SECTION A:	QUALIFICATION DETAILS																
QUALIFICATION DEVELOPER (S)	Kitso International College																
TITLE	Diploma in Heavy Plant Technology													NCQF LEVEL	6		
FIELD	Manufacturing, Engineering and Technology		SUB-FIELD		Engineering and Engineering Trades									CREDIT VALUE	395		
New Qualification		√	Review of Existing Qualification														
SUB-FRAMEWORK	General Education		TVET		√	Higher Education											
QUALIFICATION TYPE	Certificate	I		II		III		IV		V		Diploma	√	Bachelor			
	Bachelor Honours		Post Graduate Certificate			Post Graduate Diploma											
	Masters		Doctorate/ PhD														

RATIONALE AND PURPOSE OF THE QUALIFICATION

RATIONALE:

A diploma in Heavy Plant Technology (HVPT) is to prepare a learner to operate as a Heavy Equipment Technician. A Heavy Equipment Technician maintains, diagnoses faults and repairs heavy plant equipment, such as earth moving or mining equipment, including engines, mechanical parts and hydraulically or electrically powered systems. The Diploma in Heavy Plant Technology aims to focus on the imparting of knowledge, skills and competencies in the modern repair, service, and maintenance of heavy plant equipment. These skills and

competencies were identified as top priority skills areas for human capital development and economic drivers, HRDC Report (2016).

The Diploma in Heavy Plant Technology will drive to empower learners with the ability to develop skills and competencies to carry out different mechanical and electrical repair and maintenance operations on heavy plant equipment. It will also enable learners to handle and operate heavy plant machines and carry out minor and major repairs and adjustments on machines for effective and efficient machinery usage.

Heavy Plant Equipment is an important source of power for road, infrastructure, and farm construction. Learners will familiarize themselves with various components, sub-assemblies, their operations, their location, inter-relation, and functional relevance. The Diploma in Heavy Plant Technology will also empower students to run heavy plant equipment, whether privately-owned, state-owned or as part of hiring and rental services.

Automotive Engineering skills are playing a very critical role in the formal and informal sectors of Botswana's economy. Therefore, training people in Heavy Plant Technology skills and competencies is not only rendering services to the labour market but is also playing a critical role in SME formation, employment creation, poverty reduction and economic diversification

PURPOSE:

The purpose of this qualification is to provide learners with the knowledge, skills, and competence to:

- Diagnose, service and repair various heavy plant equipment makes and models.
- Innovate, create and be proactive in the ever-evolving technological advances of the industry.
- Work as employees or as entrepreneurs.
- Select, use, and care for engineering hand and power tools.
- Comply with safety, health, and environmental requirements in the workplace.
- Understand and apply the fundamentals of engine technology.

ENTRY REQUIREMENTS (including access and inclusion)

Minimum entry requirement for this qualification is a:

Certificate IV, NCQF Level 4, or equivalent, best 6 subjects with a C or better in English, Mathematics, Physics and Chemistry.

Recognition of Prior Learning (RPL):

There shall be provision for entry through Recognition of Prior Learning (RPL) and Credit Accumulation and Transfer (CAT) in line with institutional and national policies.

SECTION B	***QUALIFICATION SPECIFICATION***
GRADUATE PROFILE (LEARNING OUTCOMES)	***ASSESSMENT CRITERIA***
LO1: Apply knowledge and understanding of Safety, Health, and Environmental Risk (SHER).	1.1 Observe personal safety for all stakeholders and ensure the applications of the legislative regulatory requirements. 1.2 Identify hazards in the workplace that pose danger to personal health and provide solutions to them in accordance with regulated safety standards per your industry. 1.3 Maintain a register of the occurrence of incidents of accidents in line with organizational requirements. 1.4 Apply appropriate action to control unsafe or unhealthy hazards and propose methods of eliminating them.
LO2: Apply knowledge and skill of machine shop practices to include, human and equipment safety and operation, as it relates to an engineering environment.	2.1 Demonstrate knowledge of metallurgy and properties of other engineering materials. 2.2 Apply hand tools to perform machine shop bench operations. 2.3 Select and use temporary and permanent methods of joining metals and other engineering materials. 2.4 Demonstrate application of machine tools to solve engineering tasks. 2.5 Perform different welding processes and explain their application to engineering materials and components.
LO3: Demonstrate knowledge and skill of diesel engine internal combustion operation, maintenance, and service.	3.1 Demonstrate steps required to change diesel engine oil and filter. 3.2 Diagnose and repair vehicle leaks in fuel, lubrication and cooling systems, and other vehicle liquids.

	3.3 Diagnose and repair diesel engine noises and vibrations.
LO4: Apply knowledge and skill of diesel engine reconditioning processes.	4.1 Demonstrate knowledge and skill in diesel engine disassemble in preparation for reconditioning. 4.2 Demonstrate the application of recommended procedures for diesel engine cylinder block reconditioning. 4.3 Demonstrate the application of recommended procedures for cylinder head, crankshaft, and valve train reconditioning. 4.4 Demonstrate knowledge and skill of diesel engine reassembly. 4.5 Perform cylinder head tests and analyse results.
LO5: Perform diagnosis, service and repair of heavy plant equipment's fuel and engine management systems.	5.1 Test and service diesel fuel injectors, fuel pumps and pump control systems for pressure, regulation, and volume. 5.2 Test and diagnose electronic diesel control modules and power train/engine control modules. 5.3 Perform cylinder power balance tests. 5.4 Demonstrate knowledge and skill in the usage of digital gas analysers and emission control instruments to extract and interpret their readings in diagnosis. 5.5 Retrieve and analyse diagnostic trouble codes, OBD monitor status, and freeze frame data, live/series data. 5.6 Perform active tests of actuators and sensors using digital scan tools.
LO6: Apply knowledge and skill of heavy plant equipment electrical and electronic components and systems.	6.1 Interpret circuit wiring diagrams during diagnosis of electrical and electronic problems. 6.2 Inspect and test sensors, connectors and wiring using electronic (digital) instruments.

	6.3 Test heavy plant equipment electrical and electronic circuits according to manufacturer's specifications. 6.4 Diagnose plant equipment electronic circuits using a scan tool. 6.5 Apply manufacturer-recommended software transfers, and software updates of flush reprogramming on electronic modules. 6.6 Analyse complex heavy plant equipment circuits and diagrams to aid diagnosis and repair.
LO7: Perform diagnosis, repair, and service procedures on heavy plant equipment transmission systems.	7.1 Apply knowledge and skill to repair single, double, and planetary reduction final drives. 7.2 Demonstrate knowledge and skill to service and repair track machines with undercarriages. 7.3 Apply knowledge and skill to service and repair undercarriage working attachments. 7.4 Demonstrate knowledge and skill to service and repair undercarriage components.
LO8: Diagnose, service and repair heavy plant equipment chassis systems.	8.1 Apply knowledge and skill to diagnose, repair and use service procedures on the wheel and track machine steering systems. 8.2 Perform diagnosis, repair and service of wheel and track machine suspension systems. 8.3 Demonstrate knowledge and skill to repair and service tyres, rims and wheels on wheel and track machines.
L9: Demonstrate scientific and mathematical application of techniques in analysing and solving problems on heavy plant equipment.	9.1 Use graphs, tables, and charts to present work-related results. 9.2 Demonstrate skill in the application of scientific laws and principles in trade-related problem-solving 9.3 Interpret variances in vehicle parameters and data using calculus and differentiation concepts.

LO10: Demonstrate the ability to read, interpret and construct functional component and circuit drawings in solving heavy plant equipment challenges.	10.1 Select the appropriate drawing equipment to be used. 10.2 Produce functional drawings according to the task specifications whilst observing strict adherence to safety, health, and quality standards. 10.3 analyse drawings to determine appropriate technical decision-making and equipment use.
LO11: Utilize relevant CAD/CAM software to prepare technical graphics appropriate to heavy plant equipment in respect of functional operations.	11.1 Construct block diagrams of heavy plant equipment components/circuits used in day-to-day life. 11.2 Generate solid models and 2-D drawings of products conforming to standards. 11.3 Generate part model assembly of various machine components and systems using modelling packages. 11.4 Generate solid models and 3-D drawings for simple components. 11.5 Demonstrate knowledge of various codes and specifications of International Standards (ISO) concerned with engineering drawings. 11.6 Perform computer-aided production planning, numerical control, and Computer Numerical Control (CNC) programming. 11.7 Apply the principle of automation, the drafting and geometric modelling of database structure for graphics modelling.
LO12: Demonstrate knowledge, skill, and overall understanding of office productivity tools.	12.1 Capture data, and sort data into usable meaningful information using Information Communication Technology (ICT). 12.2 Communicate internally, externally, and globally using Information Communication Technology (ICT).

	12.3 Apply Information Communication Technology (ICT) to present work in different digital formats. 12.4 Apply Information Communication Technology (ICT) to enhance customer satisfaction and experience. 12.5 Analyse data and information using Information Communication Technology (ICT) to make informed work-related decisions.
LO13: Demonstrate Entrepreneurial and Innovation skills.	13.1 Demonstrate knowledge and understanding on creating a business plan. 13.2 Demonstrate the ability to market one's services and ideas. 13.3 Demonstrate the ability to mobilize people and resources. 13.4 Demonstrate the ability to create value in service provision.
LO14: Apply knowledge and skill in the service and maintenance hydraulic and pneumatic components and systems on heavy plant equipment.	14.1 Perform operational calculations on parameters of hydraulic components, systems and machines to aid diagnosis. 14.2 Apply standard tables, diagrams, and formulae that define the associated laws on hydraulic and pneumatic components and circuits. 14.3 Test, service and diagnose heavy plant equipment hydraulic and pneumatic systems and components. 14.4 Design practical heavy plant equipment hydraulic and pneumatic circuits targeted at problem-solving.

SECTION C	***QUALIFICATION STRUCTURE***				
COMPONENT	***TITLE***	***Credits Per Relevant NCQF Level***			***Total Credits***
		Level [5]	***Level [6]***	***Level [ ]***	
FUNDAMENTAL COMPONENT *Subjects/ Courses/ Modules/Units*	Engineering Mathematics 1	15			15
	Engineering Mathematics 2		15		15
	Engineering Science	15			15
	Engineering Drawing	10			10
	Computer Fundamentals	10			10
	Technical Communication	10			10
	Machine Shop Practice	10			10
	Entrepreneurship		10		10
CORE COMPONENT *Subjects/Courses/ Modules/Units*	Engines Technology		15		15
	Mechanical Material Handling	10			10
	Heavy Plant Transmission Systems		10		10

	Heavy Plant Body & Chassis Systems		10		10
	Undercarriages, Attachments & Winches		10		10
	Heavy Plant On-Board Diagnostics		10		10
	Preventive Maintenance	10			10
	Heavy Plant Pneumatics & Hydraulics		10		10
	Engine Electronic Control Systems	10			10
	Fluid Mechanics		10		10
	Strength of Materials		10		10
	Mechanics of Machines		10		10
	Engineering Design and Synthesis		10		10
	Computer-Aided Design (CAD)		15		15
	Workshop Organization & Safety Management	10			10
	Industrial Placement		50		50
	Workshop Practice		60		60
	Final Year Project		15		15
	Vehicle Design		10		***10***

ELECTIVE/ OPTIONAL COMPONENT *Subjects/Courses/ Modules/Units* ***Choose ONE***	Customer Care & Industrial Rapport		***10***		
	TOTAL				***395***

SUMMARY OF CREDIT DISTRIBUTION FOR EACH COMPONENT PER NCQF LEVEL	
TOTAL CREDITS PER NCQF LEVEL	
NCQF Level	***Credit Value***
5	***115***
6	***280***
TOTAL CREDITS	***395***

Rules of Combination:

(Please Indicate combinations for the different constituent components of the qualification)

Rules of Combination:

Compulsory Components Credits:

- Core Modules 285 Credits
- Fundamental Modules 100 Credits

Elective Credits:

- Elective Modules 10 Credits

Distribution Rules:

- Level 5 with a maximum of 115 Credits
- Level 6 with a maximum of 280 Credits

ASSESSMENT ARRANGEMENTS
Formative Assessments shall constitute 50% Weighting on the Final Assessment, whilst Summative Assessments shall constitute 50%.
MODERATION ARRANGEMENTS
There shall be internal and external moderation arrangements done by BQA registered and accredited Moderators.
RECOGNITION OF PRIOR LEARNING
There will be a provision for awarding the qualification through RPL mode which will be in line with the national RPL Policy.
CREDIT ACCUMULATION AND TRANSFER
There will be a provision for awarding of the qualification through CAT mode which will be in line with the national RPL and CAT Policy.
PROGRESSION PATHWAYS (LEARNING AND EMPLOYMENT)
Horizontal Articulation of Diploma in Heavy Plant Technology (HVPT) 1. Diploma in Automotive Mechanical Technology (AMT) 2. Diploma in Automotive Control Systems (ACS) 3. Diploma in Automotive Electrical Technology (AET) 4. Diploma in Automotive Mechatronics (AMS) 5. Diploma in Automotive Collusion Estimation (ACE) 6. Diploma in Automotive Body Repair and Finishing Technology (ABRT)

Vertical Articulation for Diploma in Heavy Plant Technology (HVPT)

1. Bachelors in Technology (B. Tech.) in Heavy Plant Technology
2. Bachelors in Technology (B. Tech.) in Automotive Mechanical Technology
3. Bachelors in Technology (B. Tech.) in Automotive Collision Estimation
4. Bachelors in Technology (B. Tech.) in Automotive Body Repair Technology
5. Bachelors in Technology (B. Tech.) in Automotive Electrical Technology
6. Bachelors in Technology (B. Tech.) in Automotive Control Systems
7. Bachelors in Technology (B. Tech.) in Automotive Mechatronics

Career Path in Automotive Heavy Plant Technology

1. Automotive Heavy Plant Technician
2. Diesel Plant Technician
3. Diesel Mechanic
4. Plant Service Advisor
5. Plant Shop Owner
6. Plant Parts Professional

QUALIFICATION AWARD AND CERTIFICATION

A candidate is required to achieve the stipulated **395** total credits inclusive of the fundamental, core and elective components, to be awarded the **Diploma in Heavy Plant Technology.**

Certification

Candidates meeting prescribed requirements will be awarded the **Diploma in Heavy Plant Technology (HVPT)**in accordance with the standards prescribed for the award and applicable policies.

REGIONAL AND INTERNATIONAL COMPARABILITY

In the region, we have observed no similarities in most major aspects of the qualifications for comparison. This is an indication that the qualifications in the region differ significantly. This may be attributed to varying levels of skills and competency scales by service and maintenance technicians in their day-to-day operations. The program duration for all the qualifications is similar.

They do have some differences as detailed

The Zimbabwean qualification is a Level 5 certificate, whereas the Zambian qualification is a diploma, but falls short by 25% in Exit Learning Outcomes to the Diploma in Heavy Plant Technology**.** There is a huge disparity in the credit allocations, which can be attributed to the disproportionate content coverage. Both the Zambian and Zimbabwean qualifications do not offer elective modules. The Diploma in Heavy Plant Technology covers both theoretical training and work-based learning in the program duration, compared to its regional counterparts.

In global comparison, it is observed that **t**here are no similarities in most major aspects of the qualifications for comparison. This is an indication that the qualifications, on a global scale, differ significantly. This may be attributed to different levels of skills and competency scales by service and maintenance technicians in their day-to-day operations. The program duration for all the qualifications is similar.

At the same time, it is noticed that the New Zealand qualification is a Level 4 certificate, whereas the Canadian qualification is a diploma, but falls short by 70% in Exit Learning Outcomes to the Diploma in Heavy Plant Technology. There is a huge disparity in the credit allocations, which can be attributed to the disproportionate content coverage. The New Zealand qualification does not offer elective modules. The Diploma in Heavy Plant Technology covers both theoretical training and work-based learning in the program duration, unlike its international counterparts. The assessment strategies of the two international qualifications that were compared do not offer the project component, as compared to the Diploma in Heavy Plant Technology.

Averagely the qualification duration has a majority of 3 years and corresponds to the Diploma in Heavy Plant Technology. The average number of modules per semester is 5 and totals an average of 24 modules over the entire course. The Diploma in Heavy Plant Technology has 20 modules and 6 semesters. All qualifications

offer industrial attachment or apprentice. The exit learning outcomes correspond to the modules, however, there is less coverage of advanced topics of vehicle damage cost estimation.

All qualifications do not offer electives. The Diploma in Heavy Plant Technology offers electives to enhance specialization and diversification. The idea is to produce graduates competent in the cost assessment of vehicle body framework, and mechanical and electrical damage. They do have different names, but the content is on averagely 70% to 90% similar. However, the Diploma in Heavy Plant Technology tends to cover more on vehicle damage cost estimation, insurance, customer care services, entrepreneurship, and workshop management.
In the context of Botswana, the qualification offers Entrepreneurship module(s). The qualification is outcome-based learning therefore and therefore emphasis hands and development of skills and competencies; introduced two modules, workshop practice I and II two ensure continues practice of acquired knowledge and convert to skills and competencies whilst at school. Secondly the study has also included industrial attachment to further support the stated approach.

REVIEW PERIOD

This qualification will be reviewed after a period of 5 Years