the Core component of the qualification.

The Core component covers the following competencies:

- Diagnosing, testing and repairing conventional automobile charging systems.
- Diagnosing, testing and repairing conventional automobile starting systems.
- Servicing and repairing conventional ignition systems.
- Constructing and testing basic electronic circuits.
- Tracing and repairing auto electrical circuit faults.
- Operating and monitoring a lathe.
- Appling safety, health and environment protection procedures in a process plant.

These competencies will enable the learner to work in different industries within the diverse autotronics sector.

The Qualification ensures progression of learning, enabling the learner to perform optimally within the autotronics field of learning and providing access to learning at a higher level within the same or a related sector.

Rationale:

This is the second Qualification in a series of four autotronics qualifications that range from NQF Levels 2 to 5. These qualifications constitute a learning pathway that takes the learners from basic/simple competencies in autotronics at NQF Level 2 to high level autotronics competencies at NQF Level 5. Typical learners will be persons who are currently working in an autotronics environment, who have not received any formal recognition for their skills and knowledge or for anyone wishing to follow a career in an autotronics working environment, in a variety of contexts.

The automobile is subject to ever increasing technological advances. These advances are continuously being incorporated into the electrical systems of automobiles. They represent the integration of mechanical, hydraulic, pneumatic, electronic and electrical systems and are managed by microelectronic control known as Computer Integrated Auto Management (CIAM) Systems. Consequently, the auto-electrical skills required to maintain such automobiles are changing to incorporate more electronic skills.

The field of autotronics deals with the installation, diagnosis and repair of CIAM systems. People working in the field of autotronics require specialised technical skills and knowledge and well as highly developed analytical skills to enable them to install, diagnose and repair CIAM systems.

This series will reflect the skills, knowledge and understanding required to perform effectively in industry, whether in micro, small, medium or large enterprises.

This qualification forms the basis for further learning in the field of autotronics.

The autotronics sector falls within the ambit of South Africa's large motor industry. There are huge motor assembly plants in several parts of the country, primarily in the Eastern Cape, Gauteng and Kwa Zulu Natal provinces. There are also many automotive related sectors like the automotive components manufacturing and assembly industries, automotive sales and service sector, repairs (including panel beating and spray painting) industries. It's a sector that employs a large number of people. Companies and/or industries within this sector operate in a global competitive and challenging environment.

The highly developed autotronics sector is well-established and economically powerful. In terms of transformation in the country, learners will require skills and competencies to gain access to positions within management structures by completing other qualifications and training. It will be in the interest of the country and the sector to ensure that those who operate in the autotronics environment are trained according to this Qualification to improve productivity and efficiency.

This national Qualification and its related Unit Standards were developed to standardise the accreditation of learning programmes, resulting in improved quality management in terms of programme delivery.

RECOGNIZE PREVIOUS LEARNING?
Y

LEARNING ASSUMED IN PLACE
Learners wishing to study towards this Qualification are assumed to have:

- Mathematical Literacy at NQF Level 2.
- Communication at NQF Level 2.

Recognition of Prior Learning:

This Qualification may be achieved in part (or whole) through the recognition of relevant prior knowledge and/or experience. The learner must be able to demonstrate competence in the knowledge, skills, values and attitudes implicit in this Qualification. As part of the provision of recognition of prior learning providers are required to develop a structured means for the assessment of individual learners against the Unit Standards of the Qualification on a case-by-case basis. A range of assessment tools and techniques during formative and summative assessment procedures should be used which have been jointly decided upon by the learner and the assessor. Such procedures, and the assessment of individual cases, are subject to moderation by independent assessors. The same principles that apply to assessment of this Qualification also apply to recognition of prior learning.

Learners may provide evidence of prior learning for which they may receive credit towards the Unit Standards and/or the Qualification by means of portfolios or other forms of appropriate evidence as agreed to between the relevant provider and relevant ETQA or ETQA that has a Memorandum of Understanding in place with the relevant ETQA.

Recognition of Prior Learning is particularly important, as there are people in the autotronics sector with a variety of skills and competencies of differing quality and scope. It is important that an Recognition of Prior Learning process be available to assist in making sense of existing competencies and skills, and helping to standardise these competencies and skills towards a common standard.

Access to the Qualification:

There is an open access to this Qualification. However it is preferable that learners first complete the National Certificate: Autotronics at NQF Level 2 before accessing this qualification.

QUALIFICATION RULES

The Qualification consists of a Fundamental, a Core and an Elective Component.

To be awarded the Qualification learners are required to obtain a minimum of 132 credits as detailed below.

Fundamental Component: 36 Credits.

The Fundamental Component consists of Unit Standards in:

- Mathematical Literacy at NQF Level 3 to the value of 16 Credits.
- Communication at NQF Level 3 to the value of 20 Credits.

All Unit Standards in the Fundamental Component are compulsory.

Core Component:

The Core Component consists of Unit Standards to the value of 74 Credits, all of which are compulsory.

Elective Component:

The Elective Component consists of Unit Standards offering a variety of competencies to the learner. Learners are to choose Elective Unit Standards totalling a minimum of 22 credits to attain a minimum of 132 credits for this Qualification.

EXIT LEVEL OUTCOMES

1. Test, diagnose repair and/or service conventional automobile electronic systems.
- Range: Electronic systems include charging, ignition and starting systems.

2. Construct and test basic electronic circuits.

3. Trace and repair auto-electrical circuits.

4. Apply safety, health and environment protection procedures in the workplace.

Critical Cross-Field Outcomes:

Identify and solve problems in which responses display that responsible decisions using critical and creative thinking have been made when:

- Testing the electronic systems (charging, starting and ignition systems) and diagnosing faults.
- Interpreting test results.
- Differentiating between the wiring harnesses on a vehicle.
- Testing joints.

Work effectively with others as a member of a team, group, organisation, community to:

- Contribute to the work group's efforts to maintain cleanliness, safety and quality.
- Trace faults on auto-electrical circuits on an automobile.

Organise and manage oneself and one's activities responsively and effectively when:

- Interpreting circuit diagrams of electronic systems.
- Performing tests using testing equipment.
- Servicing systems, where appropriate, using appropriate equipment.
- Repairing components where applicable (distributors, alternators, starters).
- Removing, bench-testing, dismantling, reassembling and refitting components.
- Demonstrating the ability to locate technical information in an auto electrical (autotronics) context.
- Differentiating between the wiring harnesses on a vehicle.
- Locating joints and earth points in the various harnesses.
- Applying the correct procedures for using, storing and looking after tools, test equipment and components.
- Preparing for safety and environmental inspections in work area.
- Conducting safety, health and environmental inspections in work area.

Collect, analyse, organise and critically evaluate information to:

- Interpret test results and solve problems/faults.
- Differentiate between the wiring harnesses on a vehicle.
- Locate joints and earth points in the various harnesses.
- Compare auto electrical safety devices to technical specifications.
- Respond to unsafe unacceptable conditions in work area.

Communicate effectively using visual, mathematical and/or language skills in the modes of oral and/or written presentation to:

- Prepare report for customer on condition of component.
- Prepare job-card for notifying the customer.
- Use common names for components, test equipment, circuits, and the filling in and use of fault reports and requisition forms.

Use science and technology effectively and critically, showing responsibility towards the environment and the health of others by:

- Using tools and equipment according to manufacturer's instructions and workplace procedure.

Demonstrate an understanding of the world as a set of related systems by recognising that problem-solving contexts do not exist in isolation to:

- Engage with faults on the distributor and ignition system.
- Engage with faults on the alternators and charging system.
- Relate the use of electronics to other units and equipment.

ASSOCIATED ASSESSMENT CRITERIA

Associated Assessment Criteria for Exit Level Outcome 1:

- Diagrams of the systems are interpreted in terms of symbols and components.
- The theoretical aspects of the systems are discussed to provide the basis for practical application.
- Components of relevant systems are described, maintained, tested, and serviced according to procedure.
- The system is tested using appropriate equipment and faults are diagnosed according to procedure.
- Repairs are performed, where applicable, according to manufacturer's specifications.

Associated Assessment Criteria for Exit Level Outcome 2:

- The principles of electronics and the operation of basic electronic circuits. are discussed and explained in terms of circuit diagrams and applicable scientific laws.
- Electronic and related components are described, selected and used for circuit construction as per procedure.
- Basic electronic circuits are constructed according to circuit diagrams and specifications.
- Electronic circuits are tested for short circuit and open circuit conditions.

Associated Assessment Criteria for Exit Level Outcome 3:

- Technical information in an auto electrical (autotronics) context is located and used to remove and test auto electrical devices and components.
- The wiring harnesses on a vehicle are differentiated in terms of their primary functions and the main circuits they support are identified and described.
- Auto electrical circuit diagrams and symbols are interpreted in terms of the required operation of the vehicle.
- Auto electrical components are removed and fitted according to manufacturer's specifications and procedure.
- Test equipment is select and used to locate faults on auto electrical circuits.
- Fault finding reports and requisition forms are completed according to procedure.

Associated Assessment Criteria for Exit Level Outcome 4:

- The responsibilities and liability regarding safety in the workplace are explained in terms of their implications with respect to legislation and company procedures.
- Safety and environmental inspections in work area are conducted in accordance with workplace procedures and the company safety inspection schedule.
- Unsafe conditions in work area are dealt with in accordance with workplace procedures and corrective action is taken.
- Safety, health and environmental documentation is completed according to workplace procedure.

Integrated Assessment:

The importance of integrated assessment is to confirm that the learner is able to demonstrate applied competence (practical, foundational and reflexive) and ensure that the purpose of this Qualification is achieved. Both formative and summative assessment methods and strategies are used to ensure that the Exit Level Outcomes and the purpose of the Qualification are achieved through achieving the Unit Standards. Learning, teaching and assessment are inextricably linked.

Learning and assessment should be integrated and assessment practices must be fair, transparent, valid and reliable. A variety of assessment strategies and approaches must be used. This could include tests, assignments, projects, demonstrations and/or any applicable method. Evidence of the acquisition of competencies must be demonstrated through the Unit Standards, which enhance the integration of theory and practice as deemed appropriate at this level.

Formative assessment is an on-going process which is used to assess the efficacy of the teaching and learning process. It is used to plan appropriate learning experiences to meet the learner's needs. Formative assessments can include a mix of simulated and actual (real) practice or authentic settings. Feedback from assessment informs both teaching and learning. If the learner has met the assessment criteria of all the Unit Standards then she/he has achieved the Exit Level Outcomes of the Qualification.

Summative assessment is concerned with the judgement of the learning in relation to the Exit Level Outcomes of the Qualification. Such judgement must include integrated assessment(s) which test the learners' ability to integrate the larger body of knowledge, skills and attitudes, which are represented by the Exit Level Outcomes. Summative assessment can take the form of oral, written and practical examinations as agreed to by the relevant ETQA.

Integrated assessment must be designed to achieve the following:

An integration of the achievement of the Exit Level Outcomes in a way that reflects a comprehensive approach to learning and shows that the purpose of the Qualification has been achieved;

Judgement of learner performance to provide evidence of applied competence or capability.

Assessors and moderators should make use of a range of formative and summative assessment methods. Assessors should assess and give credit for the evidence of learning that has already been acquired through formal, informal and non-formal learning and work experience.

Assessment should ensure that all specific outcomes, embedded knowledge and critical cross-field outcomes are assessed. The assessment of the critical cross-field outcomes should be integrated with the assessment of specific outcomes and embedded knowledge.

INTERNATIONAL COMPARABILITY

This qualification is part of a series of qualifications in the field of Autotronics and was compared to similar qualifications - some outcomes-based - in various countries. The following countries were used to compare this qualification with:

- United States - The US has one of the most extensive and very highly-developed car manufacturing industries in the world.
- United Kingdom - The UK also has a highly-developed car manufacturing industry. It also has a number of institutions that offer training courses in the automotive/autotronics field.

• New Zealand and Australia - They have qualification frameworks similar to the South African NQF; this facilitates comparison.
• Malaysia - Malaysia works closely with training partners in the automotive industry. These include vehicle brands such as BMW, Mercedes Benz, Nissan, Mazda, Ssangyong, Citroen, Fiat, Honda, Hyundai, Toyota, Audi and Volvo.
• Japan and Jamaica - While Japan has probably the most sophisticated car manufacturing industry, information on training course and qualifications in autotronics is very sketchy. However, some information on training was found in a cooperative agreement between Japan and Jamaica.
• Canada - Many institutions offer training in the automotive and autotronics fields.
• Uganda - While there is very little information on autotronics training in some of the African countries that were surveyed, some information was found on training in Uganda.

International comparability with the following car manufacturing countries was attempted, with little success, as there was very little or no information available:

• Japan.
• Korea.
• Sweden.
• France.
• Germany.
• Italy.
• China.

There was also a paucity of information on training offered by car manufacturers to their employees; in other words, vehicle or company-specific training. Some information is available on training by car manufacturers, namely, BMW and Volvo. This is described later.

Comparability with the following countries was possible and the comparisons are listed below:

New Zealand:

Within New Zealand a qualification such as a certificate usually consists of a number of courses/unit standards. When a unit standard in the certificate qualification is completed, the credits for that unit standards count towards the total credits one requires to complete the qualification. In some qualifications all courses/unit standards are compulsory, while in others there may be elective courses/unit standards.

Current certificates - similar to this qualification are presented in New Zealand. These include the following:

National Certificate in Motor Industry (Automotive Electrical Engineering):

• Demonstrate knowledge of vehicle security systems and their installation.
• Inspect and test an ignition distributor, and rectify faults.
• Demonstrate safety precautions on vehicles fitted with air bags and/or seatbelt pre-tensioners.
• Respond to vehicle and/or machine breakdown.
• Check a four stroke petrol engine for condition using hand held test equipment.
• Demonstrate knowledge of the operation and testing of automotive alternators and alternator controls.
• Demonstrate knowledge of automotive electronic fuel injection system operation, and fault diagnosis and repair.
• Demonstrate knowledge of fuel emissions, and vehicle emission controls.
• Create and measure automotive series-parallel circuits, and calculate values of power in automotive circuits.

• Demonstrate knowledge of inductance, capacitors and chokes, and alternating current used in automotive applications.
• Demonstrate knowledge of electronic components and their application in the automotive industry.
• Demonstrate knowledge of integrated electronic devices, multiplexing, and microprocessors in the motor industry.
• Overhaul starter motors from light vehicles.
• Diagnose and rectify faults in a contact breaker (CB) ignition system on an engine.
• Diagnose and rectify faults in a conventional-type electronic ignition system on an engine.
• Diagnose and rectify faults in light vehicle starting and charging systems.
• Identify a wiring diagram and translate information to a circuit in the motor and related industries.
• Demonstrate knowledge of wiring and wiring diagrams used in automotive circuits.
• Carry out automotive wiring repairs and replace a wiring circuit.
• Test a vehicle heating and ventilation system.
• Install electrical accessories in vehicles, and test for and rectify faults.
• Service multiple battery installations on vehicles, machines, and/or units.

National Certificate in Motor Industry (Automotive Electrical and Mechanical Engineering) (Level 3) with strands in Electrical and Electronics, Light Vehicle, Motorcycle, Outdoor Power Equipment, and Trailer Boat Systems.

The following are the many unit standards (core and electives) that are part of the qualification:

• Identify a wiring diagram and translate information to a circuit in the motor and related industries.
• Demonstrate knowledge of protecting vehicle electronics in the motor industry.
• Demonstrate knowledge of testing automotive electrical circuits.
• Select test equipment and test an automotive electrical circuit.
• Demonstrate knowledge of automotive electrical principles.
• Demonstrate knowledge of wiring and wiring diagrams used in automotive circuits.
• Carry out automotive wiring repairs and replace a wiring circuit.
• Explain the operation of two and four stroke petrol and diesel engines.
• Demonstrate knowledge of hand tools and workshop equipment for motor industry applications.
• Describe automotive starting and charging systems and their operation.
• Describe automotive ignition systems and their operation.
• Overhaul starter motors from light vehicles.
• Diagnose and rectify faults in a conventional-type electronic ignition system on an engine.
• Diagnose and rectify faults in light vehicle starting and charging systems.
• Install electrical accessories in vehicles, and test for and rectify faults.
• Service multiple battery installations on vehicles, machines, and/or units.
• Demonstrate knowledge of the operation and testing of automotive alternators and alternator controls.
• Demonstrate knowledge of automotive electronic ignition system operation.
• Protect electronics when servicing or repairing a vehicle or machine in the motor industry.
• Demonstrate knowledge of vehicle security systems and their installation.
• Demonstrate knowledge of automotive batteries.
• Remove and replace motor vehicle lamps in the motor industry.
• Demonstrate knowledge of windscreen wiper and headlamp cleaning systems.
• Demonstrate knowledge of automotive lighting requirements and lighting circuit diagnosis.
• Diagnose and rectify lighting circuit faults on vehicles or machines.
• Create and measure automotive series-parallel circuits, and calculate values of power in automotive circuits.

- Demonstrate knowledge of inductance, capacitors and chokes, and alternating current used in automotive applications.
- Demonstrate knowledge of electronic components and their application in the automotive industry.
- Demonstrate knowledge of integrated electronic devices, multiplexing, and microprocessors in the motor industry.
- Demonstrate knowledge of engine management systems.
- Demonstrate knowledge of overhauling starter motors from light vehicles.
- Demonstrate knowledge of overhauling automotive alternators.
- Test and rectify faults in automotive alternator circuits, and overhaul an automotive alternator.
- Demonstrate knowledge of automotive air conditioning.
- Service an automotive battery.
- Describe automotive starting and charging systems and their operation.
- Describe automotive ignition systems and their operation.
- Protect electronics when servicing or repairing a vehicle or machine in the motor industry.
- Demonstrate knowledge of automotive batteries.
- Remove and replace motor vehicle lamps in the motor industry.
- Demonstrate knowledge of automotive lighting systems, and headlamp adjustment.
- Rectify simple vehicle lighting faults, and adjust vehicle lamps.
- Demonstrate knowledge of electronic components and their application in the automotive industry.
- Demonstrate knowledge of integrated electronic devices, multiplexing, and microprocessors in the motor industry.
- Demonstrate knowledge of engine management systems.

Once learners complete this Certificate in Automotive and Mechanical Engineering, they can apply for cross-credits for unit standards from the National Certificate in Motor Industry (Entry Skills) and National Certificate in Mechanical Engineering (Level 2), and become an apprentice working alongside an industry employer, while continuing to study industry-based unit standards. Learners can also choose to continue their qualifications in the Certificate in Applied Technology, specializing in automotive engineering, marine engineering systems, Autotronics, or welding and fabrication.

In comparing these qualifications to the qualifications in South Africa it is clear that the qualifications in New Zealand cover almost all the competencies of this Qualification, with a few differences. Both these qualifications (New Zealand and South Africa) are streamlined for the needs of that country and therefore the unique differences between the two countries.

United Kingdom:

Within the United Kingdom there are various qualifications in the Autotronics environment. The level of qualifications in the United Kingdom is somewhat higher than the South African qualifications.

Certain aspects of the qualifications offered by the Institute of Motor Industry and City of Guilds in the United Kingdom have been used in benchmarking best practice procedures of some of the unit standards used in this qualification. The NVQ qualifications offered in the UK cover many of the objectives of this series of qualifications, which are at various levels of complexity. The qualifications in the UK are offered as an internship wherein the learner enrols with a college or training centre for the theoretical component, and achieves the practical component in-house. The qualifications are all based on specific levels of performance, and lead to progressive levels of complexity, but are identified as separate qualifications. The learning towards these qualifications is offered through long-term learner-employer relationships, with short-term stints at a training centre.

Qualification titles in the United Kingdom include:

City and Guilds:

- Certificate in Vehicle Maintenance and Repair (Auto electrical) Level 3.
- Certificate in Vehicle Maintenance and Repair (Air conditioning and Climate control) Level 3.
- Diploma in Vehicle Maintenance and Repair (Auto electrical) Level 3.

Edexcel:

- BTEC National Certificate in Vehicle Repair and Technology (Auto electrical) Level 3.
- Vehicle Maintenance and Repair (Auto electrical) Level 3.

IMI:

- Diploma in Vehicle Maintenance and Repair (Auto electrical) Level 3.
- National Certificate in Vehicle Maintenance and Repair (Auto electrical) Level 3.

Competencies covered within these qualifications include unit standards such as health and safety, customer relations, using tools, repairing, servicing and testing all the elements of electrical systems. The electives include: Carry Out Repairs to Single Electrical Circuits, Install Ancillary Electrical Components, Repair Starting Systems, Repair Electrical Systems, Repair Instruments and Warning Systems, Repair Ignition Systems, Repair Charging, Equipment Implement and Monitor Environmental Regulations in the Automotive Mechanical Industry, Repair/Retrofit Air Conditioning Systems Carry and Soft Soldering (Basic).

Other qualifications in the United Kingdom were also used to compare this Qualification. These include:

- Diploma: Vehicle Maintenance and Repair - Auto Electrical Level 3.

The competencies covered by this diploma include the following competencies and help participants to provide essential knowledge for auto-electricians working on vehicles in all types of garages, dealerships and maintenance depots.

- Certificate: Refrigerant Handling for Mobile Air Conditioner - Vehicles Level 3.
- Certificate: Auto Electricians Level 3.

The competencies covered by this diploma include the following competencies and are aimed at mechanics or electricians and people who want to increase their knowledge and ability in the field of vehicle electrics.

In comparing these qualifications to the qualifications in South Africa it is clear that there is a significant similarity between the qualifications in the United Kingdom and the South African one, with some differences. Both the qualifications (United Kingdom and South Africa) are streamlined for the needs of that country and therefore the unique differences between the two countries.

Australia:

In Australia to become an Automotive Electrician usually requires the completion of a Certificate III Apprenticeship in Automotive Electrical Technology. The length of training varies and involves both on-the-job and off-the-job components. The off-the-job training is provided through Registered Training Organizations to Certificate III level.

The competencies covered in this certificate include:

- Work with computer-controlled engine management and other systems.
- Diagnose, service, and repair faults on electronically controlled vehicle systems.
- Install electrical equipment and electrically operated accessories Use meters, test instruments and circuit diagrams to find electrical faults.
- Test, recondition and replace faulty alternators, generators, starter motors, and related items such as voltage regulators and batteries.
- Repair or replace faulty ignition, electrical wiring, fuses, lamps and switches.

Certificate III in Automotive Electrical Technology:

Description:

The Certificate III in Automotive Electrical Technology provides students with a strong grounding in both the theoretical and practical knowledge required for servicing and repairing motor vehicles, and communication and customer service skills needed to participate in a work environment.

Course Structure:

Area One - Compulsory (4 Units):

- Apply safe working practices.
- Carry out soldering of electrical wiring/circuits.
- Carry out diagnostic procedures.
- Implement and monitor environmental regulations in the automotive mechanical industry.

Area Two - from Technical Inventory (18 Units):

- Remove and replace electrical/electronic units/assemblies.
- Service, maintain or replace batteries.
- Test, service and charge batteries.
- Carry out repairs to single electrical circuits.
- Remove, refit and test electrical componentry for normal operation following body repair activities.
- Install, test and repair low voltage wiring/lighting systems.
- Install, test and repair electrical security systems/components.
- Install ancillary electrical components.
- Repair electrical systems.
- Service and repair electronically controlled steering systems.
- Service and repair electronically controlled suspension systems.
- Repair electronic systems.
- Service and repair electronic spark ignition engine management systems.
- Service and repair electronic drive management systems.
- Inspect, service and repair electronic management, monitoring and tracking systems.
- Inspect and service engines.
- Inspect suspension system.
- Repair suspension systems.

Area Three - from Retail, Service and Repair or other (6 Units):

- Repair and replace emission control systems.
- Repair transmissions (manual).
- Repair hydraulic braking systems.
- Repair final drive assemblies.
- Repair final drive (driveline).

• Repair steering systems.

Duration:

• 52 weeks (20 hours per week).

To become an automotive electrician, it is necessary to complete an Automotive Electrical Fitting Technology apprenticeship or Certificate I in Automotive (Pre Apprentice Electrical). Another pathway into the occupation is through the traineeship in Automotive (Electrical) which can lead on to the apprenticeship. Apprenticeships and traineeships are structured training programs that are a valuable alternative for those who wish to gain a qualification through employment. Practical experience at work is complemented with off the job training. Australia is currently experiencing a skills shortage and in certain industry areas there is a high demand for qualified trade people. Apprenticeships usually take four years full time to complete and successful completion will lead to a qualification as a tradesperson.

In comparing these qualifications to the qualifications in South Africa it is clear that many of the competencies in this Qualification are covered in the Australian qualification. The qualifications of both countries are streamlined for the needs of that country and this points to the difference/s between the two countries.

Malaysia:

The following qualifications exist in Malaysia and compared with the South African Qualification it is clear that the content is similar to the South African Qualifications. Although it was difficult to determine and compare the levels of these qualifications it is clear that the content and progression are similar as the South African Qualifications.

Malaysia works closely with partners in the automotive industry to expose students to real-life conditions in the automotive industry. Their training partners include companies involved in the distribution and servicing of vehicle brand such as BMW, Mercedes Benz, Nissan, Mazda, Ssangyong, Citroen, Fiat, Honda, Hyundai, Toyota, Audi and Volvo.

Certificate: Technical and Management: Automotive.

This qualification covers the following aspects:

• Fundamental operating principles
• Diagnostic and maintenance requirements of modern automotive systems

In year 1, students are introduced to:

• Automotive servicing and minor repairs in the area of engines, chassis, electrical and drive train.

In Year 2, students are:

• Engaged in troubleshooting mono and complex problems in contemporary vehicle systems
• Building up a strong understanding of electrics and electronics along the way.

Students will also pick up essential knowledge and skills in:

• Customer care.
• Communication.
• Basic service shop management.

Students will be able to immediately adapt to the working environment thanks to the unique concept of closely monitored and extensive on-the-job-training as well as familiarisation with the latest automobile models in the market.

In comparing these qualifications to the qualification in South Africa it is clear that there are differences between the qualifications and similarities in terms of competencies.

United States:

In Dallas, Texas various qualifications are presented but it was difficult to determine the level of which these certificates are presented.

Certificate: Essential Troubleshooting Skills with Hands-On Troubleshooting Training.

This certificate covers aspects such as electrical/electronics troubleshooting training using the Starter Kit Troubleshooting, testing and measuring circuit voltage, current and resistance with a DMM, circuit failure and how to interpret live circuit readings to determine a circuit problem, reading of schematic diagrams, live electrical circuit problems, Digital Logic Probe with its advantages and disadvantages.

Certificate: DC Motor Circuits and Advanced Troubleshooting Techniques.

This certificate covers aspects such as the DC Motor Circuit Troubleshooting, Advanced electrical/electronics troubleshooting techniques. The differences in ohmmeters, how to avoid damaging sensitive electronic circuits, how to properly use an analog or digital ohmmeter to test solid-state components, troubleshooting different types of DC motors, starter motor, blower motor circuits and their unique differences and motor circuit problems.

Certificate: Relay Circuit Troubleshooting & Advanced Troubleshooting Techniques.

This certificate covers aspects such as Relay Circuit Troubleshooting, How Relays work; Relay circuit failure and troubleshooting relay circuits, spike suppression diodes, 75 relay circuit problems, advanced relay circuit problems.

Kaw Area Technical School (KATS) offers the course on Auto Technology. This program prepares individuals to apply technical knowledge and skills to repair, service, and maintain all types of automobiles. Instruction includes basic theory and familiarization of automotive components, engine repair and performance, steering and suspension, automatic and manual transmission and transaxle, brakes, electricity/electronics, and heating and air conditioning systems. Hands-on activities are included for foundation and advanced courses.

Veejer Enterprises in Garland, Texas offers a five-day course entitled "The Art of Teaching Auto/Truck Electrical & Electronics Systems Troubleshooting".

Workshop Day 1: Essential Electrical Troubleshooting Skills H-111.

Essential troubleshooting skills using the Starter Kit, H-111. Material covers how electrical circuits work, how to test electrical circuits, how electrical circuits fail and how to troubleshoot electrical circuits. Teachers then practice troubleshooting up to 32 individual electrical problems and learn to insert problems in the Troubleshooting Trainers, H-PCB01 and H-PCB02 (H-111).

Workshop Day 2: Troubleshooting DC Motor Circuits H-113.

More troubleshooting skill is developed troubleshooting brushless DC Motor Circuits using the Troubleshooting Trainer, H-PCB03 from H-113. Teachers practice troubleshooting DC Motor circuit electrical problems and learn to insert problems in the Troubleshooting Trainer, H-PCB03.

Includes introduction to the various types of ohmmeters, their parameters, capabilities & limitations testing solid-state components and an introduction to key-off battery drain problems relating to DC motor circuit cooling fans. Later in Day 2 we will begin troubleshooting relays (Day 3 material) to make room in Day 3 to cover the new Troubleshooting Trainer H-PCB06, covering Wire Harness Troubleshooting.

Workshop Day 3: Troubleshooting Relay Circuits H-115.

Troubleshooting Relay Circuits using Troubleshooting Trainer H-PCB05 from H-115. Teachers troubleshoot live relay circuit problems including hard to find circuit failures, how relays cause key-off drain problems, how relays are controlled by shorts-to-voltage, etc and learn to insert problems in the Troubleshooting Trainer, H-PCB05.

Wire Harness Troubleshooting, H-116 (Overview).

A brief overview assembling and troubleshooting The Wire Harness Troubleshooting Trainer H-PCB06 from H-116. Teachers assemble a Mini-Electrical-System ("M.E.S." for short) combining all troubleshooting trainers together through the Wire Harness Troubleshooting Trainer and study unique electrical circuit problems relating to troubleshooting an electrical system.

Workshop Day 4:

Troubleshooting Batteries, unusual Battery Failures; How to troubleshoot a battery failure on the vehicle simply using a DMM and a DC Current Clamp. More about battery troubleshooting than you ever thought existed. For example, why is it sometimes impossible to jump start a vehicle with a dead battery and why you can jump start some vehicles but shouldn't.

Cranking circuits and practical cranking circuit troubleshooting on the vehicle simply using a DMM and a DC Current Clamp. Systematic troubleshooting procedures are explained for battery troubleshooting and cranking circuit troubleshooting, testing voltage drops, as well as, troubleshooting these circuits with hands-on practice using a DMM and DC Current Clamp.

Workshop Day 5:

Troubleshooting charging systems.

Systematic troubleshooting procedure is presented that shows a technician how to test the charging system in 60 seconds using only a DMM. Also discussed are the incorrect ways to test the charging system currently being promoted by some manufacturers and what those methods don't work.

Troubleshooting Key-Off Battery Drain Problems.

Discussion of key-off drain issues covers why on-board computers are the primary cause of key-off drain problems.

Troubleshooting multiple battery systems.
Covers principles of operation and troubleshooting concepts of batteries in series and parallel combinations with emphasis on battery voltage analysis versus battery current analysis.

The final day concludes with a time for open discussion and critique.

The company also offers "Auto/Truck Advanced Electrical Hands-On Troubleshooting Workshop Phase 1 and Phase 2.

Day 1: (Phase 2):

Essential Troubleshooting Skills with Hands-On Troubleshooting Training.

Day 1 covers electrical/electronics troubleshooting training using the Starter Kit Troubleshooting Trainer, H-111, (H-PCB01/02). Students learn how to test and measure circuit voltage, current and resistance with a DMM and what the readings tell you about a circuit. Students study how circuits fail and how to interpret live circuit readings to determine a circuit problem. Reading of schematic diagrams is explained. Then students troubleshoot 32 individual live electrical circuit problems one at a time for hands-on practice. Afterwards, the Digital Logic Probe is explained with its advantages and disadvantages. Students receive and use a Digital Logic Probe to gain additional troubleshooting experience.

Day 2: (Phase 2):

DC Motor Circuits and Advanced Troubleshooting Techniques

Day 2 covers the DC Motor Circuit Troubleshooting Trainer, H-113, (H-PCB03), where students learn advanced electrical/electronics troubleshooting techniques. The differences in ohmmeters; how to avoid damaging sensitive electronic circuits and how to properly use an analog or digital ohmmeter to test solid-state components are explained with hands-on application. Troubleshooting different types of DC motors, starter motor, blower motor circuits and their unique differences is reviewed. Students then troubleshoot about 37 DC Motor circuit problems one at a time for hands-on practice in troubleshooting.

Day 3: (Phase 2):

Relay Circuit Troubleshooting and Advanced Troubleshooting Techniques.

Day 3 covers Relay Circuit Troubleshooting Trainer, H-115, (H-PCB05) where students learn how relays work, how relay circuits fail and how to troubleshoot relay circuits. Students learn about spike suppression diodes; what they do and how to properly test them. Students then troubleshoot up to 75 relay circuit problems in the remainder of the third day. Several advanced relay circuit problems are used to convince students what they have learned about troubleshooting as they successfully troubleshoot the most difficult relay circuit problems when the relay is not the problem.

Day 4: (Phase 1) Advanced Electrical System Troubleshooting:

What you need to know about batteries and their dual role in the electrical system. Techniques for troubleshooting unusual battery problems many technicians often misdiagnose and why. Proper battery troubleshooting is covered with advanced battery troubleshooting techniques explained using only a DMM and DC Current Clamp.

Proper operation of cranking/starting circuits is discussed with a systematic step-by-step troubleshooting procedure for finding the cause of any starting circuit problem using only a DMM and Current Clamp.

Day 5: (Phase 1) Advanced Electrical System Troubleshooting:

Generator (alternator) circuits are explained and how the generator interfaces with the electrical system. Computer control of generators (alternators) is explained and how the PCM interacts with the generator (alternator). Analysis of the charging voltage value is discussed and a systematic troubleshooting procedures is given for testing the charging system on the vehicle. Students practice testing the charging voltage on vehicles.

The focus of the US qualifications is on trouble shooting techniques for a variety of auto electrical problems. In comparison to the South African Qualifications it is almost the same as the suggested level of this qualification, with minor differences between the two qualifications.

Japan and Jamaica:

Japan and the Board of Cornerstone Ministries of Jamaica signed a contract to establish an automotive training centre at the Ministries' Connolley Avenue training facility in Kingston, Jamaica.

The automotive training project, is administered in one-year cycles, and seeks to link the identified need for training and employment with the opportunities that the automotive industry made possible. The programme, he said would use the latest technology, utilising computerised simulated models.

In addition, the primary objectives of the project were to train 40 young persons in automotive electrical and mechanic areas and students will receive certification for the project.
Details of the programme are not available.

Canada:

Canada offers many automotive training courses. However, details of the courses listed below are sketchy. The courses are:

School: Nova Career Centre:

Course 1: Auto Detailing (Certificate):

This on-site programme will teach the students how to keep their own and anybody else's car looking "Show-Room" new Programme Objective: To enable students to acquire the knowledge, skills and attitudes required to perform tasks in the automotive industry. These include the basics such as oil and filter change, brake jobs and battery charging to more complicated procedures like engine rebuilding and transmission repairs. The learner will acquire skills in routing maintenance, shop work, drivetrain maintenance and repair, electrical systems, fuel systems and engine overhaul procedures.

Course 2: Automotive Technician:

Automobiles, like everything else are very much advanced in this high tech world. The programme for Automotive Technicians is great for solving computer and fuel injection problems or just sticking to the mechanical side of things. Graduates have a wide range of skills and can work in a number of capacities in the automobile industry.

Programme Objectives are similar to the course above.

West Island Career Centre (Pierrefonds, Quebec):

Course 1: Automobile Mechanics:

The Automobile Mechanics program enables students to acquire the knowledge, skills and attitudes to perform tasks in the automotive industry. These include the basics such as oil and filter change, brake jobs and battery charging to more complicated procedures like engine rebuilding and transmission repairs.

Automobile Mechanics repair and service automobiles and other gasoline powered vehicles. Mechanics correct mechanical problems and perform preventive maintenance to keep

automotive equipment in good operating condition. They may do everything from tune-ups to tearing down, repairing, and rebuilding engines and transmissions. Other duties include servicing suspension systems, brakes and steering, air conditioning, heating, and cooling systems.

The Trade - details:

Interpersonal Communication.
Health, Safety and Environmental Protection.
Welding and Cutting.
Shop Work.
Job Search Techniques.
Starting a Business.
Characteristics of Motor Vehicles.
Internal Combustion Engines.
Basic Electrical and Electronic Circuits.
Engine and Passenger Temperature Systems.
Road Holding Systems.
Transmission Assemblies.
Basic Computer-Controlled Systems.
Starting and Charging Systems and Electromagnetic Accessories.
Passive and Active Security Systems.
Electronic Ignition Systems.
Antipollution and Electronic Injection Systems.

Laurier Macdonald Career Centre (St. Leonard, Quebec).

Course 1: Automobile Mechanics (Diploma):

Program objectives in Automobile Mechanics include the performance of basic tasks such as tune-ups, oil and filter changes, brake jobs and charging batteries. Students also learn more complicated procedures such as engine rebuilding, transmission repairs and electromagnetic accessory repairs. Students are taught to repair air conditioning and heating systems.

Our Auto Mechanics course will teach the novice everything from the workings of internal combustion engines to repairing electronic ignitions and antipollution systems. Working with the public and communication skills are a component of the program, as are health, safety and environmental protection.

Uganda:

The Nakawa Vocational Training Institute (NVTI) is one of the four Public Vocational Training Institutes directly operated and administered by the Ministry of Education and Sports (MoES) through the BTVET Department.

The Institute was established in 1971 by the GOU in cooperation with the Government of Japan through the Japan International Cooperation Agency (JICA). The primary objective of the establishment was to provide vocational training skills to school leavers and apprentices in enterprises and to upgrade and assess competencies of industrial workers.

Among its many offerings, the NVTI offers training in motor vehicles. The course includes the following aspects:

- Electronic Control Fuel Injection (EFI).
- Automatic Transmission.
- Radiator Repair.

- Engine Overhaul.
- Auto Electrical.
- Body Care.
- Preventive Maintenance.
- Defensive driving.

Details of these courses are not available.

Training at BMW:

BMW Service Apprenticeship:

Unlike the majority of motor manufacturers, all BMW Service Apprentices attend the BMW Group Academy UK in Berkshire for their off-the-job training. This ensures consistent training throughout the country and allows our apprentices to train on up-to-the-minute products and technology. The training runs for a 2-3 year period and takes the form of classroom and workshop sessions.

On completion the learner will receive the UK's NVQ Level 2 in Vehicle Maintenance and Repair, and the NVQ Level 3 in Vehicle Maintenance and Repair.

Parts Apprenticeship:

The Parts Apprenticeship Programme is unique to BMW and is undertaken mainly within the dealership. The training consists of computer based training (CBT) and modular units. Training is completed at the dealership where candidates are allocated 4 hours per week to study for their qualification. All candidates also attend a minimum of four core parts courses, parts tutorials and off-the-job training at the BMW Group Academy UK during their training programme. The programme is primarily distance learning at the dealership and is structured to be completed in two years.

On completion the learner will receive the UK's NVQ Level 2 in Parts Operations and NVQ Level 3 in Parts Operations.

Training at Volvo:

I-CAR Training for Volvo Level 3.

50% (or a minimum of 2 technicians for small body shops):

- Measuring (MEA01).
- Structural Straightening Steel (SSS01).
- Steel Unibody Front and Rear Rails, Floors, and Front Structure (SPS01).
- Steel Unibody A, B, C, D, pillars, and Rocker Panels (SPS02).
- Volvo Structural Repair (VLV03).

SADC:

None of the SADC countries have their own qualifications relating to Autotronics, but use the British City and Guilds Standards for training learners in the automotive field. Namibia has indicated interest in the South African qualifications and may implement this qualification once it has been registered. Namibia is currently in the process of developing vocational certificates for registration on the Namibia Qualifications Framework. Various initiatives are in place to ensure that their qualifications are in line with the South African Qualifications.

Conclusion:

The competencies covered in the National Certificate: Autotronics, Level 3 are either similar to or have some overlap with some of the qualifications that are offered in countries investigated here. While direct and complete comparisons are rarely possible - given the very different contexts in the countries investigated - there are significant (and sometimes not-so-significant) overlaps between this qualification and those internationally. In some cases, it is difficult to figure out the levels of the international courses and qualifications but the overlap in competencies helped to benchmark this Qualification.

This Qualification enjoys close similarity with the qualifications from Australia and New Zealand. The qualifications in these countries are unit standards based and offer comprehensive Electives that, together with the Core, cover most of this Qualification. There is also a similarity with the levels and duration of this Qualification and those in Australia and New Zealand. The competencies of the qualifications in the United Kingdom also overlap significantly with the competencies contained herein. In addition, the UK qualifications match this Qualification in terms of duration. The comparison with these three countries is enhanced by the fact that the qualifications offered in those countries are in an outcomes-based format. An advantage was that a fair amount of information is available and this promotes a more comprehensive comparability.

The qualification in Malaysia is a general automotive qualification and is taught over a period of two years. However, aspects pertaining to the electrical - from both years - overlap with this qualification. In the United States, the identified certificate and short courses in the autotronics field have a heavy emphasis on the auto electrical aspect. The focus of these qualifications and short courses is on troubleshooting auto electrical system problems. The target audience of the workshops are those who are involved in teaching autotronics to others. The qualifications identified in Canada are more or less of the same duration as this Qualification. While they are not specifically for autotronics but are broadly for the automotive field, some of the competencies of those qualifications overlap with this Qualification. The Ugandan qualification is also of a general nature but contains the auto electrical aspect.

On the whole this qualification compares very favourably with international qualifications or aspects there from.

ARTICULATION OPTIONS

This Qualification lends itself to both vertical and horizontal articulation possibilities.

Horizontal articulation is possible with the following Qualifications:

- ID: 71989: National Certificate: Automotive Components: Manufacturing and Assembly at NQF Level 3.
- National Certificate: Automotive Repair and Maintenance at NQF Level 3.
- ID: 64529: National Certificate: Automotive Body Repair at NQF Level 3.
- ID: 64409: National Certificate: Automotive Spray Painting at NQF Level 3.

Vertical articulation is possible with the following Qualifications:

- ID: 71949: Further Education and Training Certificate: Automotive Components: Manufacturing and Assembly at NQF Level 4.
- Further Education and Training Certificate: Automotive Repair and Maintenance at NQF Level 4.
- ID: 64549: Further Education and Training Certificate: Automotive Body Repair at NQF Level 4.
- ID: 64411: Further Education and Training Certificate: Automotive Spray Painting at NQF Level 4.

MODERATION OPTIONS

• Anyone assessing a learner or moderating the assessment of a learner against this Qualification must be registered as an assessor with the relevant Education, Training, Quality, and Assurance (ETQA) Body.

• Any institution offering learning that will enable the achievement of this Qualification must be accredited as a provider with the relevant ETQA.

• Assessment and moderation of assessment will be overseen by the relevant ETQA according to the ETQA's policies and guidelines for assessment and moderation; in terms of agreements reached around assessment and moderation between ETQA's (including professional bodies); and in terms of the moderation guideline detailed immediately below.

• Moderation must include both internal and external moderation of assessments at exit points of the Qualification, unless ETQA policies specify otherwise. Moderation should also encompass achievement of the competence described both in individual Unit Standards, the integrated competence described in the Qualification and will include competence within core sales and the elective standards relevant to the economic sector.

• Anyone wishing to be assessed against this Qualification may apply to be assessed by any assessment agency, assessor or provider institution that is accredited by the relevant ETQA.

CRITERIA FOR THE REGISTRATION OF ASSESSORS

For an applicant to register as an assessor, the applicant needs:

• A minimum of 4 (four) years' practical, relevant occupational experience.
• A relevant Qualification at NQF Level 4 or higher.
• To be registered as an assessor with the relevant ETQA.

NOTES

This qualification replaces qualification 22859, "National Certificate: Autotronics", Level 3, 141 credits.

UNIT STANDARDS

	ID	UNIT STANDARD TITLE	LEVEL	CREDITS
Fundamental	119472	Accommodate audience and context needs in oral/signed communication	Level 3	5
Fundamental	9010	Demonstrate an understanding of the use of different number bases and measurement units and an awareness of error in the context of relevant calculations	Level 3	2
Fundamental	9013	Describe, apply, analyse and calculate shape and motion in 2-and 3-dimensional space in different contexts	Level 3	4
Fundamental	119457	Interpret and use information from texts	Level 3	5
Fundamental	9012	Investigate life and work related problems using data and probabilities	Level 3	5
Fundamental	119467	Use language and communication in occupational learning programmes	Level 3	5
Fundamental	7456	Use mathematics to investigate and monitor the financial aspects of personal, business and national issues	Level 3	5
Fundamental	119465	Write/present/sign texts for a range of communicative contexts	Level 3	5
Core	264996	Construct and test basic electronic circuits	Level 2	16
Core	376601	Diagnose, test and repair conventional automobile charging systems	Level 3	16
Core	376606	Diagnose, test and repair conventional automobile starting systems	Level 3	16
Core	376603	Service and repair conventional automobile ignition systems	Level 3	6
Core	260437	Trace and repair auto electrical circuit faults	Level 3	8

	ID	UNIT STANDARD TITLE	LEVEL	CREDITS
Core	376607	Use technical information to understand auto electrical circuits	Level 3	8
Core	120344	Demonstrate knowledge and understanding of relevant current occupational health and safety legislation	Level 4	4
Elective	258679	Operate and monitor a lathe	Level 2	12
Elective	116937	Use a Graphical User Interface (GUI)-based spreadsheet application to create and edit spreadsheets	Level 2	4
Elective	242814	Identify and explain the core and support functions of an organisation	Level 3	6
Elective	260723	Install, test and maintain a basic fluid power system	Level 3	8
Elective	13139	Install, test and maintain a basic pneumatic system	Level 3	10
Elective	9526	Manage basic business finance	Level 3	6
Elective	9530	Manage work time effectively	Level 3	3
Elective	114979	Operate a computer workstation in a business environment	Level 3	2
Elective	116720	Show understanding of diversity in the workplace	Level 3	3
Elective	9533	Use communication skills to handle and resolve conflict in the workplace	Level 3	3
Elective	260737	Diagnose and repair vehicle ignition systems	Level 4	6

LEARNING PROGRAMMES RECORDED AGAINST THIS QUALIFICATION
None

SOUTH AFRICAN QUALIFICATIONS AUTHORITY

UNIT STANDARD:

Diagnose, test and repair conventional automobile charging systems

SAQA US ID	*UNIT STANDARD TITLE*		
376601	Diagnose, test and repair conventional automobile charging systems		
ORIGINATOR		*PROVIDER*	
SGB Manufacturing and Assembly Processes			
FIELD		*SUBFIELD*	
6 - Manufacturing, Engineering and Technology		Fabrication and Extraction	
ABET BAND	*UNIT STANDARD TYPE*	*NQF LEVEL*	*CREDITS*
Undefined	Regular	Level 3	16

New NQF Level: NQF Level 03

This unit standard replaces:

US ID	Unit Standard Title	NQF Level	Credits	Replacement Status
12222	Diagnose, test and repair conventional automobile charging systems	Level 3	16	Will occur as soon as 376601 is registered

SPECIFIC OUTCOME 1
Interpret diagrams of charging systems.

SPECIFIC OUTCOME 2
Explain the theoretical aspects of a charging system.

SPECIFIC OUTCOME 3
Find faults and diagnose system problems.

SPECIFIC OUTCOME 4
Repair an alternator.

SPECIFIC OUTCOME 5
Fit and test a charging system.

QUALIFICATIONS UTILISING THIS UNIT STANDARD

	ID	QUALIFICATION TITLE	LEVEL
Core	78923	National Certificate: Autotronics	Level 3

SOUTH AFRICAN QUALIFICATIONS AUTHORITY

UNIT STANDARD:

Service and repair conventional automobile ignition systems

SAQA US ID	*UNIT STANDARD TITLE*		
376603	Service and repair conventional automobile ignition systems		
ORIGINATOR		*PROVIDER*	
SGB Manufacturing and Assembly Processes			
FIELD		*SUBFIELD*	
6 - Manufacturing, Engineering and Technology		Manufacturing and Assembly	
ABET BAND	*UNIT STANDARD TYPE*	*NQF LEVEL*	*CREDITS*
Undefined	Regular	Level 3	6

New NQF Level: NQF Level 03

This unit standard replaces:

US ID	Unit Standard Title	NQF Level	Credits	Replacement Status
12220	Service and repair conventional automobile ignition systems	Level 3	6	Will occur as soon as 376603 is registered

SPECIFIC OUTCOME 1
Interpret circuit diagrams of ignition systems.

SPECIFIC OUTCOME 2
Test the conventional ignition system.

SPECIFIC OUTCOME 3
Service and repair the ignition system.

SPECIFIC OUTCOME 4
Maintain the conventional distributor.

QUALIFICATIONS UTILISING THIS UNIT STANDARD

	ID	QUALIFICATION TITLE	LEVEL
Core	78923	National Certificate: Autotronics	Level 3

SOUTH AFRICAN QUALIFICATIONS AUTHORITY

UNIT STANDARD:

Diagnose, test and repair conventional automobile starting systems

SAQA US ID	*UNIT STANDARD TITLE*		
376606	Diagnose, test and repair conventional automobile starting systems		
ORIGINATOR		*PROVIDER*	
SGB Manufacturing and Assembly Processes			
FIELD		*SUBFIELD*	
6 - Manufacturing, Engineering and Technology		Manufacturing and Assembly	
ABET BAND	*UNIT STANDARD TYPE*	*NQF LEVEL*	*CREDITS*
Undefined	Regular	Level 3	16

New NQF Level: NQF Level 03

This unit standard replaces:

US ID	Unit Standard Title	NQF Level	Credits	Replacement Status
12223	Diagnose, test and repair conventional automobile starting systems	Level 3	16	Will occur as soon as 376606 is registered

SPECIFIC OUTCOME 1
Interpret circuit diagrams of starting systems.

SPECIFIC OUTCOME 2
Discuss the fundamentals of the starting system.

SPECIFIC OUTCOME 3
Test and service a starting system.

QUALIFICATIONS UTILISING THIS UNIT STANDARD

	ID	QUALIFICATION TITLE	LEVEL
Core	78923	National Certificate: Autotronics	Level 3

SOUTH AFRICAN QUALIFICATIONS AUTHORITY

UNIT STANDARD:

Use technical information to understand auto electrical circuits

SAQA US ID	*UNIT STANDARD TITLE*		
376607	Use technical information to understand auto electrical circuits		
ORIGINATOR		*PROVIDER*	
SGB Manufacturing and Assembly Processes			
FIELD		*SUBFIELD*	
6 - Manufacturing, Engineering and Technology		Manufacturing and Assembly	
ABET BAND	*UNIT STANDARD TYPE*	*NQF LEVEL*	*CREDITS*
Undefined	Regular	Level 3	8

New NQF Level: NQF Level 03

This unit standard does not replace any other unit standard and is not replaced by another unit standard.

SPECIFIC OUTCOME 1
Demonstrate the ability to locate and interpret technical information in an auto electrical (autotronics) context.

SPECIFIC OUTCOME 2
Use technical information to locate, remove and test auto electrical devices and components.

SPECIFIC OUTCOME 3
Differentiate between the wiring harnesses on a vehicle.

SPECIFIC OUTCOME 4
Locate joints and earth points in the various harnesses.

QUALIFICATIONS UTILISING THIS UNIT STANDARD

	ID	QUALIFICATION TITLE	LEVEL
Core	78923	National Certificate: Autotronics	Level 3

SOUTH AFRICAN QUALIFICATIONS AUTHORITY

QUALIFICATION:
National Certificate: Autotronics

SAQA QUAL ID	*QUALIFICATION TITLE*		
78943	National Certificate: Autotronics		
ORIGINATOR		*PROVIDER*	
SGB Manufacturing and Assembly Processes			
QUALIFICATION TYPE	*FIELD*	*SUBFIELD*	
National Certificate	6 - Manufacturing, Engineering and Technology	Manufacturing and Assembly	
ABET BAND	*MINIMUM CREDITS*	*NQF LEVEL*	*QUAL CLASS*
Undefined	130	Level 5	Regular-Unit Stds Based

This qualification does not replace any other qualification and is not replaced by another qualification.

PURPOSE AND RATIONALE OF THE QUALIFICATION
Purpose:

This Qualification is for any individual who is, or wishes to be, involved in an autotronics environment. The Qualification contains all the skills, knowledge, values and attitudes required by a learner who needs mainly to be able to perform a range of activities and thereby meet the challenges within a specific autotronics environment at this level. An individual acquiring this Qualification will be able to contribute towards the efficient operation of a number of processes within this sector as described in the Core component of the qualification.

The main competencies in this qualification are:

- Communication skills.
- Applying mathematical and statistical techniques in a production environment.
- Diagnosing and repairing vehicle stability, traction and drive control (VSTDC) systems.
- Diagnosing and repairing automobile convenience systems.
- Diagnosing and repairing climate control systems.
- Diagnosing and repairing communication and entertainment systems.
- Diagnosing and repairing supplementary restraint systems (SRS).
- Conducting on the job training.
- Analysing failure of vehicle parts.
- Applying efficient time management.

From the above, it can be seen that the learner acquires high level autotronics competencies with the emphasis being on diagnosing and repairing a variety of complex automobile systems. While there are some management competencies in the Core component of the Qualification, the Elective component contains several Level 5 generic management standards to prepare the learner to operate as a manager within his/her area of responsibility within the industry.

These competencies will enable the learner to work in different industries within the diverse autotronics sector.

The Qualification ensures progression of learning, enabling the learner to perform optimally within the autotronics field of learning and provide access to higher leaerningwithin the same or a related sector. The Qualification will facilitate access to, and mobility within, education and training for learners who:

- Would like to achieve this Qualification through the process of Recognition of Prior Learning (RPL) and/or formal study.
- Wish to extend their range of skills and knowledge and hence their competencies in the autotronics environment.

The Qualification also hopes to:

- Release the potential of people.
- Provide opportunities for people to explore related activities within the autotronics sector.

Rationale:

This is the fourth Qualification in a series of four autotronics qualifications that range from NQF Level 2 to NQF Level 5. These qualifications constitute a learning pathway that takes the learners from basic/simple competencies in autotronics at NQF Level 2 to high level autotronics competencies at NQF Level 5. Typical learners will be persons who have completed the Further Education and Training Certificate: Autotronics who presumably will be currently working in the autotronics environment and who wish to further their career in autotronics.

The automobile is subject to ever increasing technological advances. These advances are continuously being incorporated into the electrical systems of automobiles. They represent the integration of mechanical, hydraulic, pneumatic, electronic and electrical systems and are managed by microelectronic control known as Computer Integrated Auto Management (CIAM) Systems. Consequently, the auto-electrical skills required to maintain such automobiles are changing to incorporate more electronic skills.

The field of autotronics deals with the installation, diagnosis and repair of CIAM systems. People working in the field of autotronics require specialised technical skills and knowledge and well as highly developed analytical skills to enable them to install, diagnose and repair CIAM systems.

This series will reflect the skills, knowledge and understanding required to perform effectively in industry, whether in micro, small, medium or large enterprises.

The autotronics sector falls within the ambit of South Africa's large motor industry. There are huge motor assembly plants in several parts of the country, primarily in the Eastern Cape, Gauteng and KwaZulu Natal provinces. There are also many automotive related sectors like the automotive components manufacturing and assembly industries, automotive sales and service sector, repairs (including panel beating and spray painting) industries. It's a sector that employs a large number of people. Companies and/or industries within this sector operate in a global competitive and challenging environment.

The highly developed autotronics sector is well-established and economically powerful. In terms of transformation in the country, learners will require skills and competencies to gain access to positions within management structures by completing this and other qualifications and training. It will be in the interest of the country and the sector to ensure that those who operate in the autotronics environment are trained according to this Qualification to improve productivity and efficiency.

This national Qualification and its related Unit Standards were developed to standardise the accreditation of learning programmes, resulting in improved quality management in terms of programme delivery.

The National Certificate: Autotronics at NQF Level 5 supports the objectives of the NQF in that it gives the learner access to a registered Qualification. It will ensure that the quality of education and training in the sub-field is enhanced and of a world-class standard. The Qualification will allow learners not only to develop their knowledge and skills in the Autotronics sector but will also enable them to benchmark their competencies against international standards.

RECOGNIZE PREVIOUS LEARNING?
Y

LEARNING ASSUMED IN PLACE
Learners wishing to study towards this Qualification are assumed to be competent in Communication and Mathematical Literacy at NQF Level 4.

Recognition of Prior Learning:

This Qualification may be achieved in part (or whole) through the recognition of relevant prior knowledge and/or experience. The learner must be able to demonstrate competence in the knowledge, skills, values and attitudes implicit in this Qualification. As part of the provision of recognition of prior learning providers are required to develop a structured means for the assessment of individual learners against the Unit Standards of the Qualification on a case-by-case basis. A range of assessment tools and techniques during formative and summative assessment procedures should be used which have been jointly decided upon by the learner and the assessor. Such procedures, and the assessment of individual cases, are subject to moderation by independent assessors. The same principles that apply to assessment of this Qualification also apply to recognition of prior learning.

Learners may provide evidence of prior learning for which they may receive credit towards the Unit Standards and/or the Qualification by means of portfolios or other forms of appropriate evidence as agreed to between the relevant provider and relevant ETQA or ETQA that has a Memorandum of Understanding in place with the relevant ETQA.

Recognition of Prior Learning is particularly important, as there are people in the autotronics sector with a variety of skills and competencies of differing quality and scope. It is important that a Recognition of Prior Learning process be available to assist in making sense of existing competencies and skills, and helping to standardise these competencies and skills towards a common standard.

Access to the Qualification:

There is an open access to this Qualification for learners who have completed the Further Education and Training Certificate: Autotronics.

QUALIFICATION RULES
The Qualification consists of a Fundamental, a Core and an Elective Component.

To be awarded the Qualification learners are required to obtain a minimum of 130 credits as detailed below.

Fundamental Component:

- The Fundamental Component consists of Unit Standards to the value of 25 credits, all of which are compulsory.

Core Component:

• The Core Component consists of Unit Standards to the value 85 credits, all of which are compulsory.

Elective Component:

• The Elective Component consists of Unit Standards that will impart a variety of competencies to the learner. Learners are to choose Elective Unit Standards totaling a minimum of 20 credits to attain a minimum of 130 credits for this Qualification.

EXIT LEVEL OUTCOMES

1. Describe, diagnose and repair a range of auto-electrical systems.

• Range: Systems include the following:
○ Vehicle stability, traction and drive control (VSTDC).
○ Communication and entertainment systems.
○ Supplementary restraint systems (SRS).
○ Climate control systems.
○ Vehicle convenience systems.
○ Integrated starter and alternator combination systems (ISAD).

2. Apply mathematical and statistical techniques in a production environment.

3. Conduct on-the-job coaching.

4. Analyse failure of vehicle parts.

5. Apply efficient time management to the work of a department/division/section.

ASSOCIATED ASSESSMENT CRITERIA

Associated Assessment Criteria for Exit Level Outcome 1:

• The operation of the auto-electrical systems is described in terms of the functions and inter-relationships of their different sub-systems and their various circuit diagrams.
• The manufacturing specifications of the auto-electrical systems are discussed to demonstrate the importance of these specifications in interpreting and performing any work on the systems.
• The components and equipment used in the auto-electrical systems are described in terms of their functions and uses.
• The auto-electrical systems are tested and diagnosed using appropriate testing equipment and diagnostic procedures.
• The methodology/procedure to repair and/or replace a component is explained and applied according to manufacturer's requirements.
• Tools and equipment are used according to manufacturer's specifications and standard procedure.
• Communication skills are used in the preparation of relevant documentation during a repair or replace operation and in communicating with others in the workplace.

Associated Assessment Criteria for Exit Level Outcome 2:

• Mathematical and statistical calculations are performed using appropriate mathematical and statistical techniques and concepts.
◦ Range: Concepts include qualitative and quantitative analysis/data, methods of sampling, mean, median, range, mode, average and standard deviation.
• Information or data is accessed and organised according to the purpose for which it is sought.
• Mathematical and statistical techniques are applied to manage teams and staff.
• Mathematical and statistical techniques are implemented to manage a range of issues in the workplace.

o Range: Issues include safety in the workplace, production related elements, costing and pricing and related elements, inventory and stock.
• Mathematical and statistical techniques are used to budget and analyse budgets.

Associated Assessment Criteria for Exit Level Outcome 3:

• The basic principles of training are described in terms of evaluating a learner, providing feedback and counselling the learner on future assessments.
• Questioning techniques are discussed in term of their importance and examples of questions are given.
• The concepts of coaching and training are discussed in terms of their differences.
• The need for coaching is identified through discussions with the person to be coached and the necessary arrangements are made.
• The coaching session is conducted and feedback is provided to the learner.
• Monitoring of learner is conducted on an ongoing basis and feedback is provided in the workplace.
• Possible problems that may occur in relation to coaching are identified and potential solutions are proposed.
• A plan for individual coaching is developed taking the needs of the team into account.

Associated Assessment Criteria for Exit Level Outcome 4:

• Job instruction are read and interpreted and preparations are made to start the analysis process.
• Tests are conducted on the failed part using appropriate testing equipment and the problem is diagnosed.
• Safety procedures are identified and applied during the diagnosing and repairing task.
• Documentation is complete according to company requirements.

Associated Assessment Criteria for Exit Level Outcome 5:

• Time management profiles are identified and the top time wasters that impact on the organisation's productivity are identified.
• The principles of time management are explained with examples.
• Time efficient work plans are prepared to carry out department/division/ section work functions.
• Time efficient work plans are implemented.

Critical Cross-Field Outcomes

Identify and solve problems in which responses display that responsible decisions using critical and creative thinking have been made when:

• Prioritizing tasks and translating strategy into action.
• Analysing part failure.
• Using context to decode and make meaning individually and in groups in oral, reading and written activities.
• Identifying problems and using mathematical and statistical techniques to resolving them.
• Distinguishing between types of indicators and detecting non-conformances.
• Differentiate between types of budgets.
• Test and diagnose auto-electrical components.

Work effectively with others as a member of a team, group, organisation and community to:

• Effectively delegate.

• Engage colleagues during the planning, preparation, and completion and reporting phases when analysing part failures.
• Identify the need for coaching through discussions with the person to be coached.
• Complete the coaching session, and give the learner enough explanation, examples and opportunity to practice.
• Give honest feedback and encourage the learner to ask questions.
• Monitor the ongoing progress and give ongoing feedback in the workplace.
• Using interactive speech in activities, discussion and research projects.
• Diagnose, repair and replace components of auto-electrical systems.

Organise and manage oneself and one's activities responsively and effectively when:

• Preparing the vehicle and the parts to conduct a failure analysis.
• Managing resources and one's time.
• Performing mathematical and statistical calculations to obtain a better understanding of the process and resolve problems.
• Discussing the operation of auto-electrical systems and their components.
• Replacing or repairing components of auto-electrical systems.
• Performing final inspection and quality checks.

Collect, analyse, organise and critically evaluate information to:

• Translate strategic intent into daily action.
• Appreciate the process of developing language capability across language applications and fields of study.
• Interpret data and information.
• Resolve problems related to a variety of aspects in production.
• Test and diagnose auto-electrical systems.
• Replace or repair components of auto-electrical systems.
• Select appropriate components and equipment to perform replacement or repair operations.

Communicate effectively using visual, mathematical and/or language skills in the modes of oral and/ or written presentation to:

• With stakeholders regarding the organisation's strategy and with the staff with regard to tasks delegated and deadlines expected.
• Complete and process written reports on auto-electrical systems.
• Communicate effectively using visual, audio-visual and multimedia aids, mathematical, technological, commercial and language skills in formal and informal communications.
• Explore and express links, and explore a global range of contexts and texts.
• Identify problems and use mathematical and statistical techniques to resolving them.

Use science and technology effectively and critically, showing responsibility towards the environment and the health of others by:

• Using the equipment, tools and software according to manufacturer's instructions.

Demonstrate an understanding of the world as a set of related systems by recognising that problem-solving contexts do not exist in isolation when:

• When engaging with problems in auto-electrical systems.

Integrated assessment

The importance of integrated assessment is to confirm that the learner is able to demonstrate applied competence (practical, foundational and reflexive) and ensure that the purpose of this Qualification is achieved. Both formative and summative assessment methods and strategies are used to ensure that the Exit Level Outcomes and the purpose of the Qualification are achieved through achieving the Unit Standards. Learning, teaching and assessment are inextricably linked.

Learning and assessment should be integrated and assessment practices must be fair, transparent, valid and reliable. A variety of assessment strategies and approaches must be used. This could include tests, assignments, projects, demonstrations and/or any applicable method. Evidence of the acquisition of competencies must be demonstrated through the Unit Standards, which enhance the integration of theory and practice as deemed appropriate at this level.

Formative assessment is an on-going process which is used to assess the efficacy of the teaching and learning process. It is used to plan appropriate learning experiences to meet the learner's needs. Formative assessments can include a mix of simulated and actual (real) practice or authentic settings. Feedback from assessment informs both teaching and learning. If the learner has met the assessment criteria of all the Unit Standards then s/he has achieved the Exit Level Outcomes of the Qualification.

Summative assessment is concerned with the judgement of the learning in relation to the Exit Level Outcomes of the Qualification. Such judgement must include integrated assessment(s) which test the learners' ability to integrate the larger body of knowledge, skills and attitudes, which are represented by the Exit Level Outcomes. Summative assessment can take the form of oral, written and practical examinations as agreed to by the relevant ETQA.

Integrated assessment must be designed to achieve the following:

- An integration of the achievement of the Exit Level Outcomes in a way that reflects a comprehensive approach to learning and shows that the purpose of the Qualification has been achieved.
- Judgement of learner performance to provide evidence of applied competence or capability.

Assessors and moderators should make use of a range of formative and summative assessment methods. Assessors should assess and give credit for the evidence of learning that has already been acquired through formal, informal and non-formal learning and work experience.

Assessment should ensure that all specific outcomes, embedded knowledge and critical cross-field outcomes are assessed. The assessment of the critical cross-field outcomes should be integrated with the assessment of specific outcomes and embedded knowledge.

INTERNATIONAL COMPARABILITY

This qualification is part of a series of qualifications in the field of Autotronics and was compared to similar qualifications - some outcomes - based in various countries. The following are the main competencies that constitute this Qualification:

- Communication skills.
- Mathematical and statistical techniques in a production environment.
- Vehicle stability, traction and drive control (VSTDC) systems.
- Automobile convenience systems.
- Climate control systems.
- Communication and entertainment systems.
- Supplementary restraint systems (SRS).
- On the job training.

- Failure of vehicle parts.
- Efficient time management.

This Qualification was compared to qualifications and short courses in the following countries:

- United States - The US has one of the most extensive and very highly-developed car manufacturing industries in the world.
- United Kingdom - The UK also has a highly-developed car manufacturing industry. It also has a number of institutions that offer training courses in the automotive/autotronics field.
- New Zealand and Australia - They have qualification frameworks similar to the South African NQF; this facilitates comparison.
- Malaysia - Malaysia works closely with training partners in the automotive industry. These include vehicle brands such as BMW, Mercedes Benz, Nissan, Mazda, Ssangyong, Citroen, Fiat, Honda, Hyundai, Toyota, Audi and Volvo.
- India - India has a thriving car manufacturing industry.
- France - France has a large car manufacturing industry.
- Eastern Europa Countries - including Belgium, Bulgaria, Germany, France and Poland.
- Canada - Many institutions offer training in the automotive and autotronics fields.
- Singapore - Many institutions offer training in the automotive and autotronics fields.

International comparability with the following car manufacturing countries was attempted, with little success, as there was very little or no information available:

- Japan.
- Korea.
- Sweden.
- France.
- Germany.
- Italy.
- China.

There was also a paucity of information on training offered by car manufacturers to their employees; in other words, vehicle or company-specific training. Some information is available on training by car manufacturers, namely, BMW.

Comparability with the following countries was possible and the comparisons are listed below.

United States:

The following qualifications and courses are available from various companies in the US.

Universal Technical Institute (UTI) offers one-year qualifications that are specific to car manufacturers. The following is just one example of the many courses that are offered:

Automotive Technology Program (51 Weeks):

You'll gain a solid understanding of automotive mechanics and technology. Our program covers everything from foreign and domestic vehicle technology to power and performance, with Hot Rod U and Super Street sport compact vehicles. Plus, you can choose to add Ford Accelerated Credential Training (FACT) or Toyota Professional Automotive Training (TPAT) to make you even more sought after in the workforce.

UTI instructors are industry pros averaging more than 10 years of practical experience. They're continually updated by the manufacturers to provide you with the very latest in rapidly changing technology.

Understanding technology is vital. But just as important to the learner's success is maintaining a professional image and gaining the vital people skills that are so prized by employers. At UTI, we place a high priority on teaching you these attributes that have become trademarks of our UTI graduates. Successful technicians know that taking care of the customer is just as important as repairing their vehicles.

The short course called Vehicle Vibration and Driveline Service Training is designed by Roadranger Academy (part of Eaton and Dana Holding Corporation) to give a basic understanding of vehicle systems and how they interact with each other to cause common vibration complaints. These systems include the complete drivetrain and the vehicle.

During the classroom portion, technicians will be exposed to the theory of operation and troubleshooting procedures for efficiently correcting vibration complaints. Technicians will be instructed on the calculation of joint working angles.

Technicians will also learn the latest troubleshooting techniques and cover common, everyday experiences in repairing vibration complaints. In addition, the technicians will be exposed to the latest industry diagnostic tools including the (DVA) Driveline Vibration Tool. The class will also include a practical hands-on session.

Mastery Technologies provides training on Vehicle: Automatic Transmissions which brings theory and procedures to life, putting learners one step closer to successful diagnosis and repair of all types of transmissions and transaxles. Automatic transmissions are the focus of this training which features an introduction to drivetrain theory, hydraulic torque multipliers, common automatic transmissions, and hydraulic systems.

Actual automotive technicians, authentic automotive repair shops, and late-model vehicles are used to ensure that information is presented as realistically as possible. Safety is stressed in each lesson, ensuring that proper procedures are followed in the automotive shop.

Anti-Lock Brakes and Traction Control Systems.

This program is part of the following task area(s):

Mechanical II.

Description:

- Understanding Anti-Lock Brake System Operation.
- Describing Anti-Lock Brake System Parts, Diagnosis, and Repair.
- Identifying Traction Control Systems and Parts.
- Identifying Skid Control Systems and Parts.

Outline:

Module 1 - Anti-Lock Brake System Operation:

- ABS Operation And System Parts.
- Parts Identification.
- Interactive Parts Identification.
- I-CAR ABS Repair System.
- Conclusion.

Module 2 - Anti-Lock Brake System Parts and Repair:

- ABS/TCS Problem 1.

- Hydraulic Modulators.
- Electronic Control Module.
- ABS/TCS Problem 2.
- Speed Sensors and Tone Rings.
- Switches.
- Relays.
- Fluid Pumps and Accumulators.
- ABS System Brake Fluid and Bleeding.
- Conclusion.

Module 3 - Traction Control Systems:

- System Overview And Operation.
- Parts Terminology And Function.
- Review.
- ABS/TCS Problem 4.
- Conclusion.

Module 4 - Skid Control Systems:

- System Overview and Operation.
- Parts Identification and Function.
- Conclusion.

AC Delco in the US offers the following training related to traction and stability:

Intended for service technicians, this Web-based training (WBT) provides an introduction to anti-lock braking systems. It is strongly recommended that Brakes 1 S-BK05-01.01WBT be completed previously.

This course will cover the ABS, Traction Control, and Stability Systems used in vehicles. Theory and operation, component overview, component location, and diagnostic information will also be covered. Upon completion of this component technicians will be able to:

- Identify the conditions of optimum braking.
- Explain how anti-lock braking systems operate.
- Identify the different classifications, types, and key components of anti-lock braking systems.
- Identify the events of anti-lock braking.
- Describe the correct diagnostic techniques for anti-lock braking systems.
- Explain how traction control systems operate.
- Identify the events of traction control.
- Describe the correct diagnostic techniques for traction control systems.
- Explain how vehicle stability enhancement systems operate.
- Identify the events of stability enhancement.
- Identify the key components of a stability enhancement system.
- Describe the correct diagnostic techniques for stability enhancement systems.

The following training programme on automotive climate control has is a Statutory Training Course been taken from Daimler Chrysler.

Repair Technician/System Technician - Comfort and Safety

The participant can:

- Describe the design and function of current air conditioning systems in passenger cars.

- Perform leak testing using approved Mercedes-Benz test materials and test equipment.
- Troubleshoot the AC circuit using the air conditioning service station.
- Basic design, function (refrigeration circuit).
- Technical knowledge relating to work on the air conditioning systems.
- Working with the service station.
- Troubleshooting using the current diagnostic and service units.
- Servicing, inspection and repair work.

The participant has successfully completed the CBTs 1290 4001 (Vehicle Climate Control) and 1290 4057 (Climate Control Passenger Cars).

Previous participation in the following basic training courses:
Star Diagnosis Level I (PSD1-LX111) or equivalent, well-founded technical knowledge.
Theory 40%, Practice 60%.

On successful completion, the participant receives a certificate/qualification that certifies legally required professional expertise in working on air conditioning systems and handling of refrigerants. The seminar gives consideration to the new climate protection regulation on chemicals, which must be available in the companies as of July 4, 2010.

Daimler Chrysler also offers courses in Restraint Systems:

PTLP Passenger Cars, Trucks, Vans Pyrotechnical restraint systems.

Repair Technician/System Technician - Comfort and Safety.

The participant can:

- Name the work safety and accident prevention laws and regulations on that govern the handling and storage of pyrotechnical components.
- Describe the operation and triggering mechanisms of various Mercedes-Benz restraint systems.
- Perform assembly and disassembly in accordance with manufacturer instructions.
- Establish the required conditions for properly disposing of defective and scrapped system components.
- Legal basis and regulations.
- Work safety and accident prevention.
- Storage, transport and disposal.
- Recognition and differentiation of various Mercedes-Benz systems (emergency tensioning retractors, head, side and window airbags, crash-active head restraints, etc).
- Functioning of the above components.
- Characterization of explosives and propellant charges used.
- Safety precautions during assembly and disassembly work.

Theory 85%, Practice15%.
Handling the pyrotechnical systems and components that are installed in all modern motor vehicles is a very risky business. This is why the legislator requires corresponding proof of expertise for persons who work on these systems.

AC Delco in the US offers the following training related to climate control:

Introduction to Air Conditioning:

This course covers R12 and R134A refrigeration systems, recovery and evacuation procedures, charging, and leak testing. Specific topics include CCOT, VDOT, and TXV systems.

Upon completion of this course technicians will be able to:

- Identify the principles of heat and refrigeration.
- Describe the components and operation of the refrigeration system, heating and cooling system, and air distribution system.
- Describe the various control systems.
- Identify handling concerns and safety precautions for servicing HVAC systems.
- Describe basic HVAC system service, including refrigerant recovery and recharge.
- Apply concepts and procedures to diagnose basic HVAC system component concerns.

AMS Automotive Schools offers the following course:

Automotive Electrician:

Electronic equipment installers and repairers for motor vehicles install, diagnose, and repair communication, sound, security, and navigation equipment in motor vehicles. Most installation work involves either new alarm or sound systems. New sound systems vary significantly in cost and complexity of installation. Replacing a head unit (radio) with a new computer disc (CD) player is quite simple, requiring the removal of a few screws and the connection of a few wires. Installing a new sound system with a subwoofer, amplifier, and fuses is far more complicated. Motor vehicle installers and repairers work with an increasingly complex range of electronic equipment, including DVD players, satellite navigation equipment, passive-security tracking systems, and active-security systems.

Canada:

Sait Polytechnic offers the Business Administration - Automotive Management, which is a two-year diploma. It is Western Canada's only management-oriented training program designed in cooperation with and specifically for the automotive industry. The training will be a combination of business and automotive courses to prepare the learner for numerous positions and a variety of opportunities. This two-year diploma program includes two co-operative work terms which will give the learner the opportunity to gain experience in a paid placement in the automotive industry. This program will also utilize an e-learning (SAIT-issued laptop computer) instructional delivery method. This format offers the combination of classroom instruction and network delivery using WebCT via laptop computers.

Okananga College offers Anti-Lock Brake Systems/Automatic Traction Control (ABS/ATC) Air Brake Diagnostics.

Okanagan College is pleased to offer a program which has been designed to assist commercial transport and heavy duty certified technicians, and/or apprentices, who routinely conduct service, repairs and/or diagnostics on commercial transport trucks and busses equipped with electronic ABS/ATC systems.

An ever-increasing amount of these vehicles on today's highways incorporate on-board computer controlled/electronic ABS/ATC systems, in conjunction with airbrakes, to minimize tire slippage during braking and acceleration.

The program curriculum will cover the theory and operation of the ABS/ATC systems, followed by a practical/shop session. Students will receive instruction on how to systematically diagnose and repair system failures using scanners, laptop computers, multimeters, and self-diagnostic controls. Training will be done on a training aid simulator and live trucks. Students will work with wiring schematics to check for power/ground problems, sensor and actuator problems, and on-board computer programming changes.

This program is offered on evening and weekends at Okanagan College locations throughout the valley. It is offered on an as needed basis.

Among the courses offered by Holland College is one called Automotive Technology which focuses on traction and drivelines. The integrated training model used in this program provides students with a coordinated pathway taking them from pre-apprenticeship training through to a Certificate of Qualification with Red Seal. It includes all aspects of program delivery including 'on campus' training at Holland College and 'in industry' work placements. Under Provincial Legislation, registration as an apprentice working under the guidance of a journey-person or a Certificate of Qualification is compulsory for the trade of Automotive Service Technician.

The Automotive Technology program is designed to allow students to develop a strong skill foundation through classroom, lab and shop learning activities. Through increased focus on employability skills, adjunct studies are an integral part of the program. An automotive technician must be well versed in computers, mathematics, reading and communication skills along with skills specific to the trade.

The Automotive Technology program has attained national accreditation status from the Canadian Automotive Repair and Service Council (CARS) National Accreditation Board, (CNAB). This accreditation is recognized nationally as the benchmark for quality automotive programs.

The State of Manitoba in Canada offers the following course in communication and entertainment systems:

Trade Programs: Recreation Vehicle Service Technician.

What does a Recreation Vehicle Service Technician do?

Recreation vehicle service technicians are trained to inspect, test, replace and service all systems contained within a recreation vehicle, except for its engine and drive train.

Recreation vehicle service technicians have the knowledge, skills and abilities to:

- Work on vehicles that range from sophisticated motor homes to simple up tent trailers.
- Use hand and power tools, measuring tools and testing devices.
- Interpret codes, trade standards, government regulations and service literature.
- Work with supervisors and customers to ensure that repairs are done properly and cost-effectively.
- Service and repair plumbing and water distribution systems, propane systems, electrical systems.
- Install, service and repair heating and air conditioning equipment and systems, ovens, ranges, and refrigerators, interior spaces, such as cabinetry, sidewalls, flooring and floor covering, exterior panels and roofing, trailer towing and braking systems, custom accessories like security systems, leveling and stabilizing systems, awnings, skirtings and add-a-rooms.

What skills/abilities are required?

A recreational vehicle service technician requires the following:

- Mechanical and mathematical aptitude.
- Ability to plan and think sequentially.
- Problem-solving and trouble-shooting abilities.
- Good communication skills.
- Ability and desire to keep skills current with advancing technology.
- The ability to work either independently or as a team member.

or technical coordinator, remains the only person in direct contact with the carmaker and the technical assistance platforms. The 2005 selectivity criteria for the new European regulation stipulate that there must be two electrical mechanics for every seven technicians within the dealer network.

This qualification could possibly match some of the competencies acquired by the cotech.

India:

Autotronics training in India takes places by private providers such as the TechnoLabs. This is a student assistance Technological Company offering its services in the field of hands-on practical training on emerging technologies, development tools and components for self project development and involves assistance in major project development to engineering students.

The company provides hands-on practical training to students through Workshops in college or at Autotronics Labs on cutting edge technologies like Embedded Systems, Robotics, VLSI and Advanced Electronic Circuit Designing.

Autotronics India also offers development kits and robotic components for self-learning and self project development to students. These kits also help students and SMBs (small and medium businesses) to quickly develop their projects using ready to use modules and focus on project requirement without worrying about hardware development.

Autotronics India Techno Labs offers distance learning International Certification Courses for emerging technologies like Embedded Systems, Robotics and Automation, VLSI etc. These courses are innovative and one of the best offered courses in their domain, covering all the industrial requirements.

These courses are the most preferred choice of the engineering students, hobbyists and industry professionals as it gives them hands-on training experience and the knowledge of design and development process unlike any other training courses where they are not exposed to real world problems. These courses are exhaustive and cover the latest technologies in these domains, simultaneously following industrial trends for these technologies.

The Autotronics training program is recognised worldwide. While the Indian programme has a somewhat different emphasis to this Qualification, the competencies - in the technical/engineering aspects - do overlap to a certain extent, especially on aspects of circuitry and emerging technology.

Certificate/course highlights include:

- Get exposure to Emerging Technologies.
- Hands-on experience and practical approach to real world problems.
- An insight to algorithm development for smart automation.
- Get knowledge of circuit design and PCB development.
- Perform experiments throughout the course.
- Design and develop major projects at the end of the course.
- Get certified with most recognized certification in Embedded System Technology.

Malaysia:

The following qualification is offered at the Otomotif College in Malaysia.

Diploma in Automotive Engineering (DAE) PA8958:

This 2.5 years programme has much in common with the Diploma: Modern Automotive Technology offered at the same institution. It aims to prepare the learner to work in areas of high performance automotive engineering, design and manufacturing. The learner will learn the fundamental aspects of component design, research and development (R & D), product testing, manufacturing and management. This programme will allow interested students to articulate into degree level studies in automotive engineering. The programme is 60% theory and 40% practical orientated.

Internships are a unique feature of this qualification and are built in as a compulsory requirement for students to gain working experience within exciting automotive industry. It gives students the competitive edge in post-qualification employment. Students will also gain a strong foundation in business management and up-to-date knowledge on automotive retail operations. They will also be familiarized with the latest technologies associated with modern automobiles.

Diploma in Automotive Business Management (DABM) PA7725
This 2.5 years' programme is designed to develop dynamic, creative and innovative professionals for the automotive retail industry. The learner will learn the general principles of management, marketing, finance and operational aspects of a business with an automotive specialisation.

Graduates with this diploma will be able to pursue degree level qualifications in several business disciplines such as international business, marketing and business administration.

Career Options:

Automotive Dealership Management, After-Sales Management, Warranty Management, Spare Parts Management, Service Marketing, Motor Vehicle Insurance, Customer Service Operations, Vehicle Sales Operations, Fleet Management, Car Rental/Leasing, Own Business.

New Zealand:

The following qualification is registered on the New Zealand Qualifications Authority (NQZA):

National Certificate in Motor Industry (Advanced Technical) (Level 5) with strands in Automotive Electrical and Mechanical, and Collision Repair.

Core Compulsory:

All the standards listed below are required:

- Identify, interpret, and apply legal requirements relevant to the workplace in the motor industry.
- Demonstrate knowledge of, and apply, automotive workplace efficiency and productivity concepts.
- Inspect technical quality of work in the motor and related industries.
- Provide technical guidance in the motor and related industries.

Automotive Electrical and Mechanical strand:

Demonstrate knowledge of, and carry out, automotive failure analysis on systems and components.

Domain: Automotive Electrical and Electronics:

- Make up and install electronic circuitry to suit specific applications and components.
- Diagnose and rectify faults in an engine flywheel ignition system.

• Diagnose and repair faults in electronically controlled systems used on heavy vehicles and machines.
• Demonstrate knowledge of hybrid electric vehicle (HEV) technology, and service requirements.
• Demonstrate knowledge of automotive multiplex and databus applications, and diagnose faults.
• Demonstrate knowledge of in-vehicle information and control systems.
• Demonstrate knowledge of, and interpret, complex automotive wiring diagrams and circuitry.
• Demonstrate knowledge of, and use, portable computer diagnostic equipment to test vehicle systems.

Domain: Vehicle Braking Systems:

• Diagnose and rectify faults in a car or light commercial vehicle anti-lock braking system (ABS).
• Demonstrate knowledge of, diagnose, and rectify faults in a motorcycle anti-lock braking system.
• Check and rectify faults on air-braked heavy vehicle anti-lock braking and traction control systems.

Domain: Automotive Electrical and Electronics:

Describe removal and installation of body components in terms of electronic integrity of vehicles.

Australia:

Diploma of Automotive Technology:

This qualification concentrates on the acquisition of skills and knowledge in current technology which is advancing at an exceptional rate in modern vehicles. This qualification is most suitable for those working within the industry at the forefront of the implementation of these technologies.

Because technology is increasing at an exponential rate and to ensure relevance of the technical units and the competence based on these units, industry recommends that this qualification be completed within a specified time, perhaps 5 years. Such a requirement would maximise the use and integrity of this qualification.

12 units of competence from the Technical Inventory which must include:

Develop and document specifications and procedures.

• 1 unit of competence from the Advanced Technology cluster - Mechanical groups.
• 1 unit of competence from the Advanced Technology cluster - Electrical/Electronic groups.
• 5 units of competence at level 5 from the Advanced Technology cluster.
• 2 units of competence at level 5 from the Retail, Service and Repair or any endorsed Training Package.
• 2 appropriate and relevant units of competence from not less than level 4 or above from the Retail, Service and Repair any endorsed Training Package with no more than two credit units drawn from Assessment and Training units of competence.

Another qualification offered in Australia at Level 5 is the following:

Diploma of Automotive Management:

29 units of competence at levels 3, 4 or 5 are required to complete this qualification within the specific requirements as set out below:

The following three units of competence are compulsory:

- Plan and manage compliance with environmental regulations in a workplace or business.
- Contribute to business improvement.
- Monitor a safe workplace.

26 units of competence at levels 3, 4 or 5 including:

- A maximum of 4 units of competence at level 3 from the Management Inventory - Management and Administration and/or Sales, Warehousing, Purchasing and Storage clusters.
- A maximum of 4 units of competence at level 3 from any Retail, Service and Repair Inventory.
- 7 units of competence at level 4 or above from the Management Inventory - Management and Administration and/or Sales, Warehousing, Purchasing and Storage clusters.
- A minimum of 9 units of competence at level 5 or above from the Management Inventory which must be different from those above.
- 3 units of competence at level 4 or above from any Retail, Service and Repair Inventory.

Singapore:

The following qualification was found in Singapore:

Nitec in Automotive Technology - Light Vehicles offered by the Ite College East.

Course description: This specialisation provides students with the skills and knowledge to troubleshoot, service, repair and maintain light vehicles such as passenger cars, vans, sport utility vehicles and multi-purpose vehicles.

The course includes the following modules:

Core Modules (25 credits):

- Engine Service 30 hrs (T) 90 hrs (P) 6 Credits.
- Transmission Service 30 hrs (T) 90 hrs (P) 6 Credits.
- Control Service 30 hrs (T) 90 hrs (P) 6 Credits.
- Autotronics 30 hrs (T) 90 hrs (P) 7 Credits.
- Specialisation Modules - Light Vehicles (28 credits): Engine Technology 60 hrs (T) 60 hrs (P) 7 Credits.
- Engine Management 60 hrs (T) 60 hrs (P) 7 Credits.
- Control Technology (Light Vehicles) 60 hrs (T) 60 hrs (P) 7 Credits.
- Transmission Technology (Light Vehicles) 60 hrs (T) 60 hrs (P) 7 Credits.

Eastern Europa Countries

Belgium, Bulgaria, Germany, France and Poland:

Autotronics is a blended learning service enhancing automotive and electronics competencies for car garages and mechanics with Europe-wide accepted certificates. The service will address the current and anticipated skill shortages of car mechanics and employees in car garages. It will offer specifically blended learning courses tailored to the needs of small and medium sized car garages and car mechanics.

In June 2006, under the lead of Karlsruhe-based INGENATIC and the European TÜV group a European consortium of leading players in the automotive qualification market has joined forces to roll-out a certification program for automotive service personnel. Participants in this consortium are Autoform in Belgium, the Grande Ecole ENSMM in France, Technical University Sofia in Bulgaria and Zespol in Poland. TÜV Academy will be present with entities in Germany,

Poland and Bulgaria. The consortium focus on a personnel certification in the fields of IT-based and electronic sub-systems in the cars such as Onboard Diagnosis, comfort and security systems, bus systems such as CAN or LIN or Teleservice concepts.

A blended supply concept of web-based administration and e-Learning, training at various training locations and the interfacing between real cars and virtual learning environment creates a didactic value chain which makes the new automotive technology accessible in minimal time. The curriculum was developed by ENSMM, one of top private universities in France known for its long history of research cooperation with the automotive industry.

The trained persons will hence gain the acquired new competences with a certificate by the automotive world's most renowned certifier. With Autoform, Zespol and TU Sofia, the consortium gained strong national players in technical qualification as pilot partners. The 3 institutions will be interacting with the learners, taking care of in-person seminars and practical workshops.

Training at BMW:

The training outlined below could perhaps take place at Level 5.

In 1996, BMW of North America established the Service Technician Education Program (STEP) to address the need for new technicians at BMW dealerships in North America. STEP is a scholarship that is awarded to top graduates of automotive post secondary schools. Each year STEP graduates over 300 highly skilled technicians from the most respected and intense training program of its kind in the world.

The BMW Group STEP Experience:

STEP, the BMW Service Technician Education Programs of the BMW Group are all prestigious training opportunities available to the top performing graduates of the country's best post secondary transportation industry technical schools. The purpose of the program is to develop the highest quality service technician apprentices for employment at BMW Group Centers/Dealers in North America by identifying highly motivated people who show a desire to become a BMW Group technician, BMW is convinced that the level of service excellence will be maximized.

As a STEP student, one can expect an unsurpassed technical education and a career opportunity that comes once in a lifetime. All of our STEP graduates have become well-compensated, successful technicians, body and paint specialists, shop foreman, Service Advisors and Managers. On a daily basis, most reflect credit on the program, BMW, and themselves.

SADC:

None of the SADC countries have their own qualifications relating to Autotronics, but use the British City and Guilds Standards for training learners in the automotive field. Namibia has indicated interest in the South African qualifications and may implement this qualification once it has been registered. Namibia is currently in the process of developing vocational certificates for registration on the Namibia Qualifications Framework. Various initiatives are in place to ensure that their qualifications are in line with the South African Qualifications.

Conclusion:

The competencies covered in the National Certificate: Autotronics, Level 5 are either similar to or have some overlap with the qualifications and courses that are offered in countries investigated here. While direct and complete comparisons are rarely possible - given the very different contexts in the countries investigated - there are significant (and sometimes not-so-

significant) overlaps between this qualification and those internationally. In some cases, it is difficult to figure out the levels of the international courses and qualifications but the overlap in competencies helped to benchmark this Qualification.

From the US both long courses (51 weeks' duration) and short courses have been cited. The training in this qualification resonates with the training carried out in the US. Of course, while there are many differences between the qualifications in the respective countries, there are overlaps in the competencies. Even short courses offered by car manufacturers like Daimler Chrysler have been included in this exercise.

From Canada both a qualification and short courses have been cited. The Canadian qualification focuses on both automotive and management competencies at this level, with the latter being predominant. Many qualifications and courses from the UK have been cited. The significant part is that the UK courses are taught in other countries in Asia (Malaysia, Singapore and Korea).

There is hardly any information from France. And while there is no direct comparison with any qualifications in France the information on training from Renault, a big car manufacturer, is important. This qualification will compare favourably with the training for the cotech, or technical coordinator at Renault.

There is not much information available from India but the information cited here reflects the training taking place at India's TechnoLabs. The training cited here takes place at Level 5 and has some similarity with the South African Qualification. Two qualifications from Malaysia have been cited. One is more Diploma in Automotive Engineering is highly technical while the Diploma in Automotive Business Management is more orientated towards management in the automotive environment.

This Qualification enjoys closer similarity with the qualifications from New Zealand. The NZ qualification is more technical like this South African Qualification. In the case of Australia the one qualification cited focuses heavily on technology while the other focuses on management with an automotive bias. The Singapore qualification overlaps with this Qualification on key competencies.

While there is no direct comparison with Eastern European countries the information shows the Level 5 training that is envisaged in the partnerships developed.

In-house training courses from some car manufacturer's has also been cited.

On the whole this qualification compares very favourably with international qualifications or courses.

ARTICULATION OPTIONS

This Qualification lends itself to both vertical and horizontal articulation possibilities.

Horizontal articulation is possible with the following Qualifications:

- ID 71969: National Certificate: Automotive components: Manufacturing and Assembly, NQF Level 5.
- National Certificate: Automotive Repair and Maintenance, NQF Level 5.
- Diploma: Production Technology, NQF Level 5.

Vertical articulation is possible with the following Qualification:

- Higher Diploma: Production Technology at NQF Level 6.

MODERATION OPTIONS

• Anyone assessing a learner or moderating the assessment of a learner against this Qualification must be registered as an assessor with the relevant Education, Training, Quality, and Assurance (ETQA) Body.

• Any institution offering learning that will enable the achievement of this Qualification must be accredited as a provider with the relevant ETQA.

• Assessment and moderation of assessment will be overseen by the relevant ETQA according to the ETQA's policies and guidelines for assessment and moderation; in terms of agreements reached around assessment and moderation between ETQA's (including professional bodies); and in terms of the moderation guideline detailed immediately below.

• Moderation must include both internal and external moderation of assessments at exit points of the Qualification, unless ETQA policies specify otherwise. Moderation should also encompass achievement of the competence described both in individual Unit Standards, the integrated competence described in the Qualification and will include competence within core sales and the elective standards relevant to the economic sector.

• Anyone wishing to be assessed against this Qualification may apply to be assessed by any assessment agency, assessor or provider institution that is accredited by the relevant ETQA.

CRITERIA FOR THE REGISTRATION OF ASSESSORS

For an applicant to register as an assessor, the applicant needs:

• A minimum of 4 (four) years' practical, relevant occupational experience.
• A relevant Qualification at NQF Level 6 or higher.
• To be registered as an assessor with the relevant ETQA.

UNIT STANDARDS

	ID	UNIT STANDARD TITLE	LEVEL	CREDITS
Fundamental	335876	Apply mathematical and statistical techniques in a production environment	Level 5	20
Fundamental	115790	Write and present for a wide range of purposes, audiences and contexts	Level 5	5
Core	230462	Analyse failure of vehicle parts	Level 5	12
Core	15234	Apply efficient time management to the work of a department/division/section	Level 5	4
Core	7818	Conduct on-the-job coaching	Level 5	5
Core	376620	Diagnose and repair climate control systems	Level 5	10
Core	376680	Diagnose and repair communication and entertainment systems	Level 5	12
Core	376660	Diagnose and repair supplementary restraint systems (SRS)	Level 5	10
Core	376642	Diagnose and repair vehicle convenience systems	Level 5	16
Core	376623	Diagnose and repair vehicle stability, traction and drive control (VSTDC) systems	Level 5	16
Elective	9405	Analyse work requirements and plan ahead	Level 5	4
Elective	252026	Apply a systems approach to decision making	Level 5	6
Elective	243267	Apply and continuously improve company policies and procedures	Level 5	10
Elective	115821	Apply business financial practices	Level 5	4
Elective	252042	Apply the principles of ethics to improve organisational culture	Level 5	5
Elective	252037	Build teams to achieve goals and objectives	Level 5	6
Elective	252189	Deal with sub standard performance in a team	Level 5	5
Elective	252033	Demonstrate ways of dealing with the effects of dreaded diseases and in particular HIV/AIDS	Level 5	8
Elective	12458	Develop the skills of a work team	Level 5	10

	ID	UNIT STANDARD TITLE	LEVEL	CREDITS
Elective	376602	Diagnose and repair integrated starter and alternator combination systems (ISAD)	Level 5	8
Elective	10066	Establish customer needs and relationships	Level 5	16
Elective	9406	Manage a team	Level 5	4
Elective	10053	Manage customer requirements and needs and implement action plans	Level 5	8

LEARNING PROGRAMMES RECORDED AGAINST THIS QUALIFICATION
None

SOUTH AFRICAN QUALIFICATIONS AUTHORITY

UNIT STANDARD:

Diagnose and repair integrated starter and alternator combination systems (ISAD)

SAQA US ID	*UNIT STANDARD TITLE*		
376602	Diagnose and repair integrated starter and alternator combination systems (ISAD)		
ORIGINATOR		*PROVIDER*	
SGB Manufacturing and Assembly Processes			
FIELD		*SUBFIELD*	
6 - Manufacturing, Engineering and Technology		Manufacturing and Assembly	
ABET BAND	*UNIT STANDARD TYPE*	*NQF LEVEL*	*CREDITS*
Undefined	Regular	Level 5	8

New NQF Level: NQF Level 05

This unit standard replaces:

US ID	Unit Standard Title	NQF Level	Credits	Replacement Status
12237	Diagnose and repair integrated starter and alternator combination systems (ISAD)	Level 5	8	Will occur as soon as 376602 is registered

SPECIFIC OUTCOME 1
Discuss the operation of vehicle integrated starter and alternator combination.

SPECIFIC OUTCOME 2
Discuss the components and equipment used in integrated starter and alternator combination systems.

SPECIFIC OUTCOME 3
Test and diagnose integrated starter and alternator combination systems.

SPECIFIC OUTCOME 4
Replace or repair components in the integrated starter and alternator combination systems system.

QUALIFICATIONS UTILISING THIS UNIT STANDARD

	ID	QUALIFICATION TITLE	LEVEL
Elective	78943	National Certificate: Autotronics	Level 5

SOUTH AFRICAN QUALIFICATIONS AUTHORITY

UNIT STANDARD:

Diagnose and repair communication and entertainment systems

SAQA US ID	*UNIT STANDARD TITLE*		
376680	Diagnose and repair communication and entertainment systems		
ORIGINATOR		*PROVIDER*	
SGB Manufacturing and Assembly Processes			
FIELD		*SUBFIELD*	
6 - Manufacturing, Engineering and Technology		Manufacturing and Assembly	
ABET BAND	*UNIT STANDARD TYPE*	*NQF LEVEL*	*CREDITS*
Undefined	Regular	Level 5	12

New NQF Level: NQF Level 05

This unit standard replaces:

US ID	Unit Standard Title	NQF Level	Credits	Replacement Status
12233	Diagnose and repair communication and entertainment systems	Level 5	12	Will occur as soon as 376680 is registered

SPECIFIC OUTCOME 1
Discuss the operation of vehicle communication and entertainment system.

SPECIFIC OUTCOME 2
Discuss the components and the equipment used in communication and entertainment systems.

SPECIFIC OUTCOME 3
Test and diagnose communication and entertainment systems.

SPECIFIC OUTCOME 4
Replace or repair components in the communication and entertainment systems system.

QUALIFICATIONS UTILISING THIS UNIT STANDARD

	ID	QUALIFICATION TITLE	LEVEL
Core	78943	National Certificate: Autotronics	Level 5