# TRAINING REGULATIONS

## AIR DUCT SERVICING NC II

**HEATING, VENTILATION, AIR CONDITIONING AND REFRIGERATION TECHNOLOGY SECTOR**

**TECHNICAL EDUCATION AND SKILLS DEVELOPMENT AUTHORITY**
**East Service Road, South Superhighway, Taguig City, Metro Manila**

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## TRAINING REG*ULATIONS FOR

## AIR DUCT SERVICING NC II

## SECTION 1 AIR DUCT SERVICING NC II QUALIFICATION

The **AIR DUCT SERVICING NC II** Qualification consists of competencies that a person must achieve to enable him/her to interprets working drawing, fabricates, assembles and installs air ducts using hand and power tools and sheet metal working equipment.

This Qualification is packaged from the competency map of **HVAC/R Sector – Air Duct sERVICING)** as shown in Annex A.

The Units of Competency comprising this Qualification include the following:

| CODE NO. | BASIC COMPETENCIES |
|---|---|
| 500311105 | Participate in workplace communication |
| 500311106 | Work in team environment |
| 500311107 | Practice career professionalism |
| 500311108 | Practice occupational health and safety procedures |

| CODE NO. | COMMON COMPETENCIES |
|---|---|
| HVC713201 | Prepare materials and tools |
| HVC311203 | Perform mensurations and calculations |
| HVC713202 | Perform basic benchwork |
| HVC724201 | Perform basic electrical works |
| HVC311204 | Maintain tools and equipment |
| HVC315201 | Perform housekeeping and safety practices |
| HVC311205 | Document work accomplished |

| CODE NO. | CORE COMPETENCIES |
|---|---|
| HVC723331 | Survey site for installation |
| HVC723332 | Fabricate air ducts |
| HVC723333 | Install air duct system |
| HVC723334 | Perform air duct testing |
| HVC723335 | Insulate air ducts |
| HVC723336 | Repair and maintain air duct system |

A person who has achieved this Qualification is competent to be:

- Tinsmith (HVAC/R Worker)

## SECTION 2 COMPETENCY STANDARDS

This section gives the details of the contents of the basic, common and core units of competency required in **AIR DUCT SERVICING NC II**.

## BASIC COMPETENCIES

**UNIT OF COMPETENCY : PARTICIPATE IN WORKPLACE COMMUNICATION**

**UNIT CODE : 500311105**

**UNIT DESCRIPTOR :** This unit covers the knowledge, skills and attitudes required to gather, interpret and convey information in response to workplace requirements.

| ELEMENT | PERFORMANCE CRITERIA<br>***Italicized bold*** terms are elaborated in the Range of Variables |
|---|---|
| 1. Obtain and convey workplace information | 1.1 Specific and relevant information is accessed from ***appropriate sources***<br>1.2 Effective questioning , active listening and speaking skills are used to gather and convey information<br>1.3 Appropriate ***medium*** is used to transfer information and ideas<br>1.4 Appropriate non- verbal communication is used<br>1.5 Appropriate lines of communication with supervisors and colleagues are identified and followed<br>1.6 Defined workplace procedures for the location and ***storage*** of information are used<br>1.7 Personal interaction is carried out clearly and concisely |
| 2. Participate in workplace meetings and discussions | 2.1 Team meetings are attended on time<br>2.2 Own opinions are clearly expressed and those of others are listened to without interruption<br>2.3 Meeting inputs are consistent with the meeting purpose and established ***protocols***<br>2.4 ***Workplace interactions*** are conducted in a courteous manner<br>2.5 Questions about simple routine workplace procedures and maters concerning working conditions of employment are asked and responded to<br>2.6 Meetings outcomes are interpreted and implemented |

| ELEMENT | PERFORMANCE CRITERIA<br>***Italicized bold*** terms are elaborated in the Range of Variables |
|---|---|
| 3. Complete relevant work related documents | 3.1 Range of ***forms*** relating to conditions of employment are completed accurately and legibly<br>3.2 Workplace data is recorded on standard workplace forms and documents<br>3.3 Basic mathematical processes are used for routine calculations<br>3.4 Errors in recording information on forms/ documents are identified and properly acted upon<br>3.5 Reporting requirements to supervisor are completed according to organizational guidelines |

## RANGE OF VARIABLES

| VARIABLE | RANGE |
|---|---|
| 1. Appropriate sources | 1.1. Team members<br>1.2. Suppliers<br>1.3. Trade personnel<br>1.4. Local government<br>1.5. Industry bodies |
| 2. Medium | 2.1. Memorandum<br>2.2. Circular<br>2.3. Notice<br>2.4. Information discussion<br>2.5. Follow-up or verbal instructions<br>2.6. Face to face communication |
| 3. Storage | 3.1. Manual filing system<br>3.2. Computer-based filing system |
| 4. Forms | 4.1. Personnel forms, telephone message forms, safety reports |
| 5. Workplace interactions | 5.1. Face to face<br>5.2. Telephone<br>5.3. Electronic and two way radio<br>5.4. Written including electronic, memos, instruction and forms, non-verbal including gestures, signals, signs and diagrams |
| 6. Protocols | 6.1. Observing meeting<br>6.2. Compliance with meeting decisions<br>6.3. Obeying meeting instructions |

## EVIDENCE GUIDE

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|---|---|
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:<br>1.1. Prepared written communication following standard format of the organization<br>1.2. Accessed information using communication equipment<br>1.3. Made use of relevant terms as an aid to transfer information effectively<br>1.4. Conveyed information effectively adopting the formal or informal communication |
| 2. Underpinning Knowledge and Attitudes | 2.1. Effective communication<br>2.2. Different modes of communication<br>2.3. Written communication<br>2.4. Organizational policies<br>2.5. Communication procedures and systems<br>2.6. Technology relevant to the enterprise and the individual's work responsibilities |
| 3. Underpinning Skills | 3.1. Follow simple spoken language<br>3.2. Perform routine workplace duties following simple written notices<br>3.3. Participate in workplace meetings and discussions<br>3.4. Complete work related documents<br>3.5. Estimate, calculate and record routine workplace measures<br>3.6. Basic mathematical processes of addition, subtraction, division and multiplication<br>3.7. Ability to relate to people of social range in the workplace<br>3.8. Gather and provide information in response to workplace Requirements |
| 4. Resource Implications | 4.1. Fax machine<br>4.2. Telephone<br>4.3. Writing materials<br>4.4. Internet |
| 5. Methods of Assessment | 5.1. Direct Observation<br>5.2. Oral interview and written test |
| 6. Context for Assessment | 6.1. Competency may be assessed individually in the actual workplace or through accredited institution |

**UNIT OF COMPETENCY: WORK IN TEAM ENVIRONMENT**

**UNIT CODE : 500311106**

**UNIT DESCRIPTOR :** This unit covers the skills, knowledge and attitudes to identify role and responsibility as a member of a team.

| ELEMENT | PERFORMANCE CRITERIA<br>***Italicized bold*** terms are elaborated in the Range of Variables |
|---|---|
| 1. Describe team role and scope | 1.1. The ***role and objective of the team*** is identified from available ***sources of information***<br>1.2. Team parameters, reporting relationships and responsibilities are identified from team discussions and appropriate external sources |
| 2. Identify own role and responsibility within team | 2.1. Individual role and responsibilities within the team environment are identified<br>2.2. Roles and responsibility of other team members are identified and recognized<br>2.3. Reporting relationships within team and external to team are identified |
| 3. Work as a team member | 3.1. Effective and appropriate forms of communications used and interactions undertaken with team members who contribute to known team activities and objectives<br>3.2. Effective and appropriate contributions made to complement team activities and objectives, based on individual skills and competencies and ***workplace context***<br>3.3. Observed protocols in reporting using standard operating procedures<br>3.4. Contribute to the development of team work plans based on an understanding of team's role and objectives and individual competencies of the members. |

**RANGE OF VARIABLES**

| VARIABLE | RANGE |
|---|---|
| 1. Role and objective of team | 1.1. Work activities in a team environment with enterprise or specific sector<br>1.2. Limited discretion, initiative and judgement maybe demonstrated on the job, either individually or in a team environment |
| 2. Sources of information | 2.1. Standard operating and/or other workplace procedures<br>2.2. Job procedures<br>2.3. Machine/equipment manufacturer's specifications and instructions<br>2.4. Organizational or external personnel<br>2.5. Client/supplier instructions<br>2.6. Quality standards<br>2.7. OHS and environmental standards |
| 3. Workplace context | 3.1. Work procedures and practices<br>3.2. Conditions of work environments<br>3.3. Legislation and industrial agreements<br>3.4. Standard work practice including the storage, safe handling and disposal of chemicals<br>3.5. Safety, environmental, housekeeping and quality guidelines |

**EVIDENCE GUIDE**

| | |
|---|---|
| 1. Critical aspects of Competency | Assessment requires evidence that the candidate:<br>1.1. Operated in a team to complete workplace activity<br>1.2. Worked effectively with others<br>1.3. Conveyed information in written or oral form<br>1.4. Selected and used appropriate workplace language<br>1.5. Followed designated work plan for the job<br>1.6. Reported outcomes |
| 2. Underpinning Knowledge and Attitude | 2.1. Communication process<br>2.2. Team structure<br>2.3. Team roles<br>2.4. Group planning and decision making |
| 3. Underpinning Skills | 3.1. Communicate appropriately, consistent with the culture of the workplace |
| 4. Resource Implications | The following resources MUST be provided:<br>4.1. Access to relevant workplace or appropriately simulated environment where assessment can take place<br>4.2. Materials relevant to the proposed activity or tasks |
| 5. Methods of Assessment | Competency may be assessed through:<br>5.1. Observation of the individual member in relation to the work activities of the group<br>5.2. Observation of simulation and or role play involving the participation of individual member to the attainment of organizational goal<br>5.3. Case studies and scenarios as a basis for discussion of issues and strategies in teamwork |
| 6. Context for Assessment | 6.1. Competency may be assessed in workplace or in a simulated workplace setting<br>6.2. Assessment shall be observed while task are being undertaken whether individually or in group |

**UNIT OF COMPETENCY: PRACTICE CAREER PROFESSIONALISM**

**UNIT CODE : 500311107**

**UNIT DESCRIPTOR :** This unit covers the knowledge, skills and attitudes in promoting career growth and advancement.

| ELEMENT | PERFORMANCE CRITERIA<br>***Italicized bold*** terms are elaborated in the Range of Variables |
|---|---|
| 1. Integrate personal objectives with organizational goals | 1.1 Personal growth and work plans are pursued towards improving the qualifications set for the profession<br>1.2 Intra- and interpersonal relationships ~~is~~ are maintained in the course of managing oneself based on performance ***evaluation***<br>1.3 Commitment to the organization and its goal is demonstrated in the performance of duties |
| 1. Set and meet work priorities | 2.1 Competing demands are prioritized to achieve personal, team and organizational goals and objectives.<br>2.2 ***Resources*** are utilized efficiently and effectively to manage work priorities and commitments<br>2.3 Practices along economic use and maintenance of equipment and facilities are followed as per established procedures |
| 2. Maintain professional growth and development | 3.1 ***Trainings and career opportunities*** are identified and availed of based on job requirements<br>3.2 ***Recognitions*** are sought/received and demonstrated as proof of career advancement<br>3.3 ***Licenses and/or certifications*** relevant to job and career are obtained and renewed |

**RANGE OF VARIABLES**

| VARIABLE | RANGE |
|---|---|
| 1. Evaluation | 1.1 Performance Appraisal<br>1.2 Psychological Profile<br>1.3 Aptitude Tests |
| 2. Resources | 2.1 Human<br>2.2 Financial<br>2.3 Technology<br>2.3.1 Hardware<br>2.3.2 Software |
| 3. Trainings and career opportunities | 3.1 Participation in training programs<br>3.1.1 Technical<br>3.1.2 Supervisory<br>3.1.3 Managerial<br>3.1.4 Continuing Education<br>3.2 Serving as Resource Persons in conferences and workshops |
| 4. Recognitions | 4.1 Recommendations<br>4.2 Citations<br>4.3 Certificate of Appreciations<br>4.4 Commendations<br>4.5 Awards<br>4.6 Tangible and Intangible Rewards |
| 5. Licenses and/or certifications | 5.1 National Certificates<br>5.2 Certificate of Competency<br>5.3 Support Level Licenses<br>5.4 Professional Licenses |

**EVIDENCE GUIDE**

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|---|---|
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:<br>1.1 Attained job targets within key result areas (KRAs)<br>1.2 Maintained intra - and interpersonal relationship in the course of managing oneself based on performance evaluation<br>1.3 Completed trainings and career opportunities which are based on the requirements of the industries<br>1.4 Acquired and maintained licenses and/or certifications according to the requirement of the qualification |
| 2. Underpinning Knowledge | 2.1 Work values and ethics (Code of Conduct, Code of Ethics, etc.)<br>2.2 Company policies<br>2.3 Company-operations, procedures and standards<br>2.4 Fundamental rights at work including gender sensitivity<br>2.5 Personal hygiene practices |
| 3. Underpinning Skills | 3.1 Appropriate practice of personal hygiene<br>3.2 Intra and Interpersonal skills<br>3.3 Communication skills |
| 4. Resource Implications | The following resources **MUST** be provided:<br>4.1 Workplace or assessment location<br>4.2 Case studies/scenarios |
| 5. Methods of Assessment | Competency may be assessed through:<br>5.1 Portfolio Assessment<br>5.2 Interview<br>5.3 Simulation/Role-plays<br>5.4 Observation<br>5.5 Third Party Reports<br>5.6 Exams and Tests |
| 6. Context of Assessment | 6.1 Competency may be assessed in the work place or in a simulated work place setting |

**UNIT OF COMPETENCY :** **PRACTICE OCCUPATIONAL HEALTH AND SAFETY PROCEDURES**

**UNIT CODE :** **500311108**

**UNIT DESCRIPTOR :** This unit covers the outcomes required to comply with regulatory and organizational requirements for occupational health and safety.

| ELEMENT | PERFORMANCE CRITERIA<br>***Italicized bold*** terms are elaborated in the Range of Variables |
|---|---|
| 1. Identify hazards and risks | 1.1 ***Safety regulations*** and workplace safety and hazard control practices and procedures are clarified and explained based on organization procedures<br>1.2 ***Hazards/risks*** in the workplace and their corresponding indicators are identified to minimize or eliminate risk to co-workers, workplace and environment in accordance with organization procedures<br>1.3 ***Contingency measures*** during workplace accidents, fire and other emergencies are recognized and established in accordance with organization procedures |
| 2. Evaluate hazards and risks | 2.1 Terms of maximum tolerable limits which when exceeded will result in harm or damage are identified based on threshold limit values (TLV)<br>2.2 Effects of the hazards are determined<br>2.3 OHS issues and/or concerns and identified safety hazards are reported to designated personnel in accordance with workplace requirements and relevant workplace OHS legislation |

| ELEMENT | PERFORMANCE CRITERIA<br>***Italicized bold*** terms are elaborated in the Range of Variables |
|---|---|
| 3. Control hazards and risks | 3.1 Occupational Health and Safety (OHS) procedures for controlling hazards/risks in workplace are consistently followed<br>3.2 Procedures for dealing with workplace accidents, fire and emergencies are followed in accordance with organization OHS policies<br>3.3 ***Personal protective equipment (PPE)*** is correctly used in accordance with organization OHS procedures and practices<br>3.4 Appropriate assistance is provided in the event of a workplace emergency in accordance with established organization protocol |
| 4. Maintain OHS awareness | 4.1 ***Emergency-related drills and trainings*** are participated in as per established organization guidelines and procedures<br>4.2 ***OHS personal records*** are completed and updated in accordance with workplace requirements |

**RANGE OF VARIABLES**

| VARIABLE | RANGE |
|---|---|
| 1. Safety regulations | May include but are not limited to:<br>1.1 Clean Air Act<br>1.2 Building code<br>1.3 National Electrical and Fire Safety Codes<br>1.4 Waste management statutes and rules<br>1.5 Philippine Occupational Safety and Health Standards<br>1.6 DOLE regulations on safety legal requirements<br>1.7 ECC regulations |
| 2. Hazards/Risks | May include but are not limited to:<br>2.1 Physical hazards – impact, illumination, pressure, noise, vibration, temperature, radiation<br>2.2 Biological hazards- bacteria, viruses, plants, parasites, mites, molds, fungi, insects<br>2.3 Chemical hazards – dusts, fibers, mists, fumes, smoke, gasses, vapors<br>2.4 Ergonomics<br>• Psychological factors – over exertion/ excessive force, awkward/static positions, fatigue, direct pressure, varying metabolic cycles<br>• Physiological factors – monotony, personal relationship, work out cycle |
| 3. Contingency measures | May include but are not limited to:<br>3.1 Evacuation<br>3.2 Isolation<br>3.3 Decontamination<br>3.4 (Calling designed) emergency personnel |
| 4. PPE | May include but are not limited to:<br>4.1 Mask<br>4.2 Gloves<br>4.3 Goggles<br>4.4 Hair Net/cap/bonnet<br>4.5 Face mask/shield<br>4.6 Ear muffs<br>4.7 Apron/Gown/coverall/jump suit<br>4.8 Anti-static suits |

| VARIABLE | RANGE |
|---|---|
| 5. Emergency-related drills and training | 5.1 Fire drill<br>5.2 Earthquake drill<br>5.3 Basic life support/CPR<br>5.4 First aid<br>5.5 Spillage control<br>5.6 Decontamination of chemical and toxic<br>5.7 Disaster preparedness/management |
| 6. OH&S personal records | 6.1 Medical/Health records<br>6.2 Incident reports<br>6.3 Accident reports<br>6.4 OHS-related training completed |

**EVIDENCE GUIDE**

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|---|---|
| 1. Critical aspects of Competency | Assessment requires evidence that the candidate:<br>1.1 Explained clearly established workplace safety and hazard control practices and procedures<br>1.2 Identified hazards/risks in the workplace and its corresponding indicators in accordance with company procedures<br>1.3 Recognized contingency measures during workplace accidents, fire and other emergencies<br>1.4 Identified terms of maximum tolerable limits based on threshold limit value- TLV.<br>1.5 Followed Occupational Health and Safety (OHS) procedures for controlling hazards/risks in workplace<br>1.6 Used Personal Protective Equipment (PPE) in accordance with company OHS procedures and practices<br>1.7 Completed and updated OHS personal records in accordance with workplace requirements |
| 2. Underpinning Knowledge and Attitude | 2.1 OHS procedures and practices and regulations<br>2.2 PPE types and uses<br>2.3 Personal hygiene practices<br>2.4 Hazards/risks identification and control<br>2.5 Threshold Limit Value -TLV<br>2.6 OHS indicators<br>2.7 Organization safety and health protocol<br>2.8 Safety consciousness<br>2.9 Health consciousness |

| | |
|---|---|
| 3. Underpinning Skills | 3.1 Practice of personal hygiene<br>3.2 Hazards/risks identification and control skills<br>3.3 Interpersonal skills<br>3.4 Communication skills |
| 4. Resource Implications | The following resources must be provided:<br>4.1 Workplace or assessment location<br>4.2 OHS personal records<br>4.3 PPE<br>4.4 Health records |
| 5. Methods of Assessment | Competency may be assessed through:<br>5.1 Portfolio Assessment<br>5.2 Interview<br>5.3 Case Study/Situation |
| 6. Context for Assessment | 6.1 Competency may be assessed in the work place or in a simulated work place setting |

## COMMON COMPETENCIES

**UNIT OF COMPETENCY: PREPARE MATERIALS AND TOOLS**

**UNIT CODE : HVC713201**

**UNIT DESCRIPTOR :** This unit covers the knowledge, skills and attitudes in identifying, requesting and receiving construction materials and tools based on the required performance standards.

| ELEMENT | PERFORMANCE CRITERIA<br>***Italicized bold*** terms are elaborated in the Range of Variables |
|---|---|
| 1. Identify materials | 1.1 ***Materials*** are listed as per job requirements<br>1.2 Quantity and ***description of materials*** conformed to the job requirements<br>1.3 Tools and accessories are identified according to job requirements |
| 2. Requisition materials | 2.1 Materials and tools needed are requested according to the list prepared<br>2.2 Request is done as per company standard operating procedures<br>2.3 Substitute materials and tools are provided without sacrificing cost and quality of the work |
| 3. Receive and inspect materials | 3.1 Materials and tools issued are inspected as per quantity and specification<br>3.2 Tools, accessories and materials checked for damages according to enterprise procedures<br>3.3 Materials and tools are set aside to appropriate location nearest to the workplace |

## RANGE OF VARIABLES

| VARIABLE | RANGE |
|---|---|
| 1. Materials and tools | 1.1 Air-conditioning<br>1.2 Refrigeration |
| 2. Description of materials and tools | 2.1 Brand name<br>2.2 Size<br>2.3 Capacity<br>2.4 Kind of application |
| 3. Company standard procedures | 3.1 Job Order<br>3.2 Requisition Slip<br>3.3 Borrower Slip |

## EVIDENCE GUIDE

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|---|---|
| 1. Critical aspects of Competency | Assessment requires evidence that the candidate:<br>1.1 Listed materials and tools according to quantity and job requirements<br>1.2 Requested materials and tools according to the list prepared and as per company standard operating procedures<br>1.3 Inspected issued materials and tools as per quantity and job specifications<br>1.4 Tools provided with appropriate safety devices |
| 2. Underpinning Knowledge | 2.1 Types and uses of HVAC/R materials and tools<br>2.2 Different forms<br>2.3 Requisition procedures |
| 3. Underpinning Skills | 3.1 Preparing materials and tools<br>3.2 Proper handling of tools and equipment<br>3.3 Following Instructions |
| 4. Resource Implications | The following resources should be provided:<br>4.1 Workplace location<br>4.2 Materials relevant to the unit of competency<br>4.3 Technical plans, drawings and specifications relevant to the activities |
| 5. Methods of Assessment | Competency in this unit must be assessed through:<br>5.1 Direct observation and oral questioning |
| 6. Context for Assessment | 6.1 Competency may be assessed in the workplace or in a simulated workplace<br>6.2 Competency assessment must be undertaken in accordance with the endorsed TESDA assessment guidelines |

**UNIT OF COMPETENCY: INTERPRET TECHNICAL DRAWINGS AND PLANS**

**UNIT CODE : HVC311202**

**UNIT DESCRIPTOR :** This unit covers the knowledge, skills and attitudes in analyzing and interpreting symbols, data and work plan based on the required performance standards.

| ELEMENT | PERFORMANCE CRITERIA<br>***Italicized bold*** terms are elaborated in the Range of Variables |
|---|---|
| 1. Analyze signs, symbols and data | 1.1 ***Technical plans*** are obtained according to job requirements<br>1.2 Signs, symbols and data are identified according to job specifications<br>1.3 Signs symbols and data are determined according to ***classification*** or as appropriate in ***drawing*** |
| 2. Interpret technical drawings and plans | 2.1 Necessary ***tools, materials*** and equipment are identified according to the ***plan***<br>2.2 Supplies and materials are listed according to specifications<br>2.3 Components, assemblies or objects are recognized as required<br>2.4 Dimensions are identified as appropriate to the plan<br>2.5 Specification details are matched with existing/available resources in line with job requirements<br>2.6 Work plan is drawn following the specifications |
| 3. Apply freehand sketching | 3.1 Where applicable, correct freehand sketching is produced in accordance with the job requirements |

**RANGE OF VARIABLES**

| VARIABLE | RANGE |
|---|---|
| 1. Technical plans | Including but not limited to:<br>1.1 Electrical Plans<br>1.2 Architectural Plans<br>1.3 Welding Procedures Specifications (WPS) |
| 2. Work plan | 2.1 Job requirements<br>2.2 Installation instructions<br>2.3 Components instruction |
| 3. Classification | Including but not limited to:<br>3.1 Electrical<br>3.2 Mechanical |
| 4. Drawing | 4.1 Drawing symbols<br>4.2 Alphabet of lines<br>4.3 Orthographic views<br>- Front view<br>- Right side view/left side view<br>- Top view<br>- Pictorial<br>4.4 Schematic diagram<br>4.5 Electrical drawings<br>4.6 Structural drawings<br>4.7 Welding symbols |
| 5. Tools and materials | Including but not limited to:<br>5.1 Compass<br>5.2 Divider<br>5.3 Rulers<br>5.4 Triangles<br>5.5 Drawing tables<br>5.6 Computer |

**EVIDENCE GUIDE**

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|---|---|
| 1. Critical aspects of Competency | Assessment requires that the candidate:<br>1.1 Identified and determined signs, symbols and data according to work plan, job requirements and classifications<br>1.2 Identified tools and equipment in accordance with job requirements<br>1.3 Listed supplies and materials according to blueprint specifications<br>1.4 Drawn workplan following specifications<br>1.5 Demonstrated ability to determine job specifications based on working/technical drawing |
| 2. Underpinning Knowledge | 2.1 **TRADE MATHEMATICS**<br>• Linear measurement<br>• Dimension<br>• Unit conversion<br>2.2 **BLUEPRINT READING AND PLAN SPECIFICATION**<br>• Electrical, mechanical plan, symbols and abbreviations<br>• Drawing standard symbols<br>2.3 **TRADE THEORY**<br>• Basic Technical Drawing<br>• Types Technical Plans<br>• Various Types of Drawings<br>• Notes and Specifications |
| 3. Underpinning skills | 3.1 Interpreting drawing/orthographic drawing<br>3.2 Interpreting technical plans<br>3.3 Matching specification details with existing resources<br>3.4 Following instructions<br>3.5 Handling of drawing instruments |
| 4. Resource implications | The following resources should be provided:<br>4.1 Workplace<br>4.2 Drawings and specification relevant to task<br>4.3 Materials and instrument relevant to proposed activity |
| 5. Methods of assessment | Competency should be assessed through:<br>5.1 Direct Observation<br>5.2 Questions/Interview<br>5.3 Written test related to underpinning knowledge |
| 6. Context of assessment | 6.1 Competency assessment may occur in workplace or any appropriate simulated environment<br>6.2 Assessment shall be observed while task are being undertaken whether individually or in group<br>6.3 Competency assessment must be undertaken in accordance with the endorsed TESDA assessment guidelines |

**UNIT OF COMPETENCY: OBSERVE PROCEDURES, SPECIFICATIONS AND MANUALS OF INSTRUCTION**

**UNIT CODE : HVC311201**

**UNIT DESCRIPTOR :** This unit covers the knowledge, skills and attitudes in identifying, interpreting, applying services to specifications and manuals, and storing manuals.

| ELEMENT | PERFORMANCE CRITERIA<br>***Italicized bold*** terms are elaborated in the Range of Variables |
|---|---|
| 1. Identify and access specification/manuals | 1.1 Appropriate manuals are identified and accessed as per job requirements<br>1.2 Version and date of manual is checked to ensure correct specification and procedure are identified |
| 2. Interpret manuals | 2.1 Relevant sections, chapters of specifications/ manuals are located in relations to the work to be conducted<br>2.2 Information and procedure in the manual are interpreted in accordance to industry practices |
| 3. Apply information in manual | 3.1 ***Manual*** is interpreted according to job requirements<br>3.2 Work steps are correctly identified in accordance with manufacturer's specification<br>3.3 Manual data is applied according to the given task<br>3.4 All correct sequencing and adjustments are interpreted in accordance with information contained on the manual or specifications |
| 4. Store manuals | 4.1 Manual or specification are stored appropriately to ensure prevention of damage, ready access and updating of information when required in accordance with company requirements |

**RANGE OF VARIABLES**

| VARIABLE | RANGE |
|---|---|
| 1. Procedures, specifications and manuals of instructions | Kinds of Manuals:<br>1.1 Manufacturer's Specification Manual<br>1.2 Repair Manual<br>1.3 Maintenance Procedure Manual<br>1.4 Periodic Maintenance Manual |

**EVIDENCE GUIDE**

| | |
|---|---|
| 1. Critical aspects of Competency | Assessment requires that the candidate:<br>1.1 Identified and accessed specification/manuals as per job requirements<br>1.2 Interpreted manuals in accordance to industry practices<br>1.3 Applied information in manuals according to the given task<br>1.4 Stored manuals in accordance with company requirements |
| 2. Underpinning Knowledge | 2.1 Types of manuals used in HVAC/R sector<br>2.2 Identification of symbols used in the manuals<br>2.3 Identification of units of measurements<br>2.4 Unit conversion |
| 3. Underpinning Skills | 3.1 Reading and comprehension skills required to identify and interpret construction manuals and specifications<br>3.2 Accessing information and data |
| 4. Resource Implications | The following resources should be provided:<br>4.1 All manuals/catalogues relative to HVAC/R sector |
| 5. Methods of Assessment | Competency should be assessed through:<br>5.1 Direct Observation<br>5.2 Questions/Interview<br><br>Assessment of underpinning knowledge and practical skills may be combined |
| 6. Context for Assessment | 6.1 Competency assessment must be undertaken in accordance with the endorsed TESDA assessment guidelines<br>6.2 Assessment may be conducted in the workplace or a simulated environment |

**UNIT OF COMPETENCY: PERFORM MENSURATIONS AND CALCULATIONS**

**UNIT CODE : HVC311203**

**UNIT DESCRIPTOR :** This unit covers the knowledge, skills and attitudes in identifying and measuring objects based on the required performance standards.

| ELEMENT | PERFORMANCE CRITERIA<br>***Italicized bold*** *terms* are elaborated in the Range of Variables |
|---|---|
| 1. Select measuring instruments | 1.1 Object or component to be measured is identified, classified and interpreted to the appropriate regular ***geometric shape***<br>1.2 Measuring tools are selected/identified as per object to be measured or job requirements<br>1.3 Correct specifications are obtained from relevant sources<br>1.4 Appropriate ***measuring instruments*** are selected according to job requirements<br>1.5 Alternative measuring tools are used without sacrificing cost and quality of work |
| 2. Carry out measurements and calculations | 2.1 Accurate ***measurements and calculations*** are obtained to job requirements<br>2.2 Alternative measuring tools are used without sacrificing cost and quality of work<br>2.3 Calculation needed to complete work tasks are performed using the four basic process of addition (+), subtraction (-), multiplication (x) and division (/) including but not limited to: trigonometric functions, algebraic computations<br>2.4 Calculations involving fractions, percentages and mixed numbers are used to complete workplace tasks<br>2.5 Numerical computation is self-checked and corrected for accuracy<br>2.6 Instruments are read to the limit of accuracy of the tool<br>2.7 Systems of measurement identified and converted according to job requirements/ISO<br>2.8 Workpieces are measured according to job requirements |

**RANGE OF VARIABLES**

| VARIABLE | RANGE |
|---|---|
| 1. Geometric Shape | Including but I not limited to:<br>1.1 Round<br>1.2 Square<br>1.3 Rectangular<br>1.4 Triangle<br>1.5 Sphere<br>1.6 Conical |
| 2. Measuring instruments | Including but not limited to:<br>2.1 Micrometer (In-out, depth)<br>2.2 Vernier caliper (out, inside)<br>2.3 Dial gauge with mag, std.<br>2.4 Straight edge/Steel rule<br>2.5 Thickness/Torque/Small Hole/ gauge<br>2.6 Telescopic gauge<br>2.7 Try-square/Protractor<br>2.8 Combination gauge<br>2.9 Voltmeter/Ammeter/Mega-ohmeter<br>2.10 KWH meter<br>2.11 Thermometers |
| 3. Measurements and calculations | 3.1 Linear<br>3.2 Volume<br>3.3 Area<br>3.4 Wattage<br>3.5 Voltage<br>3.6 Resistance<br>3.7 Amperage<br>3.8 Frequency<br>3.9 Impedance<br>3.10 Conductance<br>3.11 Capacitance<br>3.12 Displacement<br>3.13 Inside diameter<br>3.14 Circumference<br>3.15 Length<br>3.16 Thickness<br>3.17 Outside diameter<br>3.18 Taper<br>3.19 Out of roundness |

**EVIDENCE GUIDE**

| | |
|---|---|
| 1. Critical Aspects of Competency | Assessment requires that the candidate:<br>1.1 Selected and prepared appropriate measuring instruments in accordance with job requirements<br>1.2 Performed measurements and calculations according to job requirements/ ISO |
| 2. Underpinning Knowledge | 2.1 **TRADE MATHEMATICS/MENSURATION**<br>• Four fundamental operation<br>• Linear measurement<br>• Dimensions<br>• Unit conversion<br>• Ratio and proportion<br>• Trigonometric functions<br>• Algebraic equations |
| 3. Underpinning Skills | 3.1 Performing calculation by addition, subtraction, multiplication and division: trigonometric functions and algebraic equations<br>3.2 Visualizing objects and shapes<br>3.3 Interpreting formulas for volume, areas, perimeters of plane and geometric figures<br>3.4 Proper handling of measuring instruments |
| 4. Resource Implications | The following resources should be provided:<br>4.1 Workplace location<br>4.2 Problems to solve<br>4.3 Measuring instrument appropriate to carry out tasks<br>4.4 Instructional materials relevant to the propose activity<br><br>Assessment of underpinning knowledge and practical skills may be combined. |
| 5. Methods of Assessment | Competency should be assessed through:<br>5.1 Actual demonstration<br>5.2 Direct observation<br>5.3 Written test/questioning related to underpinning knowledge |
| 6. Context for Assessment | 6.1 Competency assessment may occur in workplace or any appropriate simulated environment<br>6.2 Assessment shall be observed while task are being undertaken whether individually or in group<br>6.3 Competency assessment must be undertaken in accordance with the TESDA assessment guidelines |

**UNIT OF COMPETENCY: PERFORM BASIC BENCHWORK**

**UNIT CODE : HVC713202**

**UNIT DESCRIPTOR :** This unit covers the knowledge, skills and attitudes in preparing materials, tools and equipment, lay-outing dimensions and performing basic benchwork based on the required performance standards.

| ELEMENT | PERFORMANCE CRITERIA<br>***Italicized bold*** terms are elaborated in the Range of Variables |
|---|---|
| 1. Prepare materials, tools and equipment | 1.1 ***Work plan*** is interpreted to determine job requirements<br>1.2 ***Materials, tools and equipment*** are identified and prepared according to job requirements<br>1.3 Materials are checked according to the required specifications<br>1.4 Tools and equipment conditions are checked following the standard operating procedures (SOPs) |
| 2. Lay-out and mark dimensions/features on workplace | 2.1 Metallic and non-metallic materials are selected according to the requirements specified in the blueprint<br>2.2 ***Dimensions/features*** are laid-out/marked according to job specifications/blueprint and within the required tolerance<br>2.3 Dimensions are checked against the actual work plan |
| 3. Perform required benchworks | 3.1 ***Work instructions are followed*** to ensure work safety<br>3.2 ***Benchworks*** are performed applying knowledge on safety procedures and according to job requirements<br>3.3 Workpieces are clamped in ***workholding device*** to avoid damage and accidents<br>3.4 Work pieces are cut, chipped or filed according to required measurements, tolerance specified in the blueprint and free from burrs and sharp edges<br>3.5 Drilling is performed according to recommended sequence and specifications<br>3.6 Proper usage of materials, tools and equipment is observed<br>3.7 Appropriate ***PPE*** and safety procedures are applied<br>3.8 Worksite is cleaned and cleared of all debris and left in safe state in accordance with OHS regulations |

**RANGE OF VARIABLES**

| VARIABLE | RANGE |
|---|---|
| 1. Work plan | 1.1 Job requirements<br>1.2 Schedule of work |
| 2. Materials | 2.1 Steel brackets<br>2.2 Grinding disc<br>2.3 Drill bit<br>2.4 Flat/angle bars<br>2.5 Fastening screws |
| 3. Tools and equipment | 3.1 Portable grinder<br>3.2 Hacksaw<br>3.3 File<br>3.4 Markers<br>3.5 Screw drivers<br>3.6 Ballpen hammer<br>3.7 L-square/steel square<br>3.8 Steel rule<br>3.9 Measuring tools<br>3.10 Portable electric drill<br>3.11 Bench wire<br>3.12 Tri-square |
| 4. Metallic materials | 4.1 Mild steel plate<br>4.2 Flat / Square / Angle /Round bar<br>4.3 G.I./ B.I. sheet<br>4.4 Beam |
| 5. Non-metallic materials | 5.1 PVC/ Fiber glass/ Plastic<br>5.2 Rubber<br>5.3 Wood<br>5.4 Ceramics |
| 6. Dimensions | 6.1 Measurements<br>6.2 Tolerances |
| 7. Work instructions | 7.1 Work plan/ Blueprint<br>7.2 Manufacturer's specifications |
| 8. Personal Protective Equipment (PPE) | 8.1 Safety shoes<br>8.2 Gloves<br>8.3 Goggles |
| 9. Benchworks | 9.1 Cutting<br>9.2 Filing<br>9.3 Drilling |
| 10. Workholding device | 10.1 Machine vise<br>10.2 Pliers<br>10.3 Vise grip |
| 11. Manual | 11.1 Procedures manual<br>11.2 Instructional manual |

**EVIDENCE GUIDE**

| | |
|---|---|
| 1. Critical Aspects of Competency | Assessment requires that the candidate:<br>1.1 Interpreted work plan to determine job requirements<br>1.2 Identified and prepared supplies, materials, tools and equipment in accordance with job requirements<br>1.3 Selected and used appropriate processes, tools and equipment to carry out task<br>1.4 Laid-out and checked dimensions in accordance with job requirements and within the tolerances<br>1.5 Followed work instructions to ensure safety<br>1.6 Performed benchworks in accordance with job requirements<br>1.7 Cleaned worksite and left in safe state in accordance with OHSA regulations |
| 2. Underpinning knowledge | 2.1 **TRADE MATHEMATICS**<br>• Linear measurements<br>• Dimensions<br>• Unit conversion<br>2.2 **TRADE THEORY**<br>• Basic Benchwork<br>2.3 **SAFETY PRACTICES**<br>• PPE<br>• Handling of tools, supplies and equipment<br>• Good housekeeping |
| 3. Underpinning skills | 3.1 Performing basic benchwork<br>3.2 Communicating effectively<br>3.3 Work safety<br>3.4 Preparing materials, tools and equipment<br>3.5 Proper handling of tools and equipment |
| 4. Resource implications | The following resources should be provided:<br>4.1 Workplace<br>4.2 Work plan<br>4.3 Materials, tools and equipment relevant to the proposed activity/task |
| 5. Methods of assessment | Competency should be assessed through:<br>5.1 Actual demonstration<br>5.2 Direct observation<br>5.3 Written/questioning related to underpinning knowledge |
| 6. Context of assessment | 6.1 Competency assessment may occur in workplace or any appropriate simulated environment<br>6.2 Assessment shall be observed while task are being undertaken whether individually or in group<br>6.3 Competency assessment must be undertaken in accordance with the endorsed TESDA assessment guidelines |

**UNIT OF COMPETENCY: PERFORM BASIC ELECTRICAL WORKS**

**UNIT CODE : HVC724201**

**UNIT DESCRIPTOR :** This unit covers the knowledge, skills and attitudes in preparing materials, tools and equipment, testing electrical components and basic repairing in electricity based on the required performance standards.

| ELEMENT | PERFORMANCE CRITERIA<br>***Italicized bold*** terms are elaborated in the Range of Variables |
|---|---|
| 1. Prepare electrical tools and test instruments | 1.1 ***Work plan*** is interpreted to determine job requirements<br>1.2 ***Electrical tools and instruments*** are identified and prepared according to job requirements<br>1.3 Electrical tools and instruments are checked for conditions and calibrated as required |
| 2. Test power supply and electrical components | 2.1 Instruments are tested in accordance with PEC<br>2.2 Power supply and electrical components are checked in accordance with manufacturer's specifications/PEC<br>2.3 Defects of power supply and electrical components are identified and recorded<br>2.4 Safe working habits is observed |
| 3. Perform basic electrical repair | 3.1 ***Work instructions*** are followed to ensure safety work<br>3.2 Loose connections are tightened in accordance with PEC<br>3.3 Defective electrical components are replaced and tested in accordance with PEC<br>3.4 Work place is cleaned and in safe state in line with OHSA regulations |

**RANGE OF VARIABLES**

| VARIABLE | RANGE |
|---|---|
| 1. Work plan | 1.1 Job requirements<br>1.2 Schedule of work |
| 2. Materials | 2.1 Solid, stranded wire<br>2.2 Service plug/outlet<br>2.3 HVAC/R electrical components<br>2.4 Soldering lead<br>2.5 Terminal clips<br>2.6 Moulding<br>2.7 Fuses<br>2.8 PVC/Mold flux<br>2.9 Electrical tape |
| 3. Tools and equipment | 3.1 Clamp ammeter<br>3.2 Multi tester<br>3.3 Insulation tester<br>3.4 PPE<br>3.5 Soldering gun/iron<br>3.6 Wire stripper<br>3.7 Measuring tool<br>3.8 Markers<br>3.9 Crimping tools<br>3.10 Screw drivers<br>3.11 Electrician pliers<br>3.12 Electric drill<br>3.13 Long nose |
| 4. Work instructions | 4.1 Work plan<br>4.2 Schematic diagrams<br>4.3 Installation instruction |

## EVIDENCE GUIDE

| | |
|---|---|
| 1. Critical Aspects of Competency | Assessment requires that the candidate:<br>1.1 Interpreted work plan to determine job requirements<br>1.2 Selected and used appropriate processes, tools and equipment to carry out task<br>1.3 Identified and tested electrical tools and instruments in accordance with PEC<br>1.4 Replaced defective tools and instruments<br>1.5 Checked power supply and electrical components in accordance with PEC<br>1.6 Cleaned work place and left in safe state in line with OHSA regulations<br>1.7 Completed electrical wiring in HVAC/R units based in manufacturer's specifications and PEC<br>1.8 Communicated effectively to ensure safety works |
| 2. Underpinning Knowledge | 2.1 Linear measurements<br>2.2 Dimensions<br>2.3 Unit conversion<br>2.4 Basic electricity<br>2.5 PPE<br>2.6 Handling of tools and equipment<br>2.7 Good housekeeping |
| 3. Underpinning Skills | 3.1 Installing and repairing electrical fixtures<br>3.2 Communicating effectively<br>3.3 Work safety<br>3.4 Proper handling of materials, tools and equipment<br>3.5 Preparing materials, tools and equipment<br>3.6 Wiring components<br>3.7 Testing power supply and electrical component |
| 4. Resource Implications | The following resources should be provided:<br>4.1 Work place<br>4.2 Work plan<br>4.3 Materials, tools and equipment relevant to the proposed activity/task |
| 5. Methods of Assessment | Competency should be assessed through:<br>5.1 Direct observation<br>5.2 Written test/questioning relevant to underpinning knowledge |
| 6. Context of Assessment | 6.1 Competency assessment may occur in workplace or any appropriate simulated environment<br>6.2 Assessment shall be observed while task are being undertaken whether individually or in group<br>6.3 Competency assessment must be undertaken in accordance with the endorsed TESDA assessment guidelines |

**UNIT OF COMPETENCY: MAINTAIN TOOLS AND EQUIPMENT**

**UNIT CODE : HVC311205**

**UNIT DESCRIPTOR :** This unit covers the knowledge, skills and attitudes in checking condition, performing preventive maintenance and storing of tools and equipment based on the required performance standards.

| ELEMENT | PERFORMANCE CRITERIA<br>***Italicized bold*** terms are elaborated in the Range of Variables |
|---|---|
| 1. Check condition of tools and equipment | 1.1 ***Materials, tools and equipmen***t are identified according to classification and job requirements<br>1.2 Non-functional tools and equipment are segregated and labeled according to classification<br>1.3 Safety of tools and equipment are observed in accordance with manufacturer's instructions<br>1.4 Condition of ***PPE*** are checked in accordance with manufacturer's instructions |
| 2. Perform basic preventive maintenance | 2.1 Appropriate lubricants are identified according to types of equipment<br>2.2 Tools and equipment are lubricated according to preventive maintenance schedule or manufacturer's specifications<br>2.3 Measuring instruments are checked and calibrated in accordance with manufacturer's instructions<br>2.4 Tools are cleaned and lubricated according to standard procedures<br>2.5 Defective instruments, equipment and accessories are inspected and replaced according to manufacturer's specifications<br>2.6 Tools are inspected, repaired and replaced every after use<br>2.7 Work place are cleaned and in safe state in line with OHSA regulations |

| ELEMENT | PERFORMANCE CRITERIA<br>***Italicized bold*** terms are elaborated in the Range of Variables |
|---|---|
| 3. Store tools and equipment | 3.1 Inventory of tools, instruments and equipment are conducted and recorded as per company practices<br>3.2 Tools and equipment are stored safely in appropriate locations in accordance with manufacturer's specifications or company procedures |

**RANGE OF VARIABLES**

| VARIABLE | RANGE |
|---|---|
| 1. Materials | Including but not limited to:<br>1.1 Lubricants<br>1.2 Cleaning materials<br>1.3 Rust remover<br>1.4 Rugs<br>1.5 Spare parts |
| 2. Tools and equipment | Including but not limited to:<br>2.1 Tools<br>- Cutting tools - hacksaw, crosscut saw, rip saw<br>- Boring tools - auger, brace, grinlet, hand drill<br>- Holding tools - vise grip, C-clamp, bench vise<br>- Threading tools - die and stock, taps<br>2.2 Measuring instruments/Equipment |
| 3. PPE | Including but not limited to:<br>3.1 Goggles<br>3.2 Gloves<br>3.3 Safety shoes<br>3.4 Aprons/Coveralls |
| 4. Forms | 4.4 Maintenance schedule forms<br>4.5 Requisition Slip<br>4.6 Inventory Form Slip<br>4.7 Inspection Form Slip<br>4.8 Procedures |

**EVIDENCE GUIDE**

| | |
|---|---|
| 1. Critical Aspects of Competency | Assessment requires that the candidate:<br>1.1 Selected and used appropriate processes, tools and equipment to carry out task<br>1.2 Identified functional and non-functional tools and equipment<br>1.3 Checked, lubricated and calibrated tools, equipment and instruments according to manufacturer's specifications<br>1.4 Replaced defective tools, equipment and its accessories<br>1.5 Observed and applied safe handling of tools and equipment and safety work practices<br>1.6 Prepared and submitted inventory report, where applicable<br>1.7 Maintained work place in accordance with OHSA regulations<br>1.8 Stored tools and equipment safely in appropriate locations and in accordance with company practices |
| 2. Underpinning Knowledge | 2.1 **SAFETY PRACTICES**<br>• Use of PPE<br>• Handling of tools and equipment<br>• Good housekeeping<br>2.2 **MATERIALS, TOOLS AND EQUIPMENT**<br>• Types and Uses of lubricants<br>• Types and Uses of cleaning materials<br>• Types and Uses of measuring instruments and equipment<br>2.3 **PREVENTIVE MAINTENANCE**<br>• Methods and techniques<br>• Procedures |
| 3. Underpinning Skills | 3.1 Preparing maintenance materials, tools and equipment<br>3.2 Proper handling of tools and equipment<br>3.3 Performing preventive maintenance<br>3.4 Following instructions |
| 4. Resource Implications | The following resources should be provided:<br>4.1 Work place<br>4.2 Maintenance Schedule<br>4.3 Maintenance materials, tools and equipment relevant to the proposed activity/task |
| 5. Methods of Assessment | Competency should be assessed through:<br>5.1 Direct observation<br>5.2 Written test/questioning relevant to underpinning knowledge |
| 6. Context for Assessment | 6.1 Competency assessment may occur in workplace or any appropriate simulated environment<br>6.2 Competency assessment must be undertaken in accordance with the endorsed TESDA assessment guidelines |

**UNIT OF COMPETNCY : PERFORM HOUSEKEEPING AND SAFETY PRACTICES FOR RAC SERVICING**

**UNIT CODE : HVC7315201**

**UNIT DESCRIPTOR :** This unit covers the knowledge, skills and attitudes needed to work safely in the workplace including sorting, cleaning and dispensing materials, tools and equipment, identifying and minimizing hazards, responding and recording accidents and following basic security.

| ELEMENT | PERFORMANCE CRITERIA<br>***Italicized bold*** terms are elaborated in the Range of Variables |
|---|---|
| 1. Sort materials, tools and equipment | 1.1 Materials, tools and equipment are classified according to its kinds<br>1.2 Appropriate areas for materials, tools and equipment are designated |
| 2. Clean workplace area, materials, tools and equipment | 2.1 Cleaning materials are identified and used as per procedure<br>2.2 Workplace areas, materials, tools and equipment are cleaned as per company practices<br>2.3 Workplace are in safe state in accordance with safety regulations/company practices |
| 3. Systematize dispensing and retrieval of materials, tools and equipment | 3.1 Systems for requesting, borrowing and returning of materials, tools and equipment is in-place and implemented<br>3.2 Forms used are completely filled-up and filed<br>3.3 Borrowed tools, and equipment are returned to designated area<br>3.4 Consumable materials are requested in exact quantity |

| ELEMENT | PERFORMANCE CRITERIA<br>***Italicized bold*** terms are elaborated in the Range of Variables |
|---|---|
| 4. Identify and minimize/ eliminate hazards | 4.1 ***Hazards*** in the work area are recognized and reported to designated personnel and appropriate control actions are taken<br>4.2 Workplace policies and procedures for controlling risks are established and followed accurately<br>4.3 Workplace procedures for dealing with ***emergencies*** are followed whenever necessary within the scope of responsibilities and competencies<br>4.4 ***Safety signs and hazard warnings*** are displayed and observed at all times in line with workplace health and safety regulations<br>4.5 Equipment and safety devices***/PPE*** are used/handled according to company or manufacturer's procedures and guidelines<br>4.6 Work areas are kept clean, free from obstacles and emergency exits are know and kept clear at all times<br>4.7 Safe manual handling/fighting techniques and safe equipment operation techniques are employed at all times |
| 5. Respond and record accidents | 5.1 Workplace accidents are identified<br>5.2 Workplace emergency ***first-aid procedures/ treatment*** are followed/carried out correctly in accordance with ***standards/regulations*** and enterprise procedures/policies<br>5.3 Medical assistance/rescue is coordinated with concerned personnel in line with organizational policies<br>5.4 Accident/incident records maintained in accordance with standard operating procedures |
| 6. Follow basic security | 6.1 ***Security policies***/procedures are followed according to enterprise practices and appropriate legislation<br>6.2 Security related events are recorded/reported on the relevant forms<br>6.3 Staff are advised of enterprise security procedures and correct methods of implementation |

**RANGE OF VARIABLES**

| VARIABLE | RANGE |
|---|---|
| 1. Hazards | Hazards that may be present in the workplace include but not limited to:<br>1.1 Flammable materials<br>1.2 Running machinery/equipment<br>1.3 Toxic substances<br>1.4 Debris<br>1.5 Open flames<br>1.6 Loose objects/fixtures<br>1.7 Chemicals<br>1.8 Electrical faults<br>1.9 Hot metals |
| 2. Emergencies | Emergencies may include but not limited to:<br>2.1 Fire<br>2.2 Explosion<br>2.3 Spills<br>2.4 Falls<br>2.5 Electrocution<br>2.6 Injuries caused by falling objects<br>2.7 Injuries caused by sharp objects<br>2.8 Injuries caused by wrong usage of tools |
| 3. Safety signs, symbols and hazard warnings | Safety signs and symbols include but not limited to:<br>3.1 Industry recognized hazard warning signs and safety symbols<br>- Danger-High Voltage<br>- Unauthorized Persons Keep Out<br>- No Smoking<br>- Poisonous Gases<br>- Caution - Men working on line wires<br>3.2 Internationally recognized hazard warning signs and safety symbols |
| 4. Personal Protective Equipment (PPE) | PPE may include but not limited to:<br><br>4.1 Goggles<br>4.2 Gas mask<br>4.3 Working gloves<br>4.4 Safety shoes<br>4.5 Face shield<br>4.6 Insulating mat<br>4.7 Over-all apron<br>4.8 Hard hat<br>4.9 Safety belt<br>4.10 Protective eyewear |

| VARIABLE | RANGE |
|---|---|
| 5. First-aid Treatment | First-aid treatment includes but is not limited to:<br>5.1 CPR<br>5.2 Mouth to mouth resuscitation<br>5.3 Application of tourniquet<br>5.4 Application of pressure to bleeding wounds or cuts<br>5.5 First-aid treatment for burned victims |
| 6. Standards and Regulations | 6.1 Philippine Electrical Code<br>6.2 Philippine OH&S Standards<br>6.3 Building Code<br>6.4 Philippine Environmental Standards<br>6.5 Welding Procedures Specifications<br>6.6 Clean Air Act |
| 7. Security policies | 7.1 Wearing of ID<br>7.2 Logging-in and out<br>7.3 Wearing of uniform<br>7.4 Observance of safety/security signs and symbols |

**EVIDENCE GUIDE**

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|---|---|
| 1. Critical aspects of Competency | Assessment requires that the candidate:<br>1.1 Classified materials, tools and equipment according to kind<br>1.2 Cleaned workplace areas, materials, tools and equipment as per standard procedures<br>1.3 Implemented systematize dispensing and retrieval of materials, tools and equipment<br>1.4 Identified and described safety working practices relating to all tasks undertaken in the workplace<br>1.5 Identified and selected appropriate equipment and safety devices for particular workplace tasks and activities<br>1.6 Interpreted hazard warnings and safety signs correctly and described the application of these warnings and signs in the work activities<br>1.7 Carried out workplace emergency first-aid procedures/treatment in accordance with OHSA standards/legislation and enterprise procedures<br>1.8 Responded/maintained accidents/incidents records in accordance with SOPs<br>1.9 Followed security procedures/policies in accordance with enterprise practices and legislation<br>1.10 Kept workplace in safe state accordance with safety regulations |
| 2. Underpinning Knowledge | 2.1 Kinds and Uses of PPE<br>2.2 Identification of Safety Signs and Symbols |

| | |
|---|---|
| | 2.3 5S of Good Housekeeping<br>2.4 General OH&S principles, responsibilities and legislations<br>2.5 OH&S requirements in relations to work safety<br>2.6 Environmental requirements relative to work safety<br>2.7 Hazard identification and avoidance in the workplace<br>2.8 First-aid treatment procedures<br>2.9 Kinds of emergency situations – causes and how to deal with different situations<br>2.10 Kinds of injuries and effects<br>2.11 Accident/hazard reporting<br>2.12 Basic security procedures<br>2.13 Uses of Manuals |
| 3. Underpinning Skills | 3.1 Wearing the appropriate PPE<br>3.2 Reading skills required to interpret work instruction<br>3.3 Identifying safety signs and symbols<br>3.4 Practice of CPR, Mouth to Mouth Resuscitation and other First-Aid Treatment<br>3.5 Problem solving in emergency situation<br>3.6 Handling injured worker<br>3.7 Coordination of work in times of emergency<br>3.8 Fire fighting procedures and techniques<br>3.9 Reporting/recording accidents and potential hazards |
| 4. Resource Implications | The following resources should be provided:<br>4.1 Work place<br>4.2 Materials, tools and equipment relevant to the proposed activity/task<br>4.3 Safety signs<br>4.4 Safety devices<br>4.5 Accident reporting procedures<br>4.6 First-aid materials and guidelines |
| 5. Methods of Assessment | Competency should be assessed through:<br>5.1 Direct observation while task is being undertaken<br>5.2 Written test/questioning relevant to underpinning knowledge<br><br>Assessment of underpinning knowledge and practical skills may be combined |
| 6. Context for Assessment | 6.1 Competency assessment may occur in workplace or any appropriate simulated environment<br>6.2 Assessment shall be observed while task are being undertaken whether individually or in group in accordance with the approved industry OHSA regulations<br>6.3 Competency assessment must be undertaken in accordance with the endorsed TESDA assessment guidelines |

**UNIT OF COMPETENCY: DOCUMENT WORK ACCOMPLISHED**

**UNIT CODE : HVC311205**

**UNIT DESCRIPTOR :** This unit covers the knowledge, skills and attitudes in documenting work accomplished.

| ELEMENT | PERFORMANCE CRITERIA<br>***Italicized bold*** terms are elaborated in the Range of Variables |
|---|---|
| 1. Identify forms and data | 1.1 ***Forms*** are selected based on the reports to be prepared<br>1.2 ***Data*** are collected based on the reports to be prepared |
| 2. Prepare reports | 2.1 ***Reports*** are completed using standard form as per company procedures<br>2.2 Reports provide details of work completed, further action to be taken and other details as per company procedures<br>2.3 Reports are completed and submitted within specified time to the concerned personnel/supervisor |

**RANGE OF VARIABLES**

| VARIABLE | RANGE |
|---|---|
| 1. Forms | 1.1 Warranty Paper Request<br>1.2 Operating Log Sheet<br>1.3 Requisition Forms |
| 2. Data | 2.1 Current draw<br>2.2 Operating<br>2.3 Unit specifications<br>2.4 Records of work accomplished<br>2.5 Further work required<br>2.6 Spare parts used |
| 3. Reports | 3.1 Start-up commissioning Report<br>3.2 Warranty Paper Request<br>3.3 Turn-over Report<br>3.4 Operating Log Sheet<br>3.5 Service Report<br>3.6 Trouble Call Report<br>3.7 Requisition |

**EVIDENCE GUIDE**

| | |
|---|---|
| 1. Critical Aspects of Competency | Competency requires evidence that the candidate:<br>1.1 Prepared reports used terminology and language appropriate to all users<br>1.2 Prepared reports to include alternatives, views, approaches and other findings and recommendations for consideration by the supervisor<br>1.3 Prepared reports are coherent and based on actual findings/analysis/results<br>1.4 Prepared reports are accomplished, completed as per standard format and submitted within specified time to the concerned supervisor |
| 2. Underpinning Knowledge | 2.1 **SOURCES OF INFORMATION**<br>• Service manual<br>• Parts catalogue<br>• Service report<br>• Price estimates/quotation<br>• Warranty card<br>• Types and Uses of Forms<br>• Parts and Accessories |
| 3. Underpinning Skills | 3.1 Writing skills needed to complete prepared report forms<br>3.2 Reading skills used to read manuals and specifications |
| 4. Resource Implications | Things necessary to conduct method of assessment:<br>4.1 Work place location<br>4.2 Materials relevant to the proposed activity |
| 5. Methods of Assessment | Competency in this unit must be assessed through:<br>5.1 Direct observation<br>5.2 Questions related to underpinning knowledge |
| 6. Context for Assessment | 6.1 Competency may be assessed in the work place or in a simulated work place setting |

## CORE COMPETENCIES

**UNIT OF COMPETENCY: SURVEY SITE FOR AIR DUCT INSTALLATION**

**UNIT CODE : HVC723331**

**UNIT DESCRIPTOR :** This unit covers the knowledge, skills and attitude in surveying site for installation of air duct system such as exhaust and fresh air ducts and ventilating ducts.

| ELEMENT | PERFORMANCE CRITERIA<br>***Italicized bold*** terms are elaborated in the Range of Variables |
|---|---|
| 1. Prepare for surveying site | 1.1 Work instructions are read and interpreted to determine job requirements<br>1.2 Technical plan/drawing is interpreted as per job requirements<br>1.3 ***Equipment, tools,*** and materials are prepared according to plan and specifications<br>1.4 ***Components*** of HVAC/R ductworks system to be installed are identified as per job requirements |
| 2. Survey site | 2.1 Site is surveyed as per approved sketch/ ***plans and permits***<br>2.2 Alteration/comments are prepared as per survey conducted<br>2.3 Result of survey is prepared and submitted to appropriate personnel/ supervisor |

**RANGE OF VARIABLES**

| VARIABLE | RANGE |
|---|---|
| 1. Components | 1.1 System equipment location<br>1.2 Air Duct- installation<br>1.3 Ventilating Fans location<br>1.4 Exhaust & Fresh air Blowers location<br>1.5 Diffusers & Grilles location<br>1.6 Damper ( volume, fire and smoke ) |
| 2. Tools & Equipment | 2.1 Measuring tools such as push pull<br>2.2 Ladder / Scaffolding |
| 3. Mechanical plans & permit | 3.1 Mechanical plan: Air Duct System & Ventilation plan<br>3.2 Survey form / permit to survey |

**EVIDENCE GUIDE**

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| 1. Critical Aspects of Competency | Competency requires evidence that the candidate:<br>1.1 Surveyed site as per approved sketch/plan<br>1.2 Prepared alteration/comments as per survey conducted<br>1.3 Applied organizational quality procedure and process within the context of surveying site for installation<br>1.4 Selected and used appropriate processes, tools and equipment to carry out tasks<br>1.5 Communicated interactively with others where applicable to ensure safe and effective work operations |
| 2. Underpinning Knowledge | 2.1 **BLUEPRINT READINGS**<br>• Mechanical plans, symbols and abbreviations<br>2.2 **TRADE MATHEMATICS/MENSURATION**<br>• Linear measurement<br>• Dimension<br>• Unit conversion<br>• Ratio & proportion<br>2.3 **LEGISLATION/CODE**<br>• Building Code<br>• Mechanical Engineering Code<br>• SMACNA Duct Construction Standards<br>• NFPA90A/90B<br>• ASHRAE<br>2.4 **TRADE THEORY**<br>• Principles of air distribution<br>• Principles of Fans & Blowers<br>• Duct sizing<br>• Materials specifications<br>• Types and uses of ladders, platforms and scaffolding.<br>• Types of supports and hangers<br>• Types and uses of dampers and louvers.<br>• Types and uses of grilles and diffusers |
| 3. Underpinning Skills | 3.1 Interpreting plan and specifications<br>3.2 Communication skills |
| 4. Resource Implications | Things necessary to conduct method of assessments:<br>4.1 Technical plan/drawing relevant to the task<br>4.2 Materials relevant to the proposed activity |
| 5. Methods of Assessment | Competency in this unit must be assessed through:<br>5.1 Direct observation<br>5.2 Demonstration<br>5.3 Portfolio Report<br>5.4 Questions related to underpinning knowledge |
| 6. Context for Assessment | 6.1 Competency may be assessed in the work place or in a simulated work place setting |

**UNIT OF COMPETENCY: FABRICATE AIR DUCTS**

**UNIT CODE : HVC723332**

**UNIT DESCRIPTOR :** This unit covers the knowledge, skills and attitudes required to fabricate air ducts for HVAC/R technology in accordance with duct construction standards. It includes preparing materials , lay-out , cutting , bending and duct assembly .

| ELEMENT | PERFORMANCE CRITERIA<br>***Italicized bold*** terms are elaborated in the Range of Variables |
|---|---|
| 1. Prepare of air duct fabrication requirements | 1.1 ***Work instructions*** are read and interpreted<br>1.2 ***Air duct requirements*** are prepared and checked for damages in accordance with specifications<br>1.3 ***Tools and equipment*** are selected in accordance with job requirements<br>1.4 Work is undertaken in line with safety rules and regulations |
| 2. Lay-out air ducts | 2.1 Patterns are prepared/checked according to established procedures<br>2.2 Sheet metal is ***laid-out*** in conformity with design and specification<br>2.3 Patterns are carefully measured and free of burrs<br>2.4 Materials are used economically in accordance with established procedures |
| 3. Cut and bend sheet metal | 3.1 Sheet metal is cut in accordance with the lay out using manual and power hand tools<br>3.2 Standard cutting process is applied and observed<br>3.3 Cutting edge is maintained sharp<br>3.4 Straight curve and circular cutting is done with correct tool selection<br>3.5 Work is undertaken in line with safety requirements<br>3.6 Sheet metals are folded in accordance with tolerances of cuts and bends<br>3.7 Waste materials are disposed according to established procedures |
| 4. Assemble air ducts | 4.1 Dimension is checked as specified on the drawing<br>4.2 Longitudinal seam is aligned<br>4.3 Duct is free of wrinkles or dents<br>4.4 Joint connections are selected in |

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| | accordance with job requirements<br>4.5 Joints are checked to ensure fit and air tightness in line with standard procedure<br>4.6 Work is undertaken in line with ***safety requirements*** |

**RANGE OF VARIABLES**

| VARIABLE | RANGE |
|---|---|
| 1. Work Instructions | May include but not limited to:<br>1.1 Mechanical plan and specification<br>1.2 Air duct system manual & design<br>1.3 Detail drawings |
| 2. Air duct requirements | May include but not limited to:<br>2.1 Sheet metal – G.I.; B.I.; Stainless Aluminum<br>2.2 Angular steel / Round Bar/ Flat Bar<br>2.3 Duct sox : Vinyl Polyester<br>2.4 Marking pen<br>2.5 Sealant / Adhesive<br>2.6 Insulation : Fiberglass/ Rubber/ Styrophor/ Polyurethane |
| 3. Tool | 3.1 Sheet metal gage<br>3.2 Scratch awl/ scriber<br>3.3 Steel rule<br>3.4 T-Square<br>3.5 Dividers<br>3.6 Push-pull rule<br>3.7 Triangle<br>3.8 Straight snip<br>3.9 Aviation snip (left, straight, right, &notching)<br>3.10 Tin snip<br>3.11 Cold chisel<br>3.12 Center puncher<br>3.13 Hacksaw<br>3.14 Ball peen hammer<br>3.15 Hand riveter<br>3.16 Straight peen hammer<br>3.17 Mallet ( rubber, plastic )<br>3.18 Setting Hammer |

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| 4. Equipments | 4.1 Electric hand drill<br>4.2 Arc Welding set<br>4.3 Oxy / Acetylene outfit<br>4.4 Bender machine<br>4.5 Slip form roll machine<br>4.6 Squaring sheer<br>4.7 Box and pan brake<br>4.8 Bar folder<br>4.9 Electric spot welding<br>4.10 Plasma arc cutting outfit |
| 5. Lay out | May include but not limited to:<br>5.1 Rectangular<br>5.2 Square<br>5.3 Round<br>5.4 Circular<br>5.5 Transition<br>5.6 Offset |
| 6. Safety requirements | 6.1 Personal safety<br>6.2 Personal Protective Equipment (PPE)<br>6.3 Safety of others<br>6.4 Signs & Warnings |

**EVIDENCE GUIDE**

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| 1. Critical Aspects of Competency | Competency requires evidence that the candidate:<br>1.1 Read and interpreted work instructions to determine job requirements<br>1.2 Selected tools, equipment & materials in line with job requirements<br>1.3 Fabricated, positioned, and levelled air duct system in line with drawings, designs & specification<br>1.4 Employed safe manual handling techniques in line with enterprise procedures<br>1.5 Demonstrated compliance with safety regulation applicable to worksite operations.<br>1.6 Cleaned worksite & kept in a safe state in accordance with enterprise procedure.<br>1.7 Communicated interactively with others where applicable to ensure safety and effective work operations. |

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| 2. Underpinning Knowledge | 2.1 **SAFETY PRACTICES**<br>• PPE<br>• Handling of materials, tools, and equipment.<br>• Safety signs and symbols<br>• Knowledge of 5s + 1<br>• First aid treatment<br>• Safety and health regulation<br>2.2 **TRADE MATHEMATICS/MENSURATION**<br>• Linear measurements<br>• Dimensions<br>• Ratio and proportion<br>• Unit conversion<br>• Calculation of area , volume and weight<br>• Calculation of 2D geometric shapes<br>• Trigonometric functions and theorems<br>2.3 **Blueprint / Plan reading and Specification**<br>• Mechanical plan, symbols & abbreviations<br>• Detailed & section plan<br>2.4 **Legislation**<br>• Building code<br>• Mechanical Engineering code<br>• SMACNA Duct Construction Standards<br>• NFPA 90A/90B<br>2.5 **Tools and Materials : Uses and Specification**<br>• Lay-out and measuring tool<br>• Sheet metal cutting tools<br>• Bending and forming tools<br>• Drilling and Punching tools<br>• Holding and clamping tools<br>• Riveting tools<br>• Soldering tools<br>• Hangers and Supports<br>• Air Ducting materials<br>• Rivets<br>• Screws<br>• Bolts, nuts & washers<br>• Joints connection tools**.** |

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| | 2.6 **TRADE THEORY**<br>• Air Duct Fabrication Procedures<br>• Principles & Fundamental of Air Duct<br>• How to select sheet metal material size and gauge<br>• Triangulation method of surface and pattern development<br>2.7 **PROCESSES/PROCEDURES**<br>• Cutting/Shearing Process<br>- Cutting tolerances<br>- Materials distortions<br>- Cutting straight, curve, circular and other geometric figures sheet metals<br>- Cutting using portable power nibbler<br>- Machine cutting of sheet metal<br>- Plasma arc cutting of metals<br>• Forming Process<br>- Hand forming<br>- Machine forming<br>- Edging and hemming<br>- Forming seams and cleats<br>• Joining and Fastening Process<br>- Joining by soldering and brazing<br>- Joining using rivets, screws and bolts<br>- Joining using flanges and cleats<br>• Fabricating Process<br>- Straight ducts; Round, Square and Rectangular<br>- Elbow and bends fabrication procedures'<br>- Extractors and take- off fabrication procedures<br>- Laterals and tees fabrication procedures<br>- Transition pieces ;collars and connector |

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| 3. Underpinning Skills | 3.1 Interpreting plan and details<br>3.2 Preparing materials and specifications<br>3.3 Proper handling of tools & equipment<br>3.4 Work safety practices<br>3.5 Setting-up work<br>3.6 Performing sheet metal works<br>3.7 Triangulation method of surface and pattern development<br>3.8 Lay-outing technique<br>3.9 Cutting, Bending and Joining technique<br>3.10 Welding procedures |
| 4. Resource Implications | The following resources **MUST** be provided:<br>4.1 Work place location<br>4.2 Tools and equipment appropriate to fabricates air ducts<br>4.3 Materials relevant to the proposed activity<br>4.4 Drawings and specifications relevant to the task |
| 5. Methods of Assessment | Competency may be assessed through:<br>5.1 Direct observation<br>5.2 Demonstration<br>5.3 Portfolio report<br>5.4 Questions related to underpinning knowledge |
| 6. Context for Assessment | 6.1 Competency may be assessed in the work place or in a simulated work place setting |

**UNIT OF COMPETENCY : INSTALL AIR DUCT SYSTEM**

**UNIT CODE : HVC723333**

**UNIT DESCRIPTOR :** This unit covers the knowledge, skills and attitudes required to install air ducts in accordance with duct construction standards. It includes preparation of materials, erection of platforms and scaffoldings, and installation of hangers and supports,

| ELEMENT | PERFORMANCE CRITERIA<br>***Italicized bold*** terms are elaborated in the Range of Variables |
|---|---|
| 1 Prepare air duct installation requirements | 1.1 ***Work instructions*** are read and interpreted to determine ***air duct requirements***<br>1.2 ***Tools and Equipment*** are selected in accordance with job requirements<br>1.3 Area of work is cleaned and appropriate signs and warnings is placed<br>1.4 ***Supplies and materials*** are prepared and checked in accordance with the specifications |
| 2 Install/ Erect platforms and scaffoldings | 2.1 ***Platforms & scaffoldings*** are selected accordance with job requirements<br>2.2 Platforms and scaffoldings are rigidly erected according to established procedures<br>2.3 Work is undertaken in line with safety rules and regulations<br>2.4 Signs and warning are properly place in appropriate location |
| 3. Install hangers & supports | 3.1 ***Hangers & supports*** are selected in accordance with the plan<br>3.2 Hangers and supports are fabricated in conformity with design and specification<br>3.3 Dimensions and distance are observed according to specification and drawing<br>3.4 Hangers and supports are attached to the structural framing and concrete slabs preventing the anchor from puncturing the metal decking<br>3.5 Vertical duct is fastened with minimum of 2 supports at each floor. |
| 4. Install air duct system and its components | 4.1 Duct work is aligned at connections within 3mm tolerances and with smooth internal surfaces<br>4.2 Air ducts are installed with suitable ties, braces, hangers and anchors to prevent movement, drumming, buckling and sagging under all operating conditions |

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| | 4.3 Installed air ducts are located in conformity with the approved plan/design<br>4.4 Air ducts are installed achieving air tightness and noiseless system<br>4.5 ***Air terminals*** are installed and aligned in accordance with drawings and designs<br>4.6 Work is undertaken in line with safety requirements<br>4.7 ***Safety requirements*** are observed through out the process |

**RANGE OF VARIABLES**

| VARIABLE | RANGE |
|---|---|
| 1. Work Instructions | May include but are not limited to:<br>1.1 Mechanical plan with specification<br>1.2 Air duct system manual & design<br>1.3 Detailed drawings |
| 2. Air duct requirements/materials | May include but are not limited to:<br>2.1 Sheet metal – G.I.; B.I.; Stainless Aluminum<br>2.2 Angular steel / Round Bar/ Flat Bar<br>2.3 Duct sox : Vinyl Polyester<br>2.4 Marking pen<br>2.5 Sealant / Adhesive<br>2.6 Insulation : Fiberglass/ Rubber/ Styrophor/ Polyurethane |
| 3. Platforms and scaffolding | May include but are not limited to:<br>3.1 Two Ladders and Platform<br>3.2 Hire and Tresles and Boards<br>3.3 Steel Scaffolding<br>3.4 Rolling Scaffolding |
| 4. Hangers and supports | May include but are not limited to:<br>4.1 Expansion bolts and nuts<br>4.2 Threaded rods<br>4.3 Connector bushing<br>4.4 Angle bar<br>4.5 Anti-vibration hangers<br>4.6 Clamps for folded spiral-seam tube |

| VARIABLE | RANGE |
|---|---|
| 5. Tool | May include but are not limited to:<br>5.1 Plumb bob<br>5.2 Level Hose<br>5.3 Steel rule<br>5.4 Push-pull rule<br>5.5 Spirit level<br>5.6 Chalk line<br>5.7 Straight snip<br>5.8 Aviation snip (left, straight, right, and notching)<br>5.9 Tin snip<br>5.10 Cold chisel<br>5.11 Center puncher<br>5.12 Hacksaw<br>5.13 Ball peen hammer<br>5.14 Hand riveter<br>5.15 Straight peen hammer<br>5.16 Mallet (rubber, plastic)<br>5.17 Setting Hammer<br>5.18 Adjustable wrench<br>5.19 Screw driver (Flat and Philip) |
| 6. Equipments | May include but are not limited to:<br>6.1 Electric hand drill<br>6.2 Arc Welding set<br>6.3 Oxy / Acetylene outfit<br>6.4 Jig Saw |
| 7. Air Terminal | May include but are not limited to:<br>7.1 Grilles and Registers<br>7.2 Diffusers<br>7.3 Dampers<br>7.4 Gravity shutters<br>7.5 Flexible Connections<br>7.6 Ducts Test Holes<br>7.7 Ducts Heaters<br>7.8 Sound Attenuator |
| 8. Safety requirements | May include but are not limited to:<br>8.1 Personal safety<br>8.2 Personal Protective Equipment (PPE)<br>8.3 Safety of others<br>8.4 Signs & Warnings |

**EVIDENCE GUIDE**

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|---|---|
| 1. Critical Aspects of Competency | Competency requires evidence that the candidate:<br>1.1 Read and interpreted work instructions to determine job requirements<br>1.2 Selected tools, equipment & materials in line with job requirements<br>1.3 Completed installation of air duct system and correctly positioned & levelled in line with drawings, designs and specification<br>1.4 Employed safe manual handling techniques in line with enterprise procedures<br>1.5 Demonstrated compliance with safety regulation applicable to worksite operations<br>1.6 Identified faults and problems and made necessary action to rectify in line with ducts construction standard<br>1.7 Cleaned worksite & kept in a safe state in accordance with enterprise procedure<br>1.8 Communicated interactively with others where applicable to ensure safety and effective work operations |
| 2. Underpinning Knowledge | 2.1 **BLUEPRINT READINGS**<br>• Mechanical plans, symbols and abbreviations Detailed drawings<br>2.2 **TRADE MATHEMATICS/MENSURATION**<br>• Linear measurement<br>• Dimension<br>• Unit conversion<br>• Ratio & proportion<br>• Velocity computation<br>• Volume<br>2.3 **LEGISLATION/CODE**<br>• Building Code<br>• Mechanical engineering Code<br>• SMACNA Duct Construction Standards<br>• NFPA90A/90B<br>• ASHRAE<br>2.4 **TRADE THEORY**<br>• Principles of air distribution<br>• Principles of Fans & Blowers<br>• Equipment selection and application<br>• Duct sizing<br>• Materials specifications<br>• Types and uses of ladders, platforms and scaffolding.<br>• Types of supports and hangers<br>• Types and uses of dampers and louvers.<br>• Types and uses of grilles and diffusers<br>• Types and uses of dampers |

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| 3. Underpinning Skills | 3.1 Interpreting plan and specifications<br>3.2 Preparing materials<br>3.3 Communication skills<br>3.4 Problem Solving |
| 4. Resource Implications | The following resources must be provided:<br>4.1 Technical plan/drawing relevant to the task<br>4.2 Materials relevant to the proposed activity |
| 5. Methods of Assessment | Competency in this unit must be assessed through:<br>5.1 Direct observation<br>5.2 Demonstration<br>5.3 Questions related to underpinning knowledge<br>5.4 Portfolio Report |
| 6. Context for Assessment | 6.1 Competency may be assessed in the work place or in a simulated work place setting |

**UNIT OF COMPETENCY** : **PERFORM AIR-DUCT TESTING**

**UNIT CODE** : **HVC723334**

**UNIT DESCRIPTOR** : This unit covers the knowledge, skills and attitudes required to perform air-ducts testing in accordance with Duct Construction Standards

| ELEMENT | PERFORMANCE CRITERIA<br>***Italicized bold*** terms are elaborated in the Range of Variables |
|---|---|
| 1. Prepare for air duct test | 1.1 Work instructions are read and interpreted to determine job requirements<br>1.2 ***Materials, tools & equipment*** are selected in accordance with job requirements<br>1.3 Testing method and procedures are determined/prepared in accordance with standard operating procedure<br>1.4 Pre-testing is performed and complied according to procedures laid down in system documents<br>1.5 PPE is prepared and checked in line with job requirements |
| 2. Test air duct | 2.1 Testing materials / instruments are prepared and checked<br>2.2 Duct lengths are not in excess of 30 meters for vertical ducts and not in excess of 45 meters for horizontal ducts<br>2.3 Air duct system is checked for leaks applying light / smoke test method<br>2.4 Joints are checked to ensure fit and air tightness in line with standard procedure<br>2.5 Leaks are repaired according to system requirements<br>2.6 Work is undertaken in line with ***safety rules and regulations*** |

**RANGE OF VARIABLES**

| VARIABLE | RANGE |
|---|---|
| 1. Materials | May include but not limited to:<br>1.1 Sulfur stick<br>1.2 Electrical tape<br>1.3 Blind rivets<br>1.4 Red oxide/paint<br>1.5 B.I. fittings<br>1.6 Insulation spacers<br>1.7 Nitrogen gas<br>1.8 Clamps |
| 2. Tool | May include but not limited to:<br>2.1 Level Hose<br>2.2 Steel rule<br>2.3 Push-pull rule<br>2.4 Spirit level<br>2.5 Chalk line<br>2.6 Straight snip<br>2.7 Aviation snip (left, straight, right, and notching)<br>2.8 Tin snip<br>2.9 Hacksaw<br>2.10 Ball peen hammer<br>2.11 Hand riveter<br>2.12 Straight peen hammer<br>2.13 Adjustable wrench<br>2.14 Screw driver (Flat and Philip) |
| 3. Equipment | May include but not limited to:<br>3.1 Electric hand drill<br>3.2 Blower<br>3.3 Nitrogen regulator<br>3.4 Manometer |
| 4. Safety rules and regulations | May includes but not limited to:<br>4.1 Personal safety<br>4.2 Personal Protective Equipment (PPE)<br>4.3 Safety of others<br>4.4 Signs & Warnings |

**EVIDENCE GUIDE**

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|---|---|
| 1. Critical Aspects of Competency | Competency requires evidence that the candidate:<br>1.1 Read and interpreted work instructions to determine job requirements<br>1.2 Selected tools, equipment & materials are in line with job requirements<br>1.3 Tested air duct in accordance with system instructions and specifications<br>1.4 Employed safe manual handling techniques in line with enterprise procedures<br>1.5 Demonstrated compliance with safety regulation applicable to worksite operations<br>1.6 Identified faults and problems and made necessary action to rectify in line with ducts construction standard<br>1.7 Cleaned worksite & kept in a safe state in accordance with enterprise procedure<br>1.8 Communicated interactively with others where applicable to ensure safety and effective work operations |

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| 2. Underpinning Knowledge | 2.1 **BLUEPRINT READINGS**<br>• Mechanical plans, symbols and abbreviations<br>• Detailed drawings<br>2.2 **TRADE MATHEMATICS/MENSURATION**<br>• Linear measurement<br>  • Dimension<br>  • Unit conversion<br>  • Ratio & proportion<br>  • Velocity computation<br>  • Volume<br>2.3 **LEGISLATION/CODE**<br>  • Building Code<br>  • Mechanical engineering Code<br>  • SMACNA Duct Construction Standards<br>  • NFPA90A/90B<br>  • ASHRAE<br>2.4 **TRADE THEORY**<br>• Principles of air distribution<br>• Principles of Fans & Blowers<br>• Equipment selection and application<br>• Duct sizing<br>• Materials specifications<br>• Types and uses of ladders, platforms and scaffolding.<br>• Types of supports and hangers<br>• Types and uses of dampers and louvers.<br>• Types and uses of grilles and diffusers<br>• Types and uses of dampers<br>• Types and uses of insulation and sealant<br>• Duct leakage testing procedures |
| 3. Underpinning Skills | 3.1 Interpreting plan and specifications<br>3.2 Preparing materials<br>3.3 Proper use of duct testing tools and equipments<br>3.4 Communication skills<br>3.5 Problem Solving |
| 4. Resource Implications | The following resources must be provided:<br>4.1 Access to work place location<br>4.2 Tools and equipment appropriate for leak testing<br>4.3 Technical plan/drawing relevant to the task<br>4.4 Materials relevant to the proposed activity |
| 5. Methods of Assessment | Competency in this unit must be assessed through:<br>5.1 Direct observation<br>5.2 Demonstration<br>5.3 Questions related to underpinning knowledge |
| 6. Context for Assessment | 6.1 Competency may be assessed in the work place or in a simulated work place setting |

**UNIT OF COMPETENCY : INSULATE AIR DUCTS**

**UNIT CODE : HVC723335**

**UNIT DESCRIPTOR :** This unit covers the knowledge, skills and attitudes required to insulate air ducts. It includes preparation of insulation requirements and applying duct liners

| ELEMENT | PERFORMANCE CRITERIA<br>***Italicized bold*** terms are elaborated in the Range of Variables |
|---|---|
| 1. Prepare insulation materials and requirements | 1.1 Work instructions and plans are read and interpreted to determine insulation requirements<br>1.2 Insulating/ sealing/ adhesive ***materials*** are checked in accordance with specification and insulation requirements<br>1.3 Insulation requirements are prepared and checked for damage according to established procedures<br>1.4 ***Tools and instruments*** are identified and prepared according to job requirements |
| 2. Insulate air ducts | 2.1 Insulation of air ducts is tightly fitted with no sag<br>2.2 All connections or joints are sealed according to air duct requirements<br>2.3 Work is undertaken in line with safety requirements<br>2.4 Waste materials are disposed in accordance with established disposal procedures |
| 3. Apply duct liners | 3.1 Air duct linings are checked in accordance with approved material specifications<br>3.2 Lining is applied in accordance with manufacturer's instructions<br>3.3 Air duct is checked/tested for leaks and damages in accordance with system requirements<br>3.4 ***Air distribution system*** is checked in accordance with approved design and plan<br>3.5 Work is undertaken in line with ***safety requirements*** |

**RANGE OF VARIABLES**

| VARIABLES | RANGE |
|---|---|
| 1. Materials | May include but not limited to:<br>1.1 Insulations: fiberglass, rubber, styrophor<br>1.2 Duct tape<br>1.3 Sheet Metal: G.I., B.I., Stainless Aluminum<br>1.4 Acoustic Liner<br>1.5 G.I Wire<br>1.6 Sealant/ adhesive |
| 2. Safety requirements | May include but not limited to:<br>2.1 Personal Protective Equipment (PPE)<br>2.2 Personal safety<br>2.3 Safety of others |
| 3. Tools and Instruments | May include but not limited to:<br>3.1 Cutting tools<br>3.2 Anemometer<br>3.3 Valometer<br>3.4 Sound level meter<br>3.5 Flash light<br>3.6 Trouble light<br>3.7 Fliers |
| 4. Air Distribution System | May include but not limited to:<br>4.1 Ducting design<br>4.2 Area Requirement<br>4.3 Air terminals<br>4.4 Air Swing |

**EVIDENCE GUIDE**

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| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:<br>1.1 Performed visual inspection of all air duct system prior to insulation<br>1.2 Selected types of tools, equipment, instruments and materials in accordance with specification and job requirements<br>1.3 Performed air duct insulation as per standard operating procedures<br>1.4 Reported and repaired any signs of damage according to specification<br>1.5 Applied organizational quality procedures and processes within context of insulating air duct system<br>1.6 Demonstrated compliance with safety regulations applicable to worksite operation<br>1.7 Communicated interactively with others where applicable to ensure and effective work operation. |
| 2. Underpinning Knowledge | 2.1 **SAFETY PRACTICES**<br>• PPE / safety gears<br>• Safe handling of tools and equipment<br>• Safety signs and symbols<br>• Safety hazard<br>• Good housekeeping<br>2.2 **PLAN READING AND SPECIFICATION**<br>• Mechanical plan/symbols and abbreviation<br>• As built plan<br>2.3 **LEGISLATION/CODE**<br>• Building Code<br>• Mechanical engineering Code<br>• SMACNA Duct Construction Standards<br>• NFPA90A/90B<br>• ASHRAE<br>2.4 **TRADE THEORY**<br>• Fundamentals and principles of Air Duct System<br>• Nature of sound<br>• Principles of Fans and Blowers<br>• Duct Design and Manuals<br>• Air Duct Testing Procedure |

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| | 2.5 **TRADE MATHEMATICS/MENSURATION**<br>• Linear measurements<br>• Dimension<br>• Ratio and proportion<br>• Unit Conversion<br>• Area and Volume<br>2.6 **TOOLS/MATERIALS, USES AND SPECIFICATIONS**<br>• Materials selection and specification<br>• Proper use and care of tools needed<br>• Types of Insulation<br>• Types of Sealant/Adhesive<br>• Steel bar sizes selection<br>• Selection and uses of Riveting Tools<br>2.7 **PROCESSESS/PROCEDURES**<br>• Duct Work Insulation Procedures<br>• Acoustic Duct Lining Procedures |
| 3. Underpinning Skills | 3.1 Interpreting plan and details<br>3.2 Preparation of materials<br>3.3 Work safety<br>3.4 Handling of tools and insulation equipment<br>3.5 Communicating effectively<br>3.6 Preparing reports<br>3.7 Testing air duct system |
| 4. Resource Implications | The following materials must be provided:<br>4.1 Work place or simulated workplace setting<br>4.2 Materials, tools and equipment appropriate to air duct system insulation activities<br>4.3 Drawings and specifications relevant to the task |
| 5. Methods of Assessment | Competency in this unit must be assessed:<br>5.1 Direct observation<br>5.2 Demonstration<br>5.3 Questions related to underpinning knowledge<br>5.4 Portfolio |
| 6. Context for Assessment | 6.1 Competency may be assessed in the work place or in a simulated work place setting |

**UNIT OF COMPETENCY: REPAIR and MAINTAIN AIR DUCT SYSTEM**

**UNIT CODE : HVC723336**

**UNIT DESCRIPTOR :** This unit covers the knowledge, skills and attitudes required to repair and maintenance air ducts system in accordance with Duct Construction Standards.

| ELEMENT | PERFORMANCE CRITERIA<br>***Italicized bold*** terms are elaborated in the Range of Variables |
|---|---|
| 1. Evaluate condition of existing air duct system | 1.1 Visual inspection of air duct system is performed and any signs of damage are recorded and reported<br>1.2 Data is analyzed and evaluated according to system requirements<br>1.3 ***Materials*** are checked and prepared consistent with job requirements<br>1.4 ***Forms and documents*** are secured and prepared according to established procedures<br>1.5 Appropriate PPE is selected in line with safety rules and regulations |
| 2. Repair / Replace damaged air duct system and components | 2.1 System components are inspected and tested in accordance with established procedures<br>2.2 Faults and damages are identified and diagnosed in accordance with system requirements<br>2.3 Tools and equipment are selected in accordance with required tasks<br>2.4 Faulty components are replaced/repaired according to design<br>2.5 Work is undertaken in line with ***safety requirements*** including use of appropriate PPE |
| 4. Perform preventive maintenance | 4.1 Testing ***tools and instruments*** are prepared in accordance with system requirements<br>4.2 Inspection and testing is performed according to air duct system principles and requirements<br>4.3 ***Air distribution system*** are checked and airflows are balanced according to established procedures<br>4.4 Maintenance records/service reports are accomplished in accordance with standard policies and procedures |

**RANGE OF VARIABLES**

| VARIABLES | RANGE |
|---|---|
| 1. Materials | May include but not limited to:<br>1.1 Insulations: fiberglass, rubber, styrophor<br>1.2 Duct tape<br>1.3 Sheet Metal- G.I., B.I., Stainless Aluminum<br>1.4 Steel Bars- Flat bar, round bar, Angles<br>1.5 • Sealant/ adhesive |
| 2. Safety requirements | May include but not limited to:<br>2.1 Personal Protective Equipment (• PPE)<br>2.2 Personal safety<br>2.3 Safety of others |
| 3. Tools and Instruments | May include but not limited to:<br>3.1 Cutting tools<br>3.2 Anemometer<br>3.3 • Valometer<br>3.4 Sound Level Meter<br>3.5 Flash light<br>3.6 Trouble light |
| 4. Forms and Documents | May include but not limited to:<br>4.1 Maintenance record book<br>4.2 Job sheet<br>4.3 Request for repair forms<br>4.4 Equipment history forms<br>4.5 Preventive maintenance chart |
| 5. Air distribution system | May include but not limited to:<br>5.1 • Ducting design<br>5.2 Area requirements<br>5.3 Air terminals<br>5.4 Air swing |

**EVIDENCE GUIDE**

| | |
|---|---|
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:<br>1.1 Performed visual inspection of all air duct system<br>1.2 Selected types of tools, equipment, instruments and materials in accordance with the specification and job requirements<br>1.3 Identified and diagnosed faults in accordance with the standard operating procedures<br>1.4 Reported and repaired any signs of damage according to system requirements<br>1.5 Tested air duct system operation according to established procedures<br>1.6 Checked and maintained air distribution system to meet operational and regulatory requirements<br>1.7 Applied organizational quality procedures and processes<br>1.8 Performed preventive maintenance in accordance with system requirements<br>1.9 Demonstrated compliance with safety regulations applicable to worksite operation |
| 2. Underpinning Knowledge | 2.1 **SAFETY PRACTICES**<br>• PPE / safety gears<br>• Safe handling of tools and equipment<br>• Safety signs and symbols<br>• Safety hazard<br>• Good housekeeping<br>2.2 **PLAN READING AND SPECIFICATION**<br>• Mechanical plan/symbols and abbreviation<br>• As built plan<br>2.3 **LEGISLATION/CODE**<br>• Building Code<br>• Mechanical engineering Code<br>• SMACNA Duct Construction Standards<br>• NFPA90A/90B<br>• ASHRAE<br>2.4 **TRADE THEORY**<br>• Fundamentals and principles of Air Duct System<br>• Basic Welding<br>• Principles of Fans and Blowers<br>• Duct Design and Manuals<br>• Air Duct Testing Procedure |

| | |
|---|---|
| | **2.5 TRADE MATHEMATICS/MENSURATION**<br>● Linear measurements<br>● Dimension<br>● Ratio and proportion<br>● Unit Conversion<br>● Area and Volume<br>**2.4 TOOLS/MATERIALS, USES AND SPECIFICATIONS**<br>● Materials selection and specification<br>● Proper use and care of tools needed<br>● Types of Insulation<br>● Types of Sealant/Adhesive<br>● Steel bar sizes selection<br>● Selection and uses of Riveting Tools<br>2.5 **MAINTENANCE**<br>● Preventive Maintenance<br>**2.7 PROCESSESS/PROCEDURES**<br>● Maintenance Procedures<br>● Replacement Procedures<br>● Testing Procedures |
| 3. Underpinning Skills | 3.1 Interpreting plan and details<br>3.2 Preparing materials<br>3.3 Work safety<br>3.4 Prepare handling of tools and testing equipment<br>3.5 Communicating effectively<br>3.6 Preparing Reports |
| 4. Resource Implications | The following resources must be provided:<br>4.1 Work place or simulated workplace setting<br>4.2 Materials, tools and equipment appropriate to repairing/maintaining air duct system<br>4.3 Drawings and specifications relevant to the task |
| 5. Methods of Assessment | Competency in this unit must be assessed through:<br>5.1 Direct observation<br>5.2 Demonstration<br>5.3 Questions related to underpinning knowledge<br>5.4 Portfolio |
| 6. Context for Assessment | 6.1 Competency may be assessed in the work place or in a simulated work place setting |

## SECTION 3 TRAINING STANDARDS

These guidelines are set to provide technical and vocational education and training (TVET) providers with information and other important requirements to consider when designing training programs for AIR DUCT SERVICING NC II.

### 3.1 CURRICULUM DESIGN

**Course Title : AIR DUCT SERVICING**

**NC Level : NC II**

**Nominal Duration : 144 Hours (Basic)**
**212 Hours (Common)**
**240 Hours (Core)**

**Course Description:**

This course is designed to equip individual with operational skills to install, service and maintain, troubleshoot and repair Air Duct System In HVAC/R technology in accordance with Duct Construction Standards

To obtain this, all units prescribed for this qualification must be achieved:

## BASIC COMPETENCIES

| Unit of Competency | Learning Outcomes | Methodology | Assessment Approach |
|---|---|---|---|
| 1. Participate in workplace communication | 1.1 Obtain and convey workplace information<br>1.2 Complete relevant work related documents<br>1.3 Participate in workplace meeting and discussion | Group discussion<br>Interaction | • Demonstration<br>• Interview/ questioning |
| 2. Work in a team environment | 2.1 Describe and identify team role and responsibility in a team<br>2.2 Describe work as a team member | Discussion<br>Interaction | • Demonstration<br>• Interview/ questioning |

| Unit of Competency | Learning Outcomes | Methodology | Assessment Approach |
|---|---|---|---|
| 3. Practice career professionalism | 3.1 Integrate personal objectives with organizational goals<br>3.2 Set and meet work priorities<br>3.3 Maintain professional growth and development | Discussion<br>Interaction | • Demonstration<br>• Interviews/ questioning |
| 4. Practice occupational health and safety | 4.1 Evaluate hazard and risks<br>4.2 Control hazards and risks<br>4.3 Maintain occupational health and safety awareness | Discussion<br>Plant tour<br>Symposium | • Demonstration<br>• Interview |

## COMMON COMPETENCIES

| Unit of Competency | Learning Outcomes | Methodology | Assessment Approach |
|---|---|---|---|
| 1. Prepare materials and tools | 1.1 Identify materials and tools<br>1.2 Request materials and tools<br>1.3 Receive and inspect materials and tools | • Self-paced/ Modular<br>• Demonstration<br>• Small Group Discussion<br>• Distance Education | • Written<br>• Practical / Performance Test |
| 2. Observe procedures, specifications and manuals of instructions | 2.1 Identify and access specifications and manuals<br>2.2 Interpret manuals<br>2.3 Apply information in manuals | • Discussion<br>• Lecture<br>• Modular | • Written<br>• Practical / Performance Test |
| 3. Perform mensuration and calculation | 3.1 Select measuring instruments<br>3.2 Carry-out measurements and calculations | • Self-paced/ Modular<br>• Demonstration<br>• Small Group Discussion<br>• Distance Education | • Written/Oral Examination<br>• Practical Demonstration |

| Unit of Competency | Learning Outcomes | Methodology | Assessment Approach |
|---|---|---|---|
| 4. Perform basic bench work | 4.1 Prepare materials, tools and equipment for layout<br>4.2 Layout features in workplace<br>4.3 Cut sheets, plates and bars<br>4.4 Smooth sheets plates and bars<br>4.5 Drill holes in sheets, plates and bars<br>4.6 Bore holes in sheet plates and bars<br>4.7 Bend sheets, plates and bars<br>4.8 Join sheets, plates and bars | • Modular<br>• Film Showing<br>• Demonstration<br>• On-the-job training | • Interview<br>• Demonstration |
| 5. Perform basic electrical works | 5.1 Measure and analyze circuit and load resistance in electrical system<br>5.2 Measure and analyze voltage in electrical system<br>5.3 Measure and analyze current in electrical system<br>5.4 Test simple electrical components and connections<br>5.5 Repair minor electrical system troubles | • Modular<br>• Computer-based training (Simulation)<br>• Demonstration<br>• On- the-job training | • Interview<br>• Demonstration |
| 6. Maintain tools and equipment | 6.1 Check the conditions of tools and equipment<br>6.2 Perform basic preventive maintenance<br>6.3 Store tools and equipment | • Small Group Discussion<br>• Demonstration of Practical Skills<br>• Modular | • Demonstration and Oral questioning<br>• Written test |
| 7. Perform housekeeping and safety practices | 7.1 Sort materials, tools and equipment<br>7.2 Clean workplace area, materials, tools and equipment<br>7.3 Systematize dispensing and retrieval of materials, tools and equipment<br>7.4 Identify and minimize/ eliminate hazards<br>7.5 Respond and record accidents<br>7.6 Follow basic securities | • Small Group Discussion<br>• Demonstration of Practical Skills<br>• Modular | • Demonstration and Oral questioning<br>• Written test |

| Unit of Competency | Learning Outcomes | Methodology | Assessment Approach |
|---|---|---|---|
| 8. Document work accomplished | 8.1 Identify forms and data<br>8.2 Prepare reports | • Small Group Discussion<br>• Demonstration of Practical Skills<br>• Modular | • Demonstration and Oral questioning<br>• Written Test |

## CORE COMPETENCIES

| Unit of Competency | Learning Outcome | Methodology | Assessment Approach |
|---|---|---|---|
| 1. Survey Site For Air Duct Installation | 1.1 Interpret plan and specifications<br>1.2 Make preparations for site survey<br>1.3 Prepare alteration and deviation from the plan<br>1.4 Prepare technical report | • Discussion<br>• Lecture<br>• Plant visit | • Questioning<br>• Written report |
| 2. Fabricate Air Ducts | 2.1 Prepare air duct requirements<br>2.2 Lay out sheet metal<br>2.3 Cuts sheet metals to a given dimension<br>2.4 Perform bending and folding<br>2.5 Join air duct components | • Discussion<br>• Demonstration<br>• Practical exercises | • Demonstration<br>• Oral and written questioning |
| 3. Install Air Duct System | 3.1 Prepare air duct installation requirements<br>3.2 Install/ Erect platforms and scaffoldings<br>3.3 Install hangers & supports<br>3.4 Install air duct system and its components | • Discussion<br>• Demonstration<br>• Hands-on | • Demonstration<br>• Oral and written exam |
| 4. Perform Air Duct Testing | 4.1 Prepare for testing<br>4.2 Test air duct | • Discussion<br>• Demonstration<br>• Hands-on | • Demonstration<br>• Oral and written exam |
| 5. Insulate Air Duct | 5.1 Prepare insulation requirements<br>5.2 Insulate air duct<br>5.3 Apply duct liners | • Discussion<br>• Demonstration<br>• Hands-on | • Demonstration<br>• Oral and written exam |
| 6. Repair and Maintain Air Duct System | 6.1 Evaluate condition of air duct system<br>6.2 Repair air duct system and components<br>6.3 Perform preventive maintenance | • Discussion<br>• Demonstration<br>• Hands-on | • Demonstration<br>• Oral and written exam |

## 3.2 TRAINING DELIVERY

The delivery of training should adhere to the design of the curriculum. Delivery shall be guided by the 10 basic principles of competency-based TVET:

- The training is based on curriculum developed from the competency standards;
- Learning is modular in its structure;
- Training delivery is learner-centered and should accommodate individualized and self-paced learning strategies;
- Training is based on work that must be performed;
- Training materials are directly related to the competency standards and the curriculum modules;
- Assessment is based in the collection of evidence of the performance of work to the industry required standard;
- Training is based both on and off-the-job components;
- Training program allows for recognition of prior learning (RPL) or current competencies;
- Training allows for multiple entry and exit; and
- Training programs are registered with the UTPRAS.

The competency-based TVET system recognizes various types of delivery modes, both on and off-the-job as long as the learning is driven by the competency standards specified by the industry. The following training modalities may be adopted when designing training programs:

- The dualized mode of training delivery is preferred and recommended. Thus programs would contain both in-school and in-industry training or fieldwork components. Details can be referred to the Dual Training System (DTS) Implementing Rules and Regulations.

- Modular/self-paced is a competency-based training modality wherein the trainee is allowed to progress at his own pace. The trainer facilitates the training delivery.

- Peer teaching/mentoring is a training modality wherein fast learners are given the opportunity to assist the slow learners.

- Supervised Industry Training or On-the-Job Training is an approach in training designed to enhance the knowledge and skills of the trainee through actual experience in the

workplace to acquire specific competencies prescribed in the training regulations.

- Distance learning is a formal education process in which majority of the instruction occurs when the students and instructor are not in the same place. Distance learning may employ correspondence study, or audio, video or computer technologies.

- Project-based instruction is an authentic instructional model or strategy in which students plan, implement and evaluate projects that have real world applications.

## 3.3 TRAINEE ENTRY REQUIREMENTS

This section specifies the qualifications of trainees and educational experience. Other requirements like health and physical requirements are also stated. Passing entry written examinations may also be indicated if necessary.

- Can communicate both orally and in writing
- Good moral character
- Can perform basic mathematical computation
- Physically and mentally fit

## 3.4 LIST OF TOOLS, EQUIPMENT AND MATERIALS

Recommended list of tools, equipment and materials for the training of 25 trainees for AIR DUCT SERVICING NC II.

| TOOLS | | EQUIPMENT | | MATERIALS | |
|---|---|---|---|---|---|
| **QTY.** | **Description** | **QTY** | **Description** | **Qty.** | **Description** |
| 15 sets | Adjustable wrench | 3 units | Arc Welding set | | Acoustic Liner |
| 5 sets | Anemometer | 3 units | Bar folder | | Angular steel / Round Bar/ Flat Bar |
| 15 pairs | Aviation snip (left, straight, right, &notching) | 3 units | Bender machine | | B.I. fittings |
| 15 pcs | Ball peen hammer | 3 units | Blower | | Blind rivets |
| 15 units | Center puncher | | Box and pan brake | | Clamps |
| 15 units | Chalk line | | Electric hand drill | | Duct sox: Vinyl Polyester |
| 15 | Cold chisel | 3 | Electric spot | | Duct tape |

| | | | | | |
|---|---|---|---|---|---|
| pcs | | units | welding | | |
| 15 pcs | Cutting tools | 2 units | Jig Saw | | Electrical tape |
| 15 pcs | Dividers | 3 sets | Manometer | | G.I Wire |
| 15 pcs | Flash light | 3 sets | Nitrogen regulator | | Insulation : Fiberglass/ Rubber/ Styrophor/ Polyurethane |
| 15 pairs | Fliers | 3 units | Oxy / Acetylene outfit | | Insulation spacers |
| 15 pcs | Hacksaw | 2 units | Plasma arc cutting outfit | | Marking pen |
| 5 pcs | Hand riveter | 2 units | Slip form roll machine | | Nitrogen gas |
| 2 units | Ladder / Scaffolding | 3 units | Squaring sheer | | Red oxide/paint |
| 15 pcs | Level Hose | | | | Sealant / Adhesive |
| 15 pcs | Mallet (rubber, plastic) | | | | Sealant/ adhesive |
| 15 pcs | Plumb bob | | | | Sheet Metal: G.I., B.I., Stainless Aluminum |
| 15 pcs | push pull rule | | | | Steel Bars- Flat bar, round bar, Angles |
| 15 pcs | Scratch awl/ scriber | | | | Sulfur stick |
| 15 pcs | Screw driver (Flat and Philip) | | | | |

## 3.5 TRAINING FACILITIES
## AIR DUCT SERVICING NC II

Based on a class intake of 25 students/trainees.

| SPACE REQUIREMENTS | Space (m) | Area in Sq. Meters | Total Area in Sq. Meters |
|---|---|---|---|
| A. LECTURE AREA* | 4.00 x 8.00 | 32.00 | 32.00 |
| B. LEARNING RESOURCE AREA | 4.00 x 6.00 | 24.00 | 24.00 |
| C. TOOL/STORAGE AREA* | 4.00 x 4.00 | 16.00 | 16.00 |
| D. WASH, TOILET AND LOCKER ROOM* | 3.00 x 4.00 | 12.00 | 12.00 |
| TOTAL | | | 84 |
| E. FACILITIES/ EQUIPMENT/ CIRCULATION | | | 25 |
| **TOTAL AREA** | | | **109** |

*Common facilities for all HVAC/R Courses

## 3.6 TRAINER'S QUALIFICATION FOR HVAC/R SECTOR

### AIR DUCT SERVICING TRAINER QUALIFICATION II (TQ II)

- Must have undergone training on Training Methodology II or equivalent training/experience
- He must be a holder of AIR DUCT SERVICING NC II or equivalent qualification/experience
- Good moral character
- Must be physically and mentally fit
- Must be computer literate
- Must be a Civil Service eligible (for government position or appropriate professional license issued by the Professional Regulatory Board)
- *Must have at least two (2) years job/industry experience

*Optional: Only when required by the hiring institution
Reference: TESDA Board Resolution No. 2004-03

### 3.2 INSTITUTIONAL ASSESSMENT

Institutional assessment is undertaken by trainees to determine their achievement of units of competency. A certificate of achievement is issued for each unit of competency.

## SECTION 4 NATIONAL ASSESSMENT AND CERTIFICATION ARRANGEMENTS

4.1 To attain the National Qualification of **AIR DUCT SERVICING NC II**, the candidate must demonstrate competence covering all the units listed in Section 1. Successful candidates shall be awarded a National Certificate signed by the TESDA Director General.

4.2 Assessment shall focus on the core units of competency. The basic and common units shall be integrated or assessed concurrently with the core units.

4.3 The following are qualified to apply for assessment and certification:

4.4.1 Graduates of formal, non-formal and informal including enterprise-based training programs

4.4.2 Experienced Workers (wage employed or self-employed)

4.4 The guidelines on assessment and certification are discussed in detail in the "Procedures Manual on Assessment and Certification" and "Guidelines on the Implementation of the Philippine TVET Qualification and Certification System (PTQCS)".

## DEFINITION OF TERMS

1) **Air Distribution** – the process of distributing conditioned air into a confined space.

2) **Air Duct** – a tubular or rectangular passageway for air distribution to a various locations in a building.

3) **Air Filtration** – process whereby air passes into or out of an enclosed area through cracks and other opening in the structure.

4) **Anemometer** –an instrument for measuring the velocity of air in a ducts.

5) **ASHRAE** – American Society of Heating, Refrigeration and Air Conditioning Engineers

6) **ASTM** – American Society for Testing Materials

7) **Attenuation** – the sound reduction process in which sound energy absorbed or diminished in intensity as the result of energy conversion from sound to motion or heat.

8) **Bending** – a working process causing a deformation of the work pieces without chips removal.

9) **Check** – to verify, inspect , or test an RAC SERVICE component for satisfactory condition with the use of an instrument or a device.

10) **Dampers** – a device used to vary the volume of air passing through an air outlet, inlet or duct.

11) **Diffuser** – a square or circular facing devices that cover the supply opening in a ceiling.

12) **Ducts Materials** – are sheet metal, aluminum, fiberglass and plastic.

13) **Fan** – a mechanical device for moving air.

14) **Grilles** – a covering for opening through which air passes.

15) **Hem** – a simple fold at the raw edges of the metal to prevent from cutting.

16) **Louver** – an assembly of sloping vanes intended to permit air to pass through and to inhibit transfer of water droplets.

17) **NFPA** – National Fire Protection Association.

18) **Register** – grilles fitted with damper to control the quantity of air passing through it.

19) **Returned Air** – air returned from conditioned or refrigerated.

20) **Riveting** – a permanent method of fastening metal together.

21) **Scaffolding** –is a temporary modular system of metal pipes forming a framework use to support peoples and materials in the constructions.

22) **SMACNA** – Sheet Metal and Air Conditioning Contractors National Association.

23) **Sheet Metal** – any kind of metal that has been formed into sheets.

24) **Sound** – the sensation perceived by the human ear resulting from rapid fluctuations in air pressure.

25) **Ventilation** – the process of supplying or removing air by natural or mechanical means to or from space

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