SECTION A:	QUALIFICATION DETAILS							
QUALIFICATION DEVELOPER (S)	Department of Teacher Training &Technical Education							
TITLE	Diploma in Refrigeration & Air-conditioning Engineering				NCQF LEVEL		6	
STRANDS (where applicable)	1. N/A 2. 3. 4.							
FIELD	Manufacturing, Engineering and Technology	SUB-FIELD	Engineering and Engineering Trades		CREDIT VALUE		376	
New Qualification			✓		Legacy 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:

Sub field of Refrigeration and Air conditioning has been identified as one of the occupations in high demand in Botswana and beyond (HRDC Occupation Code No. 7127). This is based on the Labour Market Analysis conducted by the HRDC. The qualification Diploma in Refrigeration and Air conditioning Engineering is developed as a response to the need established by Human Resource Development Council Report (HRDC 2019) ON Top Occupations in Demand, which identified Refrigeration and Air conditioning Technicians as one of the occupations in high demand in Botswana.

This qualification has been developed in line with Botswana Government's Vision 2036 which acknowledges Technical and Vocational Education Training (TVET) as one of the key contributors to economic growth and employment creation (page 17) and NDP11 (page 71)

The Vision further emphasizes implementation of curriculum which is aligned to the needs of the economy, business, science, mathematics and technology (page 20).

Furthermore the Continental Education Strategy for Africa 2016 – 2025 stipulate that there is a need to expand TVET opportunities at both secondary and tertiary level and strengthen linkage between the world of work and education and training systems.

This qualification was developed following thorough consultations with industry practitioners in the field together with trainers/assessors in the TVET institutions who identified, analysed and verified a set of typical Duties, Tasks, Generic Skills, Attitudes and future trends for the occupation of a "Refrigeration and Air conditioning". The data obtained here was used by TVET trainers to develop most of the Exit level outcomes and Learning Outcomes which eventually resulted in a Learning Programme which was also audited by another team of Industry Experts and TVET trainers.

PURPOSE: (itemise exit level outcomes)

The purpose of this qualification is to produce Refrigeration and Air Conditioning Engineering Technician with advanced technical knowledge, skills and competencies to:

- Install , troubleshoots, repair, service and maintain heating, ventilation, refrigeration , air conditioning and related systems
- Performs tests and maintenance on mechanical, electrical and electronics equipment; interprets readings and outputs of equipment; ensures proper functioning of equipment
- Reads and interprets wiring diagrams, mechanical drawings, and specifications related to installations or repair work.
- Use of drawing software such as Auto CAD, Revit and others
- Makes verbal and written reports of work performed and performs record keeping functions.
- Initiates work orders and ensures that orders are accurate and complete
- Use Heating, Ventilation, Air Conditioning and Refrigeration (HVACR) software's to troubleshoot and select systems components.
- Carry out pre commissioning and commissioning of HVACR systems
- Execute electrical & electronics skills in servicing and maintaining HVACR systems

MINIMUM ENTRY REQUIREMENTS (including access and inclusion)

Minimum entry requirement for this qualification is as follows:

- Certificate IV, NCQF Level 4(General Education or TVET Intermediate Certificate)
- Applicants who do not meet minimum entry will be absorbed through RPL and CAT according to the ETP's policies aligned to BQA RPL and CAT policies

(Note: Please use Arial 11 font for completing the template)

SECTION B	QUALIFICATION SPECIFICATION
GRADUATE PROFILE (LEARNING OUTCOMES)	***ASSESSMENT CRITERIA***
1.1 Apply refrigeration , air-conditioning and mechanical engineering principles to solve and calculate engineering problems	1.1.1 Execute the skill to use measuring and testing instruments 1.1.2 Interpret measurements of refrigeration & air-conditioning quantities using graphs and charts 1.1.3 Implement food storage practices and standards 1.1.4 Employ the skill to work with refrigeration oils and refrigerants 1.1.5 Employ the skills to work with Engineering application softwares 1.1.6 Establish thermodynamic parameters for refrigeration and air conditioning systems 1.1.7 Implement and monitor environmentally friendly and energy efficient practices and standards
1.2 Employ professional skills for installation of refrigeration & air-conditioning systems	1.2.1 Carry out work on metal fabrication and manufacturing 1.2.2 Carryout site inspection processes prior to installation 1.2.3 Comply with health and safety installation standards 1.2.4 Apply commissioning and decommissioning procedures and standards 1.2.5 Apply codes and standards for fixing and securing installed mechanical and electrical equipment 1.2.6 Recover, reclaim, pressure test, evacuate, leak test and charge installed refrigeration and air conditioning equipment 1.2.7 Verify functionality and compliance of refrigeration and air conditioning installation
1.3 Apply procedures for carrying out maintenance according to refrigeration & air-conditioning required standards	1.3.1 Carryout inspection prior to maintenance work 1.3.2 Plan for execution of maintenance work 1.3.3 Perform maintenance work according to required standards and procedures 1.3.4 Carry out pre-starting and test running procedures 1.3.5 Establish pre and post service maintenance schedules for the plant/system

1.4 Carryout service and repair procedures for refrigeration & air-conditioning systems according to required standards	1.4.1 Execute the skill to carry out inspection prior to service and repair work 1.4.2 Employ the skill to carry out fault finding tests(trouble shooting) procedures 1.4.3 Carry out remedial action for maintenance of refrigeration & air-conditioning systems 1.4.4 Test run the system for proper operation
1.5 Modify refrigeration & air-conditioning systems	1.5.1 Apply the skills for selecting refrigeration and air conditioning piping, piping systems, accessories, components and control systems 1.5.2 Replace components, accessories and control systems 1.5.3 Execute the skill to retrofit refrigeration & air-conditioning systems 1.5. 3 Verify functionality and compliance of the modified refrigeration and air conditioning system
1.6 Apply electrical & electronics skills in servicing and maintaining refrigeration & air-conditioning systems	1.6.1 Carry out voltage, resistance, continuity, amperage, and wattage test in refrigeration & air-conditioning systems 1.6.2 Perform electrical and electronic tests of components and accessories in refrigeration & air-conditioning systems 1.6.3 Execute the skill to apply electrical installation maintenance and repair standards 1.6.4 Employ the skill to apply electronic installation, maintenance and repair standards 1.6.4 Test run the system after repair and service of the refrigeration and air conditioning units
1.7 Apply engineering mathematics skills to analyse systems in refrigeration & air-conditioning discipline	1.7.1 Perform calculations in order to solve problems within an engineering field 1.7.2 Apply mathematical concepts and principles in field of refrigeration & air-conditioning engineering 1.7.3 Perform calculations on refrigeration & air-conditioning engineering systems
1.8 Design engineering system drawings used in refrigeration & air-conditioning engineering industry	1.8.1 Produce engineering components in orthographic projection 1.8.2 Produce engineering components in pictorial projection 1.8.3 Produce designs and construction drawings of duct layout, pipelines and water reticulation systems using drawing software

1.9 Apply professional (generic/soft skills) applicable in refrigeration & air-conditioning engineering field	1.9.1 Employ ICT skills in refrigeration & air-conditioning engineering to execute the assigned tasks 1.9.2 Communicate effectively and efficiently in an refrigeration & air-conditioning (oral and written) 1.9.3 Apply entrepreneurship practical skills in a business set up 1.9.4 Execute administrative & management duties in refrigeration & air-conditioning engineering industry. 1.9.5 Employ the skill to carryout research in refrigeration & air-conditioning discipline 1.9.6 Adhere to code of ethics for engineers in work environment
1.10 Adhere to health and safety measures in the workplace	1.10.1 Apply and monitor occupational, health and safety regulations, codes and practices in the work place 1.10.2 Adhere to health and safety regulations in the workplace to minimise risks and accidents 1.10.3 Administer first aid according to the required standards 1.10.4 Comply to health & safety reporting procedures for injuries and accidents in the workplace 1.10.5 Comply with safety standards for working with flammable refrigerants 1.10.6 Comply with safety standards for working with machinery charged with/containing flamma ble refrigerants

Note: Please use Arial 11 font for completing the template)

SECTION C	***QUALIFICATION STRUCTURE***				
COMPONENT	***TITLE***	***Credits Per Relevant NCQF Level***			***Total Credits***
		Level [ ]	***Level [5]***	***Level [6]***	
FUNDAMENTAL COMPONENT *Subjects/ Courses/ Modules/Units*	Introduction to Computing		8		**8**
	Occupational Health and Safety		6		**6**
	Communication Skills		8		**8**
	Introduction to Research Methods			8	**8**
	Entrepreneurship		8		**8**
	Engineering Ethics			8	**8**
CORE COMPONENT *Subjects/Courses/ Modules/Units*	Refrigeration and Air-conditioning Engineering Drawing		10		**10**
	Refrigeration and Air Conditioning Engineering Principles		14		**14**
	Engineering Mathematics		18	18	**36**
	Mechanical Engineering Principles		14		**14**
	Installation of Refrigeration and Air		16	48	**64**

	Conditioning systems				
	Maintenance of Refrigeration and Air Conditioning systems		14	14	**28**
	Refrigeration and Air Conditioning Electrical Workshop Practice		14		**14**
	Thermodynamics			6	**6**
	Engineering Management Skills			6	**6**
	Refrigeration and Air Conditioning Electronics Workshop Practice			13	**13**
	Refrigeration and Air Conditioning Computer Aided Design			12	**12**
	Modification of Refrigeration and Air Conditioning Systems			16	**16**
	Refrigeration and Air conditioning Contracts Management			7	**7**
	Integrated Project			30	**30**
	Work placement			60	**60**
STRANDS/ SPECIALIZATION	*Subjects/ Courses/ Modules/Units*	***Credits Per Relevant NCQF Level***			***Total Credits***
		Level [ ]	***Level [ ]***	***Level [ ]***	

1.					
2.					
Electives					

SUMMARY OF CREDIT DISTRIBUTION FOR EACH COMPONENT PER NCQF LEVEL	
TOTAL CREDITS PER NCQF LEVEL	
NCQF Level	*Credit Value*
Level 5	***130***
Level 6	***246***
TOTAL CREDITS	***376***

Rules of Combination:

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

Fundamentals NCQF 5= 30
Fundamental NCQF 6 = 16

Core NCQF 5 = 100
Core NCQF 6=230

Total Credits 376

The candidate has to pass all core modules and fundamentals modules.

N.B. There are no electives for this qualification

(Note: Please use Arial 11 font for completing the template)

ASSESSMENT ARRANGEMENTS
Documentation All necessary documents including: qualification document, alignment matrices, assessment instruments and Assessment criteria/rubrics should be available. **Formative (60%)** The contribution of formative assessment to the final grading shall be 60% **Summative Assessment (40%)** The contribution of summative assessment to the final grade shall be 40% Assessment shall be carried out by BQA registered and accredited Assessors
MODERATION ARRANGEMENTS
Internal and external moderators to be engaged will be BQA accredited subject specialists in relevant fields with relevant industry experience and academic qualification. The moderators should be holders of Bachelor of Engineering in Refrigeration and Air-conditioning**,** Bachelor of Engineering in Building Services, relevant/similar qualifications and industrial experience will be an added advantage
RECOGNITION OF PRIOR LEARNING
Recognition of Prior Learning (RPL) will be considered for the award of the credits according to applicable RPL policies
CREDIT ACCUMULATION AND TRANSFER
Credit Accumulation and Transfer will be considered for the award of the credits according to applicable RPL policies
PROGRESSION PATHWAYS (LEARNING AND EMPLOYMENT)
Horizontal Articulation(related qualifications of similar level that graduates may consider) • Diploma in Building Services • Diploma in Heating, Ventilation and Air conditioning Refrigeration (HVACR) • Diploma in Mechanical Engineering Graduates may consider undertaking professional certifications since vendor training is recognized internationally as an industry benchmark for product specific training. • Vertical Articulation(qualifications to which the holder may progress to)

- Bachelor of Engineering in Building Services
- Bachelor of Engineering in Heating, Ventilation and Air conditioning Refrigeration (HVACR)
- Bachelor of Engineering in Mechanical Engineering

Employment Pathways

- On successful completion of this qualification the holder may be absorbed in the job market as:
- Air conditioning technician
- Refrigeration technician
- Truck Refrigeration Technician
- Automotive air conditioning technician
-
- Maintenance manager
- HVAC Technician
- HVAC Installation Technician
- HVAC Sales Representative
- HVAC Service Technician
- HVAC Maintenance Technician
- Chiller Technician

QUALIFICATION AWARD AND CERTIFICATION

Qualification Award

- Candidate meeting the required minimum of 376 credits will be awarded Diploma in Refrigeration and Air Conditioning Engineering in accordance with the qualification composition rules and applicable policies.

Certification

- There will be certification upon awarding of Diploma in Refrigeration and Air Conditioning Engineering qualification.

SUMMARY OF REGIONAL AND INTERNATIONAL COMPARABILITY

Title of Qualifications

They have similar qualification tittles: TAFE- Queensland is Diploma of Air Conditioning and Refrigeration Engineering, Intec College: Diploma: Air Conditioning and Refrigeration whereas the proposed qualification is Diploma in Refrigeration and Air Conditioning Engineering.

Duration and Level

The duration of the qualification by TAFE Queensland is between 1-2 years, Intec College is 2 years and the proposed qualification is 3 years. The TAFE Queensland entry level is for graduates of NQF level 5(who have first year- Artisans/ Certificate V) while for Intec College and the proposed minimum entry levels is NQF/NCQF level IV(high school leavers). The NCQF/NQF for Intec College and the proposed ends at level 10 whereas for TAFE Queensland ends with level 12 but the content and depth is equivalent.

Main Exit outcomes

The benchmarked qualifications and the proposed qualification have similar competencies such as communicate effectively, conduct research, develop entrepreneurial opportunities, use computer aided draft systems to produce basic engineering drawing, produce detailed engineering drawings, install and commission HVAC systems and others

Modules

The proposed and the benchmarked qualification share some similar modules as shown on the table below:

Proposed Qualification(DTT&TE)	**Intec College**	**TAFE Queensland**
Communication Skills	Communication Skills	Thermodynamics
Engineering Mathematics	Engineering mathematics	Communication Skills
Installation of Refrigeration and Air Conditioning Systems	Management	Computer Aided Design
Computer aided Design	Air Conditioning and Refrigeration	HVAC Systems
Thermodynamics		Installation, Commissioning, Operation, Testing and Maintenance
Work Placement		Electrical and Electronics
Engineering Management Skills		Food Preservation
		Project Works
		Engineering Mathematics

Assessment strategies and Weightings

The proposed qualifications do have formative and summative assessments

Qualification rules and minimum Standards for the award of the qualification

The proposed qualification and the benchmarked have stated that the candidate has to certify all the set minimum standards (such as all the modules should be passed) of the qualification in order to be awarded a diploma.

Comparability and Articulation

The proposed qualification allows both horizontal and vertical articulation. The candidates of the proposed qualification can transfer to institutions offering the same qualification at NQF level 6 or choose a qualification that is in the Refrigeration and Air Conditioning discipline at the same Level(NQF level 6) For vertical articulation, candidates can study related NQF (NCQF) Level 7 qualification that is in the Refrigeration and Air Conditioning discipline such as Bachelor's Degree in Refrigeration and Air Conditioning Engineering. The graduates of the proposed qualification can be employed locally and internationally in areas such as manufacturing plants, research labs, medical facilities, government offices, shopping centres, tourism industry, mining and others. The learner or graduate can be employed as Project Mangers, Technical Estimators, Service dispatcher, HVAC Technician, HVAC Installation Technician ,HVAC Sales Representative, HVAC Service Technician, HVAC Maintenance Technician, Chiller Technician
REVIEW PERIOD
The qualification will be reviewed every five (5) years or as and when required depending on the changing needs of the market**.**

(Note: Please use Arial 11 font for completing the template)

For Official Use Only:

CODE (ID)			
REGISTRATION STATUS	**BQA DECISION NO.**	**REGISTRATION START DATE**	**REGISTRATION END DATE**
LAST DATE FOR ENROLMENT		**LAST DATE FOR ACHIEVEMENT**	
REVISION DATE:		**NAME OF PROFESSIONAL BODIES/REGULATORY**	