



**NATIONAL COMPETENCY STANDARDS
FOR
COMMERCIAL HVAC TECHNICIAN
(NC3)**

**Department of Occupational Standards
Ministry of Labour and Human Resources
Thimphu, Bhutan.
(March 2021)**



**NATIONAL COMPETENCY STANDARDS
FOR
COMMERCIAL HVAC TECHNICIAN
(NC3)**

**Department of Occupational Standards
Ministry of Labour and Human Resources
Thimphu, Bhutan.
(March 2021)**

First Publication 2021

© Department of Occupational Standards (DOS)

FOREWORD

The Department of Occupational Standards of the Ministry of Labour and Human Resources is pleased to present the National Competency Standards (NCSs) for Commercial HVAC Technician. The standards represent the fruits of hard work and invaluable experiences gained by the department since its establishment in the latter half of 2003. The main aim of developing NCS is to set up a well-defined nationally recognized Vocational Qualification System that will help set a benchmark for the Technical Vocational Education and Training (TVET) System in our country aligned to international best practices.

NCS is one of the base pillars in the Bhutan Vocational Qualification Framework (BVQF) and is the first step in its implementation. The NCS are developed and revised to ensure that employees or vocational graduates possess and acquire the desired competencies required by industries and employers. In order to ensure this close match in supply and demand of competencies, NCS have been developed and revised in close consultation and partnership with industry experts and validated by the Technical Advisory Committees of the concerned economic sectors.

A vocational education and training system based on NCS shall ensure that delivered training is of a high quality and relevant to the needs of the labour market. As a result, future TVET graduates will be better equipped to meet the need and expectations of industries and employers. This positive impact on the employability of TVET graduates will enhance the reputation of vocational education and training and make it attractive to school leavers.

I gratefully acknowledge collaboration and the valuable contributions made by experts from industries during the consultation and validation processes of the standards. I look forward for continued engagement and participation of the industry and employers in the development of a quality assured demand driven TVET system and to build competent and productive national workforce that will contribute to the continued socio-economic progress of our country.

Director
Department of Occupational Standards
Ministry of Labour and Human Resources

ACKNOWLEDGEMENT

Validation date : 13/03/2021

Date of Review : 13/03/2023 (Max. 3 years).

Technical Advisory Committee (TAC) members for the Manufacturing Sector involved in the validation of the NCS:

1. Tara Bir Tiwari (**Chairperson**) Dolma Enterprise, Thimphu
2. Karma Loday (**Member Secretary**), Specialist, Standards and Qualification Division, Department of Occupational Standards, MoLHR, Thimphu.
3. D S Tamang, Dy. Manager, Druk Wang Alloys Limited, Pasakha.
4. B B Rai, Sr. Manager, Bhutan Fruit Product Private Limited, Samtse.
5. Kinzang Namgyel, Dy. Chief Engineer, Penden Cement Authority Limited, Gomtu.
6. Chorten Dorji, Manager, Bhutan Ferro Alloys Limited, Pasakha.
7. Subash Gurung, Executive Engineer, Bhutan Carbide & Chemicals Limited, Pasakha.
8. G S Rai, Manager, Bhutan Board Product Limited, Tala.
9. Karma Dorji, Programme Officer, Training and Professional Services Division, Department of Human Resources, MoLHR, Thimphu

Subject experts (RAC Technicians) involved during the consultation workshop:

First group of experts:

1. Bhuktiman Rai, Bhutan Brewery Private Limited, Pasakha.
2. Keshab Phuyel, Bhutan Carbide & Chemicals Limited, Pasakha
3. Palden Lama, Dolma Enterprise, Phuntsholing
4. Sapan Pee, Dolma Enterprise, Phuntsholing

5. Arun Kumar, Dolma Enterprise, Phuntsholing
6. Pushpalal, Bhutan Fruit Product Limited, Samtse.
7. Purna Bdr. Tamang, Food Corporation of Bhutan, Phuntsholing
8. Pema Tshering, Food Corporation of Bhutan, Phuntsholing
9. Kinley Gyeltshen, TPSD, DHR, MoLHR, Thimphu.

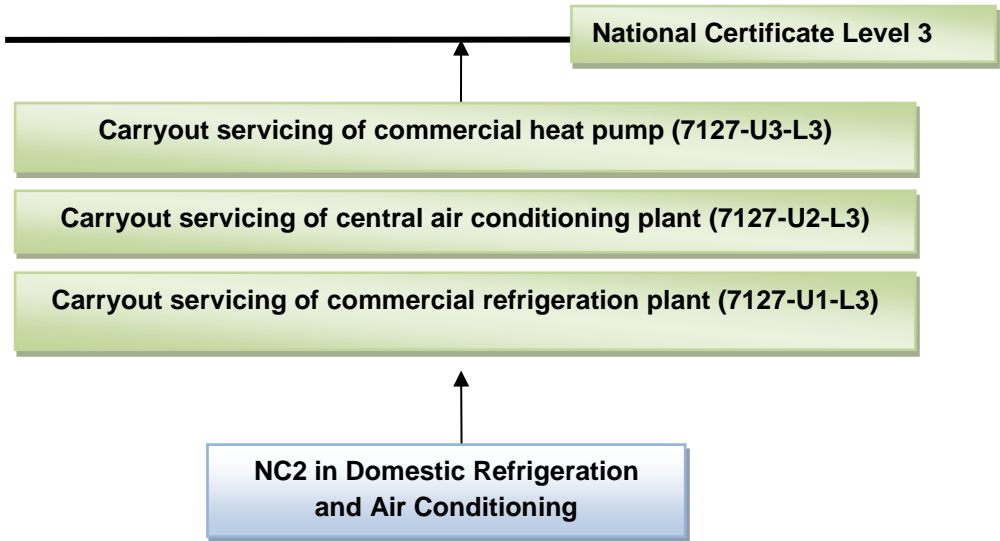
Second Group of Experts:

1. Kado, Dolma Enterprise, Thimphu
2. Sonam Wangmo, Principal, TTI-Thimphu
3. Sonam Choden, Trainer, TTI-Thimphu
4. Kumar Golay, Eden Refrigeration and Electronics, Thimphu
5. Nima Gyeltshen, Trainer, TTI-Samthang, Wangdue
6. Chimi Tshewang, Trainer, TTI-Thimphu
7. Gopal Pradhan, G.P Electronic, Thimphu

Facilitators:

1. Karma Loday, Specialist, SQD, DOS, MoLHR
2. Chogay Lhendup, Sr. Program Officer, SQD, DOS, MoLHR

PACKAGING OF QUALIFICATIONS



Overview of National Competency Standards

UNIT TITLE	ELEMENTS OF COMPETENCE
1. Carryout servicing of commercial refrigeration plant	<ol style="list-style-type: none">1. Prepare for servicing of commercial refrigeration plant2. Perform servicing of commercial refrigeration plant3. Conduct test
2. Carryout servicing of central air conditioning plant	<ol style="list-style-type: none">1. Prepare for servicing of central air conditioning plant2. Perform service of central air condition plant3. Conduct test
3. Carryout servicing of commercial heat pump	<ol style="list-style-type: none">1. Prepare for servicing of commercial heat pump2. Perform servicing of commercial heat pump3. Conduct test

UNIT TITLE : **Carryout servicing of commercial refrigeration plant**

DESCRIPTOR : This unit covers the competencies required to identify the faults in commercial refrigeration plant and service following all safety procedures at all times

CODE : **7127-U1-L3**

ELEMENTS OF COMPETENCE	PERFORMANCE CRITERIA
1. Prepare for servicing of commercial refrigeration plant	1.1 Select and use tools and equipment as per the job requirements. 1.2 Select and use materials as per the job requirements. 1.3 Select and use personal protective equipment (PPE) as per the job requirements.
2. Perform servicing of commercial refrigeration plant	2.1 Troubleshoot the faults following standards procedures. 2.2 Estimate the cost of service following standard procedures. 2.3 Repair the faulty electrical and mechanical components of refrigeration plant as per the job requirements following standard procedures. 2.4 Replace the electrical components as per the job requirements following standard procedures. 2.5 Replace the mechanical components as per the job requirements following standard procedures.

	2.6	Charge the refrigerant following standard procedures in accordance with relevant rules and regulations
3. Conduct test	3.1	Test the refrigeration plant for proper functioning following standard procedures.
	3.2	Maintain records / documents as per the job requirements.
	3.3	Store materials and clean the workplace following standard procedures.

RANGE STATEMENT

Personal protective equipment (PPE) may include but not limited to:

- Mask
- Gloves
- Goggles
- Safety shoes
- Working dress

Materials may include but not limited to:

- Wires
- Refrigerant
- Tubes

Tools and equipment may include but not limited to:

- Screw driver set
- Multi meter
- Pliers
- Vacuum pump
- Pressure gauge
- Allen key set

Faults may include but not limited to:

- Electrical
- Mechanical

Electrical components may include but not limited to:

- Thermostat/temperature controller
- Fuse
- Relay
- Over load protector
- Sensors
- Solenoid valve
- Capacitors
- Timers
- Panel board
- Motors
- Connections
- Pressure switch(HP/LP)
- Defrost system components

Mechanical components may include but not limited to:

- Evaporator
- Condenser
- Blower
- Belts

<ul style="list-style-type: none"> • Compressor • Filter dryer • Tubes 	<ul style="list-style-type: none"> • Oil separator • Receiver tank • Cooling system
Test may include but not limited to:	
<ul style="list-style-type: none"> • Cooling • Leakage 	<ul style="list-style-type: none"> • Humidity
Records / documents may include but not limited to:	
<ul style="list-style-type: none"> • Maintenance / service record • Job card 	<ul style="list-style-type: none"> • Bills
Critical Aspects:	
<ul style="list-style-type: none"> • Demonstrating compliance with safety regulation applicable to work site operation. • Troubleshooting and rectifying the faults following standards procedures • Charging the refrigerant following standard procedures in accordance with relevant rules and regulations 	

UNDERPINNING KNOWLEDGE	UNDERPINNING SKILLS
<ul style="list-style-type: none"> • Ethics and Integrity • Occupational Health and Safety (OHS) Regulations • Working principles of commercial refrigeration plant • Types of refrigeration plant • Basic First Aid • Types of refrigerants • Environment hazards • Waste prevention and management 	<ul style="list-style-type: none"> • Team Work • Communication • Interpersonal relationship • Problem solving • Time management

UNIT TITLE **Carryout servicing of central air conditioning**

:

DESCRIPTOR : This unit covers the competencies required to service central air conditioning following safety procedures at all times.

CODE : **7127-U2-L3**

ELEMENTS OF COMPETENCE	PERFORMANCE CRITERIA
1. Prepare for servicing of central air conditioning plant	1.1 Select and use tools and equipment as per the job requirements. 1.2 Select and use materials as per the job requirements. 1.3 Select and use personal protective equipment (PPE) as per the job requirements.
2. Perform servicing of central air conditioning plant	2.1 Troubleshoot the faults following standards procedures. 2.2 Estimate cost for the service in accordance with standard procedures. 2.3 Adjust the set points as per the job requirement following standard procedures. 2.4 Repair faulty components as per the job requirements following standard procedures. 2.5 Replace faulty mechanical components following standard procedures as per the job requirements. 2.6 Replace faulty electrical components following standard procedures. 2.7 Charge the refrigerant following standard procedures in accordance with relevant rules and regulations.
3. Conduct test	3.1 Test the plant following standard procedures.

	3.2	Document the required documents as per the job requirements.
	3.3	Store materials and clean the workplace following standard procedures.

RANGE STATEMENT	
Tools and equipment may include but not limited to:	
<ul style="list-style-type: none"> • Screw driver set • Multi meter • Pliers • Allen key set • Vacuum pump 	<ul style="list-style-type: none"> • Pressure gauge • Recovery machine
Materials may include but not limited to:	
<ul style="list-style-type: none"> • Wires • Refrigerant • Wire mesh 	<ul style="list-style-type: none"> • Tubes • Glass wool (insulation)
Personal protective equipment (PPE) may include but not limited to:	
<ul style="list-style-type: none"> • Goggles • Mask safety shoes 	<ul style="list-style-type: none"> • Gloves • Workshop dress
Faults may include but not limited to:	
<ul style="list-style-type: none"> • Electrical 	<ul style="list-style-type: none"> • Mechanical
Electrical components may include but not limited to:	
<ul style="list-style-type: none"> • Contactor assembly • Over load protector • Motors • Capacitors • Thermostat 	<ul style="list-style-type: none"> • Relays • Solenoids • Heater • Electrical circuit • Oil pressure cut / switch
Mechanical components may include but not limited to:	
<ul style="list-style-type: none"> • Compressor • Evaporator • Condenser • Filter drier • Valves • V-belts • AC duct 	<ul style="list-style-type: none"> • Oil separator • Water pump • Cooling tower • Air handling unit • Filters • Moisture separator
Test may include but not limited to:	
<ul style="list-style-type: none"> • Cooling 	<ul style="list-style-type: none"> • Leakage
Records / documents may include but not limited to:	

- Maintenance / service record
- Job cards
- Bills

Critical Aspects:

- Demonstrating compliance with safety regulation applicable to work site operation.
- Troubleshooting and rectifying the faults following standards procedures
- Charge the refrigerant following standard procedures in accordance with relevant rules and regulations

UNDERPINNING KNOWLEDGE	UNDERPINNING SKILLS
<ul style="list-style-type: none"> • Ethics and Integrity • Working principles of central AC plant • Occupational Health and Safety (OHS) Regulations • Basic First Aid • Troubleshooting procedures • Basic electrical controls and connections • Estimation and costing • Installation procedures • Environment hazards • Waste prevention and management 	<ul style="list-style-type: none"> • Team Work • Communication • Interpersonal relationship • Problem solving • Time management

UNIT TITLE : Carryout servicing of commercial heat pump

DESCRIPTOR: This unit covers the competencies required to service commercial heat pump following safety procedures at all times.

CODE : 7127-U3-L3

ELEMENTS OF COMPETENCE	PERFORMANCE CRITERIA
1. Prepare for servicing of commercial heat pump	1.1 Select and use tools and equipment as per the job requirements. 1.2 Select and use materials as per the job requirements. 1.3 Select and use Personal protective equipment (PPE) as per the job requirements.
2. Perform servicing of commercial heat pump	2.1 Troubleshoot the faults following standards procedures. 2.2 Estimate the cost of service following standard procedures. 2.3 Repair the faulty electrical and mechanical components as per the job requirements following standard procedures. 2.4 Replace the electrical components as per the job requirements following standard procedures. 2.5 Replace the mechanical components as per the job requirements following standard procedures. 2.6 Charge the refrigerant following standard procedures in accordance with relevant rules and regulations.
3. Conduct test	3.1 Test the heat pump following standard procedures. 3.2 Document the required documents as per the job requirements.

	3.3 Store materials and clean the workplace following standard procedures.
--	--

RANGE STATEMENT	
Tools and equipment may include but not limited to:	
<ul style="list-style-type: none"> • Screw driver set • Multi meter • Pliers • Allen key set • Vacuum pump 	<ul style="list-style-type: none"> • Pressure gauge • Tube bender
Materials may include but not limited to:	
<ul style="list-style-type: none"> • Wires 	<ul style="list-style-type: none"> • Tubes
Personal protective equipment (PPE) may include but not limited to:	
<ul style="list-style-type: none"> • Helmet • Goggles • Mask • Ear muff 	<ul style="list-style-type: none"> • Safety shoes • Gloves • Workshop dress
Faults may include but not limited to:	
<ul style="list-style-type: none"> • Electrical 	<ul style="list-style-type: none"> • Mechanical
Electrical components may include but not limited to:	
<ul style="list-style-type: none"> • Contactor assembly, • Over load protector • Motors • Capacitors • Thermostat 	<ul style="list-style-type: none"> • Relays • Solenoids • Heater • Electrical circuit • Fuses
Mechanical components may include but not limited to:	
<ul style="list-style-type: none"> • Compressor • Evaporator • Condenser • Filter dryer • Valves • Blower fan 	<ul style="list-style-type: none"> • Water pump • Cooling tower • Filters • V-belts • Duct • Grill
Test may include but not limited to:	
<ul style="list-style-type: none"> • Cooling • Leakage 	<ul style="list-style-type: none"> • Flow
Records / document may include but not limited to:	
<ul style="list-style-type: none"> • Service / maintenance record • Job card 	<ul style="list-style-type: none"> • Bills

Critical Aspects:

- Demonstrating compliance with safety regulation applicable to work site operation.
- Troubleshooting and rectifying the faults following standards procedures
- Charging the refrigerant following standard procedures in accordance with relevant rules and regulations

UNDERPINNING KNOWLEDGE	UNDERPINNING SKILLS
<ul style="list-style-type: none">• Ethics and Integrity• Working principle of commercial heat pump• Occupational Health and Safety (OHS) Regulations• Basic knowledge of electronic components• Basic First Aid• Troubleshooting procedures• Basic Installation procedures• Environment rules and regulations• Environment hazards• Waste prevention and management	<ul style="list-style-type: none">• Team Work• Communication• Interpersonal relationship• Problem solving• Time management

ANNEXURE

A. 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.

Purpose of National Competency Standards

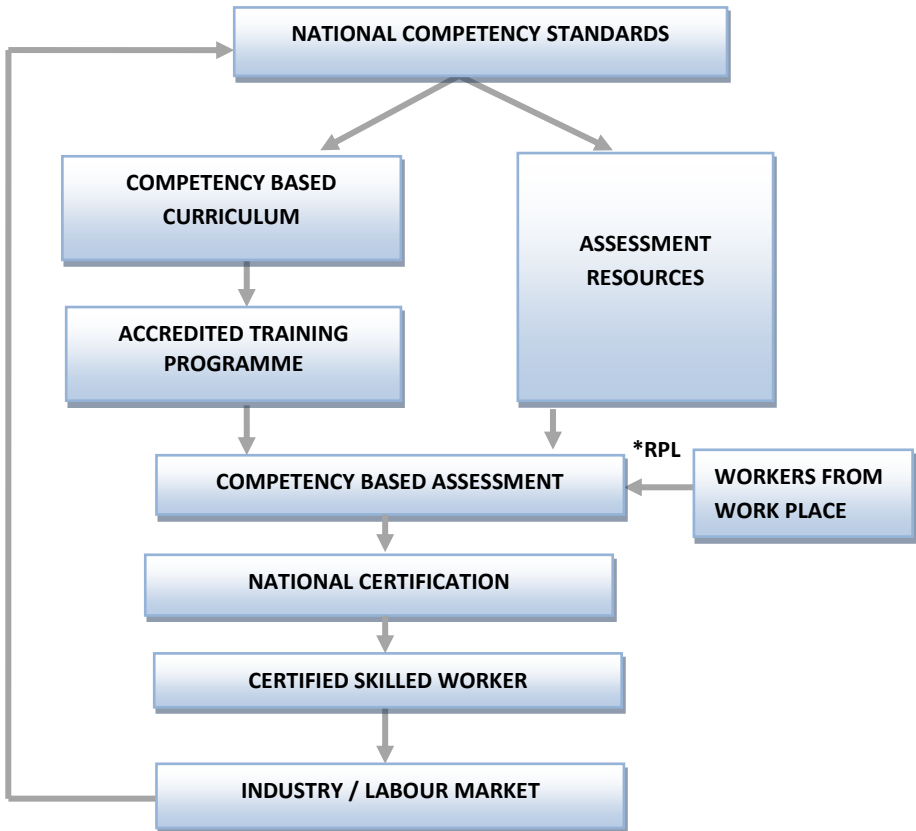
National Competency Standards serve a number of purposes including:

- Providing advice to curriculum developers about the competencies to be included in 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.

B. Bhutan Vocational Qualifications Framework (BVQF)

Bhutan Vocational Qualifications Framework is an agreed system of Assessing, Certifying and Monitoring nationally recognized qualifications for all learning in the TVET sector against national competency standards, in training institutions, in the workplace, in schools or anywhere where learning takes place.

Components of the Bhutan Vocational Qualifications Framework (BVQF)



* RPL = Recognition of Prior Learning

BVQF Levels

The Bhutan Vocational Qualifications Framework has three levels classified based on the competency of the skilled workers. The three levels are:

- National Certificate Level 3 (NC III)
- National Certificate Level 2 (NC II)
- National Certificate Level 1 (NC I)

BVQF Level Descriptors

The qualification levels are decided based on level descriptors. The detail of the qualification level descriptor is as follows:

National Certificate Level 1

Carry out processes that:	Learning demand:	Responsibilities which are applied:
<ul style="list-style-type: none">• Are narrow in range.• Are established and familiar.• Offer a clear choice of routine responses.• Involve some prioritizing of tasks from known solutions.	<ul style="list-style-type: none">• Basic operational knowledge and skill.• Utilization of basic available information.• Known solutions to familiar problems.• Little generation of new ideas.	<ul style="list-style-type: none">• In directed activity.• Under general supervision and quality control.• With some responsibility for quantity and quality.• With no responsibility for guiding others.

National Certificate Level 2

Carry out processes that:	Learning demand:	Responsibilities which are applied:
<ul style="list-style-type: none"> • Require a range of well-developed skills. • Offer a significant choice of procedures requiring prioritization. • Are employed within a range of familiar context. 	<ul style="list-style-type: none"> • Some relevant theoretical knowledge. • Interpretation of available information. • Discretion and judgments. • A range of known responses to familiar problems 	<ul style="list-style-type: none"> • In directed activity with some autonomy. • Under general supervision and quality checking. • With significant responsibility for the quantity and quality of output. • With some possible responsibility for the output of others.

National Certificate Level 3

Carry out processes that:	Learning demand:	Responsibilities which are applied:
<ul style="list-style-type: none"> • Requires a wide range of technical or scholastic skills. • Offer a considerable choice of procedures requiring prioritization to achieve optimum outcomes. • Are employed in a variety of familiar and unfamiliar contexts. 	<ul style="list-style-type: none"> • A broad knowledge base which incorporates some theoretical concepts. • Analytical interpretation of information. • Informed judgment. • A range of sometimes innovative responses to concrete but often unfamiliar problems. 	<ul style="list-style-type: none"> • In self-directed activity. • Under broad guidance and evaluation. • With complete responsibility for quantity and quality of output. • With possible responsibility for the output of others.

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 practises. The Bhutanese coding and classification system is based on the International Standard Classification of Occupations, 2008 (ISCO-08) developed by the International Labour Organisation (ILO).

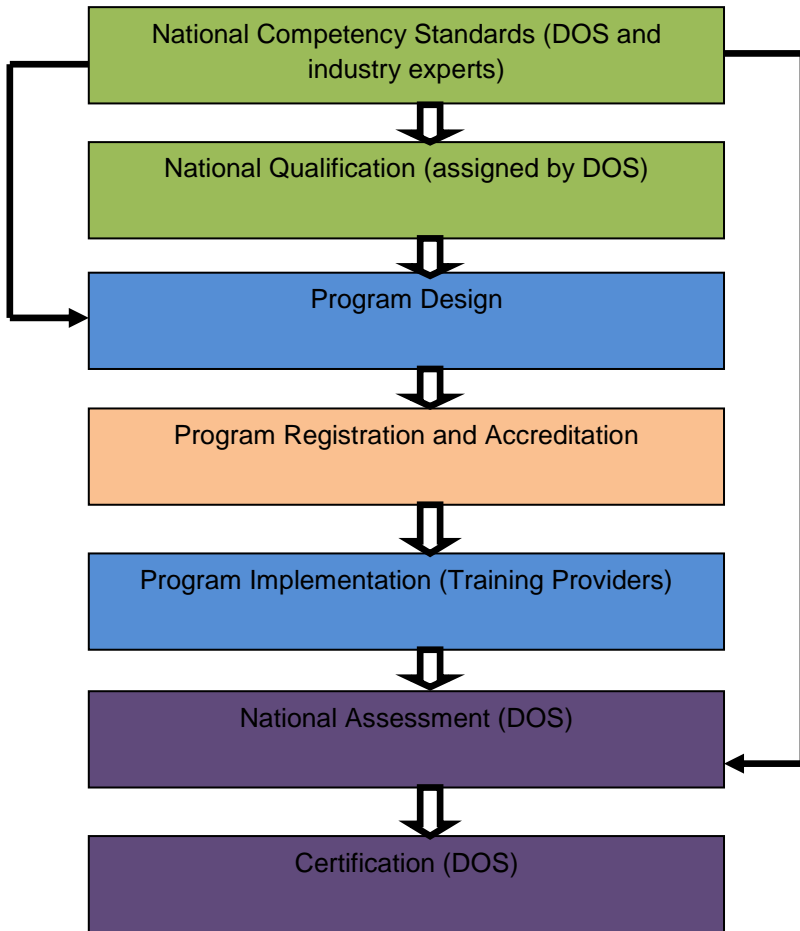
The coding of the national competency standards forms the basis of the identification code for the Vocational Education and Training Management Information System (VET – MIS) both in terms of economic sector identification and that of the individual standard.

Coding the individual units of competency standard is to identify the level in qualification packages to which it belongs.

While packaging, in order to follow a logical order, only 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 packages.

The ILO assigns the code 7127 to the occupation of Air conditioning and refrigeration/HVAC mechanics. Therefore, in the Bhutan context, the occupation Air conditioning and refrigeration technician has been assigned the code 7127 in the National Coding System. The first unit is assigned the code U1, the first Unit of Competency Standard clustered into the first qualification is designated the code 7127-U1. Levels are assigned the code L and follow a logical progression from the National Certificate Level 1 (NC I) to the National Certificate Level 3 (NC 3). Therefore the National Certificate Level 2 is assigned the code L2. The complete unit code will be 7127-U1-L2.

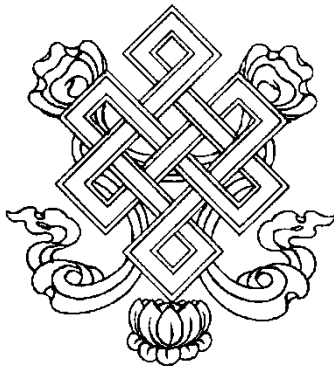
Implementation and Operational Procedures for National Competency Standards



Key:

MoLHR – Ministry of Labour and Human Resources

DOS – Department of Occupational Standards



Department of Occupational Standards
Ministry of Labour & Human Resources
Thongsel Lam, Lower Motithang
P.O. Box 1036, Thimphu.
Tel: 02-331611, Fax: 02-326873
www.molhr.gov.bt