

Appendix N

**ARCHITECTURE AND CONSTRUCTION
YOUTH APPRENTICESHIP**

**CONSTRUCTION PATHWAY
MECHANICAL/HEATING, VENTILATION, AND AIR CONDITIONING (HVAC) (UNIT 7)**

UNIT 7: Construction Pathway Mechanical/HVAC Fundamentals Unit

Competency

1. Read blueprints, plans and specifications

Performance Standard Condition

Competence will be demonstrated

- At the worksite and classroom

Performance Standard Criteria

Performance will be successful when learners:

- Articulate the functionality of blueprints, plans and specifications
- Interpret technical drawings accurately as needed for job task
- Use appropriate terminology for mechanical/HVAC careers
- Identify the types of schedules/drawings used in the HVAC trade
- Identify basic elements of technical drawings
- Identify lines, views, symbols, and representations on the drawings as applicable
- Interpret dimensions and scale on the drawings as applicable
- Utilize a metric scale to properly read a drawing

Learning Objectives:

- Identify basic design principles
- Explain where a design professional finds basic Architectural/Structural design codes
- Demonstrate basic drafting skills (AutoCAD)
- Demonstrate blueprint reading skills
- Explain why precision in interpretation is critical
- Demonstrate knowledge of fundamentals of statistics, trigonometry, and algebra and explain their relevance
- Discuss different types of architectural technical drawings
- Define and explain the use of lines, views, symbols, dimensions, and scale on architectural technical drawings
- Identify different lines by name, type, order of usage and application such as object, hidden, center, section, dimension, extension, cutting plane, short break, long break, phantom
- Compare pictorial format, orthographic projection, sectional views, and detail schedules
- Describe the standard usage of metric (SI) linear units in architectural drafting
- Interpret the following within an HVAC drawing
 - Piping
 - Air-handling equipment
 - AC system(s)
 - HVAC component diagram
 - Schematics

Comments:

UNIT 7: Construction Pathway Mechanical/HVAC Fundamentals Unit

Competency

2. Interpret symbols and procedures

Performance Standard Condition

Competence will be demonstrated

- At the worksite and classroom

Performance Standard Criteria

Performance will be successful when learners:

- Explain the role of drawings and specifications
- Identify drawings and symbols used on a drawing
- Apply information from drawings in activities
- Interpret specifications appearing on drawings
- Interpret and convert measurements in terms of actual dimensions requires
- Explain specifications in terms of work requirements
- Interpret the welding process plan from a technical drawing which includes tools, equipment, speeds, feeds, fixtures and holders as applicable.

Learning Objectives:

- Explain the role of drawings in relation to quantities, project specifications, and contract documentation
- Explain the role of specifications in relation to quantities, quality of work, contract documentation and payment to contractors
- State the difference between general and project specifications
- Identify drawings in terms of type and application for a construction process
- Explain the key functions of the drawing in terms of the finished product
- Identify the key users of the drawing in terms of work responsibility
- Interpret symbols and abbreviations in terms of their functions and meanings
- Interpret the layout in terms of the different views shown
- Explain the purpose of each view in terms of the result of the end product

Comments:

UNIT 7: Construction Pathway

Mechanical/HVAC Fundamentals Unit

Competency

3. Identify job prep needs and develop job task plan

Performance Standard Condition

Competence will be demonstrated

- At the worksite and classroom

Performance Standard Criteria

Performance will be successful when learners:

- Set up and prepare tool/equipment for safe operation:
- Determine the scope of work:
 - Timetable
 - Work schedule
 - Cleanup process
 - Safety measures
 - Acceptable noise levels
- Describe contractual relationships between all parties involved in the building process
- Apply scheduling practices to ensure the successful completion of a construction project

Learning Objectives:

- Articulate the process to prepare the site and work with other construction professionals
- Strategize the scope of work for successful project completion
- Learn the importance of planning ahead to prevent problems on site before they occur
- Understand safety inspections to ensure regulations relating to health safety and the environment are adhered to
- Prepare sample project schedule that incorporates sequencing of events
- Prepare a flow chart explaining shop drawing review process
- Describe the approval procedures required for successful completion of a construction project

Comments:

UNIT 7: Construction Pathway

Mechanical/HVAC Fundamentals Unit

Competency

4. Execute job prep needs as a coordinated effort

Performance Standard Condition

Competence will be demonstrated

- At the worksite and classroom

Performance Standard Criteria

Performance will be successful when learners:

- Illustrate how to control the main resources of a job:
 - Materials
 - Tools
 - Equipment
 - Labor
- Read and comply with dispatch orders
- Write a service report

Learning Objectives:

- Identify the components of building systems needed to complete a construction project
- Define planning and describe what it involves
- Explain why it is important to plan
- Explain the importance of documenting one's work
- Explain the sequence of events for project completion
- Explain how schedules are developed and used
- Define the terms production and productivity and explain why they are important
- Describe how efficiency can affect costs associated with the project
- Explain the supervisors role in controlling costs
- Describe the estimating process and classification of costs (e.g., direct and indirect, fixed and variable, methods and standards)
- Identify the steps to overseeing the running of several projects
- Demonstrate a working knowledge of communicating with a range of people including the client, subcontractor, supplier, the public and the workforce

Comments:

UNIT 7: Construction Pathway Mechanical/HVAC Fundamentals Unit

Competency

5. Select tools and materials

Performance Standard Condition

Competence will be demonstrated

- At the worksite and classroom

Performance Standard Criteria

Performance will be successful when learners:

- Choose the tools they are going to work with taking into consideration the usefulness and portability of the tool
- Choose the appropriate tools and materials to minimize cost while meeting product performance goals

Learning Objectives:

- Identify the hand tools commonly used by mechanical/HVAC technicians and describe their uses
- Use hand tools in a safe and appropriate manner
- State the general rules for properly maintaining all power tools, regardless of type
- Explain importance of equipment and tool tracking
- Describe ways that a contractor can manage materials
- Compare the value of renting versus purchasing equipment

Comments:

UNIT 7: Construction Pathway Mechanical/HVAC Fundamentals Unit

Competency

6. Use hand tools and light duty tools

Performance Standard Condition

Competence will be demonstrated

- At the worksite and classroom

Performance Standard Criteria

Performance will be successful when learners:

- Use correct hand tools in a safe and appropriate manner
- Demonstrate the general safety rules for operating all power tools, regardless of type
- Use portable power tools in a safe and appropriate manner
- Use stationary power tools in a safe and appropriate manner
- Demonstrate proper handling and storage of tools.

Learning Objectives:

- Identify the hand tools commonly used and describe their uses
- Identify the portable power tools commonly used and describe their uses
- Identify the stationary power tools commonly used and describe their uses
- Describe the proper handling and storage of hand and power tools.
- Identify trends in power tool use
- Explain battery time and voltage in various power tools.

Comments:

UNIT 7: Construction Pathway Mechanical/HVAC Fundamentals Unit

Competency

7. Operate tools and equipment safely

Performance Standard Condition

Competence will be demonstrated

- At the worksite and classroom

Performance Standard Criteria

Performance will be successful when learners:

- Operate only equipment that he/she is trained on
- Choose correct tool(s) or equipment for the task
- Follow and complete a tool check list
- Inspect tool/equipment and work area for safety considerations
- Verify tool/equipment is available for use and in working order
- Verify tool/equipment is current for preventative maintenance and/or calibration
- Verify safety equipment and any Personal Protective Equipment (PPE) needed for tool/equipment use
- Wear the required Personal Protective Equipment (PPE) at all times as required for the operation of the tool/equipment
- Operate tools/equipment safely with guarding devices in the manner required for the job task
- Investigate and promptly report abnormal tool/equipment conditions
- Properly shut down and label any tool/equipment that is not operating as expected
- Follow Lock Out/Tag Out procedures as applicable
- Document use and maintenance as required

Learning Objectives:

- Distinguish between common hand tools including battery operated tools, sawzall, screw drivers and hex nut drivers, caulking gun, electrical testers, wire strippers and pliers, and pipe wrenches
- Outline applications of each tool and equipment
- Describe and demonstrate the safety requirements for each tool and equipment
- Discuss start up and shut down procedures for each tool/equipment you will operate
- Explain the purpose of preventative maintenance
- Describe emergency shutdown procedures for the tool/equipment you will operate
- Explain how to recognize and address malfunctions for the tool/equipment you will operate
- Describe how to recognize wear and tear on equipment components
- Describe how to select lubricants and coolants as applicable
- List which tools and equipment require safety certification

Comments:

UNIT 7: Construction Pathway Mechanical/HVAC Fundamentals Unit

Competency

8. Assist with the installation of materials per job specifications

Performance Standard Condition

Competence will be demonstrated

- At the worksite and classroom

Performance Standard Criteria

Performance will be successful when learners:

- Articulate the scope of work
- Retrieve the correct material(s) for the job
- Demonstrate the application of measuring knowledge
- Demonstrate the ability to identify labels and read labels on products
- Demonstrate the ability to read and follow directions
- Demonstrate the ability to listen and take direction well
- Assist with loading unloading of materials, tools, equipment and supplies
- Assist in lifting, position, and securing of materials and work pieces during installation
- Plan sequencing, tools, and equipment needed for the installation
- Identify set up needed
- Consult with worksite professional to verify production schedule, deadlines, and timeframes

Learning Objectives:

- Define the needed materials associated with the various jobs
- Determine effective and active listening skills
- Use acceptable language in the classroom
- Demonstrate writing legibly for all assignments
- Determine technical reading strategies
- Determine proper measuring techniques and explain how to use measuring tools.
- Demonstrate the ability to follow directions from the teacher/mentor in the classroom
- Explain the functions or collaborative nature of each department or unit within the larger organization

Comments:

UNIT 7: Construction Pathway Mechanical/HVAC Fundamentals Unit

Competency

9. Demonstrate accuracy in measuring using various instruments

Performance Standard Condition

Competence will be demonstrated

- At the worksite and classroom

Performance Standard Criteria

Performance will be successful when learners:

- Choose the appropriate instrument or aid for measuring task
- Verify instrument is accurate for calibration if applicable
- Use and/or measure as required
- Read measuring instrument accurately
- Scale proportions accurately
- Apply appropriate formula and units for measurements
- Confirm measurement to given specification
- Record measurements using proper symbols
- Calibrate, clean, and store measuring instruments properly as required

Learning Objectives:

- List drafting aids and measuring devices commonly used by HVAC Technicians
- List common measurements used by HVAC Technicians
- Discuss how to convert standard English measures to metric and vice versa
- Explain architectural scale
- Explain the impact of error in measurement
- Add, subtract, multiply, and divide whole numbers, fractions, decimals and percent's
- Calculate averages, ratios, proportions, and rates
- Compare accuracy and precision when using measuring equipment
- Identify various calipers, micrometer instruments, and layout tools and their applications
- Identify digital measuring gages and instruments and their applications
- Describe how to read and interpret gages

Comments:

UNIT 7: Construction Pathway Mechanical/HVAC Fundamentals Unit

Competency

10. Maintain clean and safe work environment

Performance Standard Condition

Competence will be demonstrated

- At the worksite and classroom

Performance Standard Criteria

Performance will be successful when learners:

- Inspect tools and work area for safety considerations
- Comply with posted safety warnings and symbols
- Identify unsafe conditions and/or work habits and reports them to the worksite professional immediately, if applicable
- Help maintain a clean and safe working environment free of debris and obstacles
- Clean, organize, put away items in the work area
- Safely identify, handle, store, and use hazardous materials according to company procedure, if applicable
- Report any indications of insects or pests

Learning Objectives:

- List the major components of a facility safety program
- List the different state and federal agencies that provide regulatory oversight at your facility for personal safety, environmental safety, and equipment safety
- List accident and fire prevention techniques
- Describe posted safety warnings and symbols and what they mean
- Describe safe and unsafe work habits and their implications
- Discuss the importance of keeping the work area and tools/equipment clean
- List mechanical, electrical, and equipment safety hazards at your facility
- Discuss how to identify and report unsafe conditions in your facility
- Discuss safety procedures to prevent accidents
- Describe the requirements at your facility for safety training and auditing
- Assess need for good housekeeping practices
- List hazards that contribute to injury due to slips, trips, or falls
- Outline compliance requirements of sanitation and health inspections

Comments:

UNIT 7: Construction Pathway Mechanical/HVAC Fundamentals Unit

Competency

11. Clean up work area

Performance Standard Condition

Competence will be demonstrated

- At the worksite and classroom

Performance Standard Criteria

Performance will be successful when learners:

- Follow directions based on foreman scope of work plans.
- Clean and maintain materials and tools as required
- Store materials and tools properly
- Follow facility procedures for clean-up and shut down after use

Learning Objectives:

- Demonstrate basic clean up procedures at the end of classroom or project build
- Demonstrate the proper storage of tools and materials
- Explain how a clean work environment supports safety
- Explain how a clean work environment support efficiency

Comments:

UNIT 7: Construction Pathway Mechanical/HVAC Fundamentals Unit

Competency

12. Practice quality craftsmanship

Performance Standard Condition

Competence will be demonstrated

- At the worksite and classroom

Performance Standard Criteria

Performance will be successful when learners:

- Inspect and/or test materials/piece/product at all stages of production to determine quality or condition
- Monitor materials, processes, equipment, tools, and products throughout the production process for safety and quality specifications
- Inspect final product/piece to ensure it meets specifications
- Promptly identify and segregate materials and/or product that do not meet specification
- Communicate with worksite professional if materials and/or product do not meet requirements
- Document all quality checks

Learning Objectives:

- Explain and analyze the quality approval process used in the Mechanical/HVAC industry
- Describe the roles and responsibilities for quality in your facility
- List the major stages involved in producing products
- Explain the procedures for rejecting sub-standard products
- Define terms used in quality assurance
- Describe the impact of quality standards within the HVAC industry
- Describe how materials are selected and tested for product requirements

Comments:

Unit 7: Construction Pathway Mechanical/HVAC Fundamentals Unit

Competency

13. Assist with basic equipment problem identification and diagnosis for heating and cooling systems

Performance Standard Condition

Competence will be demonstrated

- At the worksite and classroom

Performance Standard Criteria

Performance will be successful when learners:

- Assist with preventive maintenance procedures on heating and cooling units
- Demonstrate knowledge of the electrical components of a cooling system
- Under supervision, use temperature and pressure measuring instruments to make readings at key points in the refrigeration cycle
- Measure temperatures in an operating air conditioning system
- Demonstrate knowledge of cylinder color codes to identify refrigerants
- Demonstrate knowledge of compressors, condensers, evaporators, metering devices, controls, and accessories

Learning Objectives:

- Construct a structure to evaluate conduction, convectional and radiant heating methods
- Explain principles of matter and energy
- Determine the temperature rise across the condenser
- Explore and analyze alternative heating and cooling methods
- Explain proper heating and cooling methods for residential and commercial structures
- Explain how heat transfer occurs in a cooling system and the concepts in the refrigeration cycle
- Identify the major components of a heating and cooling system and explain how each type works
- Identify the control devices used in heating and cooling systems and explain how each works
- Identify the components of various commercial heating systems
- Explain the operational principles of various commercial heating systems
- Identify the components of an induced draft and condensing gas furnace, and state their purpose
- Identify commonly used refrigerants and explain the proper procedures for handling these refrigerants

Comments:

Unit 7: Construction Pathway
Mechanical/HVAC Fundamentals Unit

Competency

14. Assist with basic equipment repair for heating systems and cooling systems

Performance Standard Condition

Competence will be demonstrated

- At the worksite and classroom

Performance Standard Criteria

Performance will be successful when learners:

- Apply critical thinking to troubleshooting operational problems
- With supervision, provide preventive maintenance procedures such as: including filter replacement, cleaning of components, and temperature measurements
- Demonstrate proper use of testing equipment

Learning Objectives:

- Demonstrate a practical knowledge of basic electricity and of the electrical components of heating, air-conditioning, and refrigeration equipment
- Identify electrical generation and distribution components for commercial heating and air conditioning systems
- Explain the properties of matter and heat behavior
- Demonstrate knowledge of retail refrigeration and heating systems
- Demonstrate knowledge of commercial and industrial refrigeration and heating systems
- Explain how to maintain, test, and troubleshoot electrical motors and their components for commercial heating and air-conditioning systems
- Explain proper repair procedures when working with pressurized systems, electrical energy, heat, cold, and chemicals

Comments:

Unit 7: Construction Pathway Mechanical/HVAC Fundamentals Unit

Competency

15. Set up and fabricate metals

Performance Standard Condition

Competence will be demonstrated

- At the worksite and classroom

Performance Standard Criteria

Performance will be successful when learners:

- Complete general set up for fabrication
- Layout and plan work
- Perform safety checks
- Assemble tools and equipment as required
 - Place parts and assemblies into fixtures
 - Demonstrate how to fabricate metal to meet the specific project requirements.

Learning Objectives:

- Identify the physical properties of metal and how they are used
- Describe how to produce and assemble structural metal products for machinery, ovens, tanks, pipes, stacks and parts for buildings
- Demonstrate how to read job orders and blueprints
- Explain how to set up and use equipment to cut, shear and saw, form, roll and bend metals
- Identify the physical properties of metal and be able to figure the stock allowances for thickness
- Adjust safety guards and holding devices as needed
- Select correct tip size and type
- Set regulator for tip, fuel gas and material
- Measure corner and align track mechanism
- Set appropriate travel speeds
- Identify main parts of ac system, heating system, range vent system and spot ventilation system
- Identify general building codes for ac, heat, and duct runs

Comments:

Unit 7: Construction Pathway
Mechanical/HVAC Fundamentals Unit

Competency

16. Assist with the installation of fabricated parts

Performance Standard Condition

Competence will be demonstrated

- At the worksite and classroom

Performance Standard Criteria

Performance will be successful when learners:

- Verify that the metal is fabricated to meet the specific project requirements
- Assist with the installation of various duct shapes to allow for proper flow
- Assist with loading unloading of materials, tools, equipment and supplies
- Assist in lifting, position, and securing of materials and work pieces during installation
- Examine how to create and install in the most efficient manner possible (Shop versus site installation)
- Perform minor maintenance or cleaning of tools and equipment
- Identify the different strategies to procure materials for fabrication vs. construction.

Learning Objectives:

- Determine how to fabricate sheet metal duct work components
- Demonstrate different fastening techniques for sheet metal components
- Define sheet metal components for proper air flow
- Describe the various types of materials for the proper process
- Interpret drawings so that duct work can be constructed to specification
- Determine boots, bends and finish grates for job

Comments:

Unit 7: Construction Pathway
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Competency

17. Transfer measurements into a workable drawing

Performance Standard Condition

Competence will be demonstrated

- At the worksite and classroom

Performance Standard Criteria

Performance will be successful when learners:

- Verify measurements of ducts in the drawings
- Ensure duct shapes selected will allow proper flow of materials
- Develop a shop drawing for HVAC fittings
- Turn drawings into Computer Aided Machining (CAM) or Computer Aided Design (CAD) instructions that drive the sheet metal cutting devices used to produce fittings.
- Determine a plan for installation prior to going to the site

Learning Objectives:

- Explain scaling of dimensional drawings for a particular component
- Explain how various metals are used for different types of HVAC operations
- Explain how flow is affected by various design types
- Demonstrate the various HVAC fittings using CAM and CAD
- Demonstrate different bending processes at the right degrees and measurements
- Determine correct mechanical units based on airflow for heat/AC units

Comments: