



**NATIONAL COMPETENCY STANDARDS
FOR
HVAC TECHNOLOGIST
(DIPLOMA)**

**TVET QUALITY COUNCIL
BHUTAN QUALIFICATIONS AND PROFESSIONALS
CERTIFICATION AUTHORITY
THIMPHU, BHUTAN
JULY 2024**

FOREWORD

The TVET Quality Council, BQPCA is pleased to present the National Competency Standards (NCS) for **HVAC Technologist, Diploma**. The main objective of developing National Competency Standards is to set up a well-defined nationally recognized TVET Qualifications that will help in setting a benchmark for the TVET Qualifications in our country aligned to the international best practices.

The standards are developed to ensure that the TVET trainees possess the desired Skills, Knowledge and Attitude required by the industries. In order to ensure the relevancy of the competencies, the standards are developed in close consultation with industry experts and trainers from training institutes.

A training system based on National Competency Standards shall ensure that the training is relevant to the needs of the industries. As a result, future TVET trainees will be better skilled to meet the needs and expectations of industries and employers. Such a positive impact on the employability of TVET graduates will enhance the reputation of the TVET system and make it attractive to the youths.

While acknowledging the existing level of cooperation and collaboration, the Council earnestly requests employers and training providers to extend the fullest support and cooperation in development and implementation of the National Competency Standards. The ultimate objective is to build a competent and productive national workforce that will contribute to the socio-economic development of our country.

We gratefully acknowledge the valuable contributions made by experts from industries and trainers during the consultation and validation processes of the NCS development. We further look forward to improved industry engagement and active participation of trainers in the development of a quality-assured demand driven TVET system.

Director
BQPCA

ACKNOWLEDGEMENT

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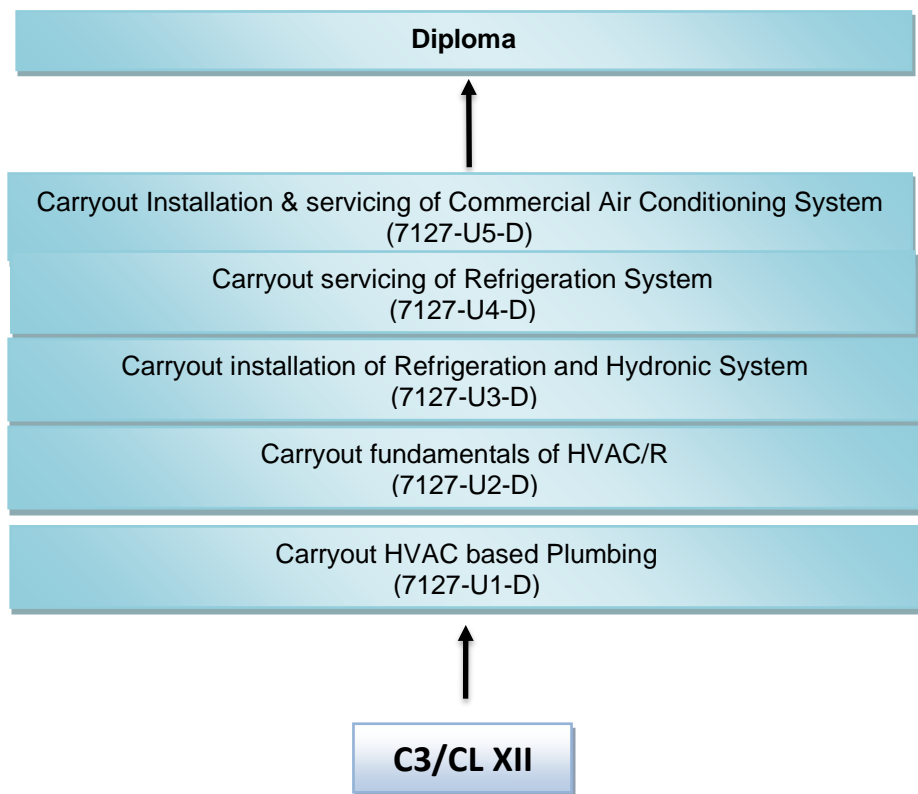
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PACKAGING OF QUALIFICATIONS



Overview of the National Competency Standards

UNIT TITLE	ELEMENTS OF COMPETENCE
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1. Carryout HVAC based Plumbing	<ol style="list-style-type: none"> 1. Prepare for plumbing 2. Perform pipe jointing 3. Install water pump
2. Carryout fundamentals of HVAC/R	<ol style="list-style-type: none"> 1. Apply basic mechanics of thermodynamics 2. Perform testing of electrical/ electronic components 3. Perform metal sheet works 4. Perform copper tubing
3. Carryout installation of refrigeration and hydronic system	<ol style="list-style-type: none"> 1. Prepare for installation of refrigeration system 2. Install refrigeration system 3. Commission refrigeration system 4. Perform installation of hydronic system
4. Carryout servicing of refrigeration system	<ol style="list-style-type: none"> 1. Perform servicing of mechanical components 2. Service electrical components 3. Troubleshoot refrigeration system
5. Carryout Installation and servicing of commercial Air Conditioning system	<ol style="list-style-type: none"> 1. Perform installation of commercial air conditioning system 2. Perform servicing of commercial air conditioning system 3. Troubleshoot commercial air conditioning system

UNIT TITLE	Carryout HVAC based Plumbing
DESCRIPTOR	This unit covers the competencies required to perform pipe jointing and installation of water pump.
CODE	7127-U1-D
ELEMENTS OF COMPETENCE	PERFORMANCE CRITERIA
1. Prepare for plumbing	1.1 Identify waterpipes and fittings following standard procedure 1.2 Identify tools and equipment following standard procedure 1.3 Estimate materials following standard procedure
2. Perform pipe jointing	2.1 Use PPEs as per the job requirements following standard procedure. 2.2 Select and use tools and equipment as per the job requirements following standard procedure 2.3 <i>Prepare pipe</i> for jointing following standard procedure 2.4 Perform threading on GI pipe following standard procedure 2.5 Perform <i>pipe jointing</i> following standard procedure
3. Install water pump	3.1 Interpret drawing following standard procedure 3.2 Fix pumps and its accessories following standard procedure 3.3 Perform testing of water pump following standard procedure

RANGE STATEMENT	
<i>Prepare pipes</i> may include but not limited to:	
<ul style="list-style-type: none"> • Cut • File 	<ul style="list-style-type: none"> • Ream •
<i>Pipe jointing</i> may include but not limited to:	
<ul style="list-style-type: none"> • GI Pipe joint • CPVC Pipe joint • Copper pipe joint 	<ul style="list-style-type: none"> • PPR pipe joint • Pex pipe joint
Critical Aspects:	
<ul style="list-style-type: none"> • Demonstration of occupational health and safety practices at workplace • Perform pipe jointing following standard procedure. 	

UNDERPINNING KNOWLEDGE	UNDERPINNING SKILLS
<ul style="list-style-type: none"> • Ethics and Integrity • OHS regulations • Basic hydraulics • Types of pipe joints • Working principle of water pump 	<ul style="list-style-type: none"> • Team work • Communication • Negotiation • Creativity • Problem solving • Time management

UNIT TITLE	Carryout Fundamentals of HVAC/R
DESCRIPTOR	This unit covers the competencies required to apply basic thermodynamics, perform testing of electrical/electronic components and perform metal sheet works.
CODE :	7127-U2-D
ELEMENTS OF COMPETENCE	PERFORMANCE CRITERIA
4. Apply basic mechanics of thermodynamics	4.1 Measure parameters following standard procedure. 4.2 Measure fluid flow following standard procedure 4.3 Interpret pressure enthalpy following standard procedure
5. Perform testing of electrical/electronic components	5.1 Use PPEs as per the job requirements following standard procedure. 5.2 Select and use tools and equipment as per the job requirements following standard procedure 5.3 Test electrical/electronic components following standard procedure. 5.4 Test transformer following standard procedure 5.5 Test motor following standard procedure
6. Perform metal sheet works	6.1 Use PPEs as per the job requirements following standard procedure. 6.2 Select and use tools and equipment as per the job requirements following standard procedure 6.3 Perform metal sheet works following standard procedure 6.4 Perform gas welding following standard procedure 6.5 Perform arc welding following standard procedure

7. Perform copper tubing works	<p>7.1 Use PPEs as per the job requirements following standard procedure.</p> <p>7.2 Select and use tools and equipment as per the job requirements following standard procedure</p> <p>7.3 Perform copper tubing works following standard procedure</p>
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RANGE STATEMENT	
Parameters may include but not limited to:	
<ul style="list-style-type: none"> • humidity • pressure 	<ul style="list-style-type: none"> • temperature
Electrical/Electronic components may include but not limited to:	
<ul style="list-style-type: none"> • relay • solenoid 	<ul style="list-style-type: none"> • contactors • circuit breaker
Metal sheet works components may include but not limited to:	
<ul style="list-style-type: none"> • Cutting • Filing 	<ul style="list-style-type: none"> • Grinding • Drilling
Copper tubing works components may include but not limited to:	
<ul style="list-style-type: none"> • Cutting • Flaring • Swaging 	<ul style="list-style-type: none"> • Bending • Pinching • Piercing
Critical Aspects:	
<ul style="list-style-type: none"> • Demonstration of occupational health and safety practices at workplace • Test Electrical/Electronic components following standard procedure. 	

UNDERPINNING KNOWLEDGE	UNDERPINNING SKILLS
<ul style="list-style-type: none"> • Ethics and Integrity • OHS regulations • Basic Thermodynamics • Basic electronics and electrical • Working principle of Motor and Transformer • Working principle of Refrigeration and Air Conditioning 	<ul style="list-style-type: none"> • Team work • Communication • Negotiation • Creativity • Problem solving • Time management

UNIT TITLE:	Carryout installation of Refrigeration and Hydronic System
DESCRIPTOR:	This unit covers the competencies required to prepare for installation of refrigeration system, install refrigeration system, commission refrigeration system and installation of hydronic system.
CODE :	7127-U3-D
ELEMENTS OF COMPETENCE	PERFORMANCE CRITERIA
1. Prepare for installation of refrigeration system	1.1 Use PPEs as per the job requirements following standard procedure. 1.2 Select and use tools and equipment as per the job requirements following standard procedure 1.3 Perform site inspection following standard procedure 1.4 Determine cooling load following standard procedure 1.5 Prepare installation layout following standard procedure
2. Install refrigeration system	2.1 Install walk in cooler following standard procedure 2.2 Install walk in freezer following standard procedure 2.3 Install cold storage following standard procedure
3. Commission refrigeration system	3.1 Perform physical inspection following standard procedure 3.2 Measure parameters following standard procedures 3.3 Prepare report following standard procedure

4. Perform installation of hydronic system	4.1 Install heat pump following standard procedure 4.2 Install heat pump controller following standard procedure 4.3 Install heat pump components following standard procedure. 4.4 Commission hydronic system following standard procedure
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RANGE STATEMENT	
PPEs may include but not limited to:	
<ul style="list-style-type: none"> • Safety glasses • Safety gloves • Safety belt 	<ul style="list-style-type: none"> • Safety shoes • Safety Helmet • Work dress
Tools and equipment may include but not limited to:	
<ul style="list-style-type: none"> • HVAC Hand tools • Hand tools set • Lifting machine 	<ul style="list-style-type: none"> • Allen key set • Vacuum pump • Recovery machine
Physical Inspection may include but not limited to:	
<ul style="list-style-type: none"> • Leakages • Drainage 	<ul style="list-style-type: none"> • Wiring connection •
Parameters may include but not limited to:	
<ul style="list-style-type: none"> • Pressure • Humidity 	<ul style="list-style-type: none"> • Temperature • Fluid flow
Heat pump components may include but not limited to:	
<ul style="list-style-type: none"> • Manifold • Pipes • Radiator 	<ul style="list-style-type: none"> • Thermostat • Wiring center
Critical Aspects:	
<ul style="list-style-type: none"> • Demonstration of occupational health and safety practices at workplace • Prepare installation layout following standard procedure 	

- Commission refrigeration and hydronic system following standard procedure

UNDERPINNING KNOWLEDGE	UNDERPINNING SKILLS
<ul style="list-style-type: none"> • Ethics and Integrity • OHS regulations • Working principle of Refrigeration and Air Conditioning • Working principle of Hydronic system • Basic design and drawing • Estimation and costing • Basic management and supervision • Procurement rules 	<ul style="list-style-type: none"> • Team work • Communication • Negotiation • Creativity • Problem solving • Time management

UNIT TITLE	Carryout Servicing of Refrigeration System
DESCRIPTOR	This unit covers the competencies required to perform servicing of mechanical components, service electrical components and troubleshoot refrigeration system
CODE :	7127-U4-D
ELEMENTS OF COMPETENCE	PERFORMANCE CRITERIA
1. Perform servicing of mechanical components	1.1 Use PPEs as per the job requirements following standard procedure. 1.2 Select and use tools and equipment as per the job requirements following standard procedure 1.3 Perform recovery/pump down following standard procedure 1.4 Service outdoor and indoor units following standard procedure 1.5 Perform leak test, evacuation and charge refrigerant following standard procedure 1.6 Inspect insulation of rooms following standard procedure
2. Service electrical components	2.1 Inspect electrical circuits following standard procedure 2.2 Replace thermostat following standard procedure 2.3 Service electrical components following standard procedure
3. Troubleshoot refrigeration system	3.1 Prepare for trouble shooting following standard procedure 3.2 Troubleshoot electrical faults following standard procedure

	3.3 Troubleshoot mechanical faults following standard procedure
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RANGE STATEMENT	
PPEs may include but not limited to:	
<ul style="list-style-type: none"> • Safety glasses • Safety gloves • Safety belt 	<ul style="list-style-type: none"> • Safety shoes • Safety Helmet • Work dress
Tools and equipment may include but not limited to:	
<ul style="list-style-type: none"> • HVAC Hand tools • Hand tools set • Lifting machine 	<ul style="list-style-type: none"> • Allen key set • Vacuum pump • Recovery machine
Electrical components may include but not limited to:	
<ul style="list-style-type: none"> • fan motor, • overload protectors • contactors 	<ul style="list-style-type: none"> • Service LP/HP/Oil pressure control switch • Defrost timer • PCB
Electrical faults may include but not limited to:	
<ul style="list-style-type: none"> • Continuity • Short circuit 	<ul style="list-style-type: none"> • Overload • Insulation
Mechanical faults may include but not limited to:	
<ul style="list-style-type: none"> • Leakage • Wear and tear • Blockage 	<ul style="list-style-type: none"> • Cavitation • Vibration • Mis-alignment • Pressure drop
Critical Aspects:	

- Demonstration of occupational health and safety practices at workplace
- Troubleshoot faults following standard procedure
- Service electrical and mechanical components following standard procedure

UNDERPINNING KNOWLEDGE	UNDERPINNING SKILLS
<ul style="list-style-type: none"> • Ethics and Integrity • OHS regulations • Working principle of Refrigeration and Air Conditioning • Basic design and drawing • Estimation and costing • Procurement rules 	<ul style="list-style-type: none"> • Team work • Communication • Negotiation • Creativity • Problem solving • Time management

UNIT TITLE	Carryout Installation and Servicing of Commercial Air Conditioning System
DESCRIPTOR	This unit covers the competencies required to install, service and troubleshoot air conditioning system.
CODE	7127-U5-D
ELEMENTS OF COMPETENCE	PERFORMANCE CRITERIA
1. Perform installation of commercial air conditioning system	1.1 Use PPEs as per the job requirements following standard procedure. 1.2 Select and use tools and equipment as per the job requirements following standard procedure 1.3 Install air conditioning units following standard procedure 1.4 Install boiler following standard procedure
2. Service air conditioning system	2.1 Service air conditioning unit following standard procedure 2.2 Service boiler following standard procedure
3. Troubleshoot air conditioning system	3.1 Prepare for trouble shooting 3.2 Troubleshoot electrical faults 3.3 Troubleshoot mechanical faults

RANGE STATEMENT	
PPEs may include but not limited to:	
<ul style="list-style-type: none"> • Safety glasses • Safety gloves • Safety belt 	<ul style="list-style-type: none"> • Safety shoes • Safety Helmet • Work dress

Tools and equipment may include but not limited to:	
<ul style="list-style-type: none"> • HVAC Hand tools • Hand tools set • Lifting machine 	<ul style="list-style-type: none"> • Allen key set • Vacuum pump • Recovery machine
Air Conditioning Units may include but not limited to:	
<ul style="list-style-type: none"> • Treated Fresh Air Unit (TFA) • Fan Coil Unit 	<ul style="list-style-type: none"> • Air Handling Unit (AHU) • Duct
Critical Aspects:	
<ul style="list-style-type: none"> • Demonstration of occupational health and safety practices at workplace • Installation of Air Conditioning Units following standard procedure • Troubleshoot air conditioning system following standard procedure 	

UNDERPINNING KNOWLEDGE	UNDERPINNING SKILLS
<ul style="list-style-type: none"> • Ethics and Integrity • OHS regulations • Working principle of Refrigeration and Air Conditioning • Basic design and drawing • Estimation and costing • Basic management and supervision • Procurement rules 	<ul style="list-style-type: none"> • Team work • Communication • Negotiation • Creativity • Problem solving • Time management

ANNEXURE

1. National Competency Standards (NCS)

The National Competency Standards specify the skill, knowledge and attitudes applied to a particular occupation. Standards also specify the standards or criteria of performance of a competent worker and the various contexts in which work may take place. Standards provide explicit advice to assessors regarding the skill and knowledge to be demonstrated by candidates seeking formal recognition either following training or through work experience.

2. Purpose of National Competency Standards

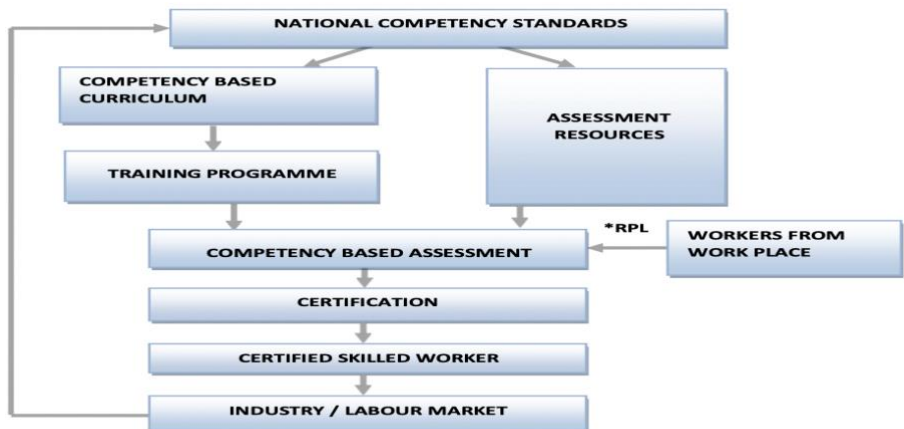
National Competency Standards serve a number of purposes including:

- Providing advice to curriculum developers about the competencies to be included in the curriculum.
- Providing specifications to assessment resource developers about the competencies within an occupation to be demonstrated by candidates.
- Providing advice to industry/employers about job functions, which in turn can be used for the development of job descriptions, performance appraisal systems and work flow analysis.

Bhutan Qualifications Framework (BQF)

Bhutan Qualifications Framework is an integrated national framework that outlines all types of qualification in Bhutan. As an established and nationally accepted instrument, the BQF has been benchmarked against international practices in terms of standards. The BQF aims to recognize all forms of learning systems, including formal, non-formal, and informal learning. It acknowledges technological advancements and recognizes contemporary modes of delivery. It covers a broad range of education systems including the TVET education.

3. Implementation of TVET Qualifications



* RPL = Recognition of Prior Learning

4. TVET Qualifications Levels

TVET Qualifications has seven levels as per the BQF. The levels are:

Bhutan Qualifications Framework 2023

Table 2: Qualification Types and Levels Based on Education Sector.

BQF Level	Community Education	School Education	TVET	Higher Education	Monastic Education
8				Doctoral Degree	<i>Khewang</i> མཁས་དབང་།
7			Master's Degree Postgraduate Diploma Postgraduate Certificate	Master's Degree Postgraduate Diploma Postgraduate Certificate	<i>Tsugla Gongma</i> གཞུག་ལག་ཤོད་མ།
6			Applied Degree	Bachelor's Degree Bachelor's Degree (Honours) Graduate Diploma Graduate Certificate	<i>Tsugla Wogma</i> གཞུག་ལག་འོག་མ།
5			Advanced Diploma	Advanced Diploma	
4			Diploma	Diploma	
3		Bhutan Higher Secondary Education Certificate	Certificate 3		<i>Dringrim Gongma</i> འབྲིང་རིམ་གོད་མ།
2		Bhutan Certificate for Secondary Education	Certificate 2		<i>Dringrim Barma</i> འབྲིང་རིམ་བར་མ།
1	ALC		Certificate 1		

5. Level Descriptors

The TVET Qualification levels are set based on the level descriptors, as defined in the BQF. The detail of the qualification level descriptor is as follow:

Level	Knowledge <i>Knowledge that is:</i>	Skills <i>Demonstrate skills that involve:</i>	Values <i>Demonstrate values that involve:</i>	Application <i>Applied in contexts that involve:</i>
4	Broad theoretical, technical and operational	<p>Selecting and applying a range of standard processes relevant to varied and sometimes unpredictable tasks</p> <p>Selecting and applying a range of solutions involving formulation of solutions to resolve complex issues</p> <p>Demonstrating a high level of proficiency in English and Dzongkha</p>	<p>Strong level of awareness of self and others; and an appreciation of belief system, role of social norms, and the importance of relationship building</p> <p>Application of ethical norms and legal rules in decision-making; and comprehending the correlation between values and behaviour</p> <p>Commitment to own profession and quality of work</p>	<p>Stable tasks with predictable changes</p> <p>Broad guidance with some self-direction that requires sound judgement</p> <p>Taking some responsibility for planning and coordination with others</p>
3	Theoretical with some technical and operational processes	Applying a range of standard processes to	Sound level of self-awareness and beliefs; and ability to apply	<p>Stable tasks with some aspects of change</p> <p>General guidance and supervision</p>

		<p>known but varied tasks</p> <p>Selecting and applying a range of solutions to familiar and unfamiliar problems</p> <p>Communicating effectively and clearly, both oral and written, in both English and Dzongkha</p>	<p>social norms and build relationships</p> <p>Application of a set of ethical norms</p> <p>Commitment to own field of interest and apply self- management of learning and performance</p>	<p>that require discretion and judgement</p> <p>Adapting to own behaviour to work with others</p>
2	Basic, factual and conceptual	<p>Applying standard processes relevant to carry out known tasks</p> <p>Applying a set of known solutions to solve simple and straightforward issues</p> <p>Using simple and direct exchange of information on familiar and routine matters</p> <p>Developing basic proficiency in</p>	<p>Some level of self-awareness and beliefs, and appreciation of social norms; and significance of relationships</p> <p>Awareness of ethical norms, and openness to different activities</p> <p>Developing own knowledge and skills</p>	<p>Structured and stable tasks</p> <p>General support and Supervision that require some discretion and judgement</p> <p>Collaboration with others to achieve goals</p>

		Dzongkha and English		
1	Foundational , every day and general	<p>Applying operational literacy, numeracy skills required to carry out simple tasks</p> <p>Applying simple solutions to solve simple and straightforward everyday issues</p> <p>Communicating using everyday expressions and simple phrases in Dzongkha and English</p>	<p>Basic awareness of self, beliefs, and social norms; and understand the significance of relationships</p> <p>Basic awareness of fundamental ethical norms, basic civil rights, and responsibilities</p> <p>Willingness to understand tasks and motivated to implement them successfully</p>	<p>Highly structured tasks with close support and supervision</p> <p>Minimal Discretion and judgement</p> <p>Readiness to work together and share knowledge with others</p>

6. CODING USED FOR NATIONAL COMPETENCY STANDARDS

The coding and classification system developed in Bhutan is logical, easy to use, and also aligned with international best practices. The Bhutanese coding and classification system is based on the International Standard Classification of Occupations, 2008 (ISCO-08) developed by the International Labour Organization (ILO).

The coding of the National competency standards forms the basis of the identification code for the Vocational Education and Training Management Information System (VET – MIS) both in terms of economic sector identification and that of the individual standard.

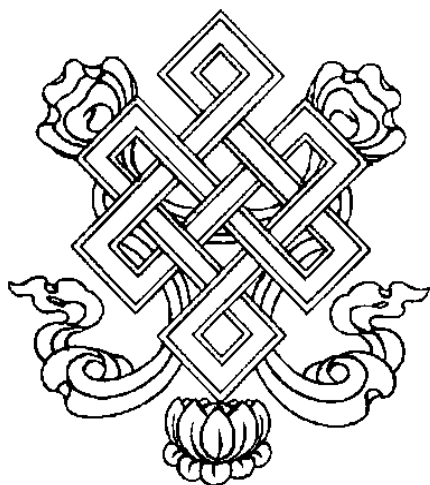
7. Coding the individual national competency standards

Coding the individual skills standard has a multiple purpose:

- to identify the occupational code
- to identify the units
- to identify the qualification level

A job can include a number of competencies described in the national competency standards.

However, in order to follow a logical order, only national competency standards related to each other and following a logical sequence in terms of training delivery, from the simple to the complex, are clustered into a qualification level. Some standards are so complex that they need to stand alone.



TVET Quality Council
Bhutan Qualifications and Professional Certification Authority
Thimphu, Bhutan