Advanced Manufacturing Technologies Program of Study with Complementary Course Standards

This document was prepared by:

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Vision

All Nevada students are equipped and feel empowered to attain their vision of success

Mission

To improve student achievement and educator effectiveness by ensuring opportunities, facilitating learning, and promoting excellence

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Acknowledgements

The development of Nevada career and technical education (CTE) standards and assessments is a collaborative effort sponsored by the Nevada Department of Education (NDE) Office of Career Readiness, Adult Learning, and Education Options. The Nevada Department of Education relies on educators and industry representatives who have the technical expertise and teaching experience to develop standards and performance indicators that truly measure student skill attainment. More importantly, the NDE would like to recognize the time and commitment by the writing team members in developing the career and technical standards for Advanced Manufacturing Technologies.

Standards Development Members

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Business and Industry Validation

All CTE standards developed through the Nevada Department of Education are validated by business and industry through one or more of the following processes: (1) the standards are developed by a team consisting of business and industry representatives, or (2) a separate review panel is coordinated with industry experts to ensure the standards include the proper content, or (3) nationally recognized standards currently endorsed by business and industry.

The Advanced Manufacturing Technologies standards were validated through active participation of business and industry representatives on the development team.

Introduction

The standards in this document are designed to clearly state what the student should know and be able to do upon completion of a high school Advanced Manufacturing Technologies program of study. These standards are designed for a two-credit course sequence that prepares the student for a technical assessment directly aligned to the standards.

These exit-level standards are designed for the student to complete all standards through their completion of a program of study. These standards are intended to guide curriculum objectives for a program of study.

The standards are organized as follows:

- **Content Standards** are general statements that identify major areas of knowledge, understanding, and the skills students are expected to learn in key subject and career areas by the end of the program.

- **Performance Standards** follow each content standard. Performance standards identify the more specific components of each content standard and define the expected abilities of students within each content standard.

- **Performance Indicators** are very specific criteria statements for determining whether a student meets the performance standard. Performance indicators may also be used as learning outcomes, which teachers can identify as they plan their program learning objectives. The indicators are followed by designations that reflect the course sequence (e.g., L1 for the first-year course of a two-year program and L2 for the second-year course, C is to designate the indicators to be taught in the complementary courses) as referenced in the Core Course Sequence table.

The crosswalks and alignments are located in the Program Supplemental Program Resources document. These will show where the performance indicators support the Nevada Academic Content Standards. For individual course descriptions, please reference the Supplemental Program Resource or the Nevada CTE Catalog.

All students are encouraged to participate in the career and technical student organization (CTSO) that relates to the Advanced Manufacturing Technologies program. CTSOs are co-curricular national organizations that directly reinforce learning in the CTE classroom through curriculum resources, competitive events, and leadership development. CTSOs provide students the ability to apply academic and technical knowledge, develop communication and teamwork skills, and cultivate leadership skills to ensure college and career readiness.

The Employability Skills for Career Readiness identify the skills needed to be successful in all careers and must be taught as an integrated component of all CTE course sequences. These standards are available in a separate document.

The **Standards Reference Code** is only used to identify or align performance indicators listed in the standards to daily lesson plans, curriculum documents, or national standards. The Standards Reference Code is an abbreviated name for the program, and the content standard, performance standard and performance indicator are referenced in the program standards. This abbreviated code for identifying standards uses each of these items. For example, ADVMFG is the Standards Reference Code for Advanced Manufacturing Technologies. For Content Standard 2, Performance Standard 3 and Performance Indicator 4 the Standards Reference Code would be ADVMFG.2.3.4.

Advanced Manufacturing Technologies

Program Information

Program of Study: **Advanced Manufacturing Technologies**
Standards Reference Code: **ADVMFG**
Career Cluster: **Manufacturing**
Career Pathway(s): **Manufacturing Production Process Development / Production**
Program Length: **2-year, completed sequentially**
CTSO: **SkillsUSA**

Program Structure Required Program of Study Courses

The core course sequencing is provided in the following table. Complementary Courses are available and provided later in this document. The following courses provide a completed program of study. The Lab is a complementary course available concurrently with the Advanced Manufacturing Technologies II course.

Core Course Sequence (R) with Lab Course(s) (C)

Required/ Complementary	Course Title	Abbreviated Name
R	Advanced Manufacturing Technologies I	AMT I
R	Advanced Manufacturing Technologies II	AMT II
C	Advanced Manufacturing Technologies II LAB	AMT II L

CONTENT STANDARD 1.0: INTEGRATE CAREER AND TECHNICAL STUDENT ORGANIZATIONS (CTSOs)

Performance Standard 1.1: Explore the History and Organization of CTSOs

1.1.1 Discuss the requirements of CTSO participation/involvement as described in Carl D. Perkins Law (Level 1 (L1), Level 2 (L2), Complementary (C))

1.1.2 Research nationally recognized CTSOs (L1, L2, C)

1.1.3 Investigate the impact of federal and state government regarding the progression and operation of CTSOs (e.g., Federal Statutes and Regulations, Nevada Administrative Code [NAC], Nevada Revised Statutes [NRS]) (L1, L2, C)

Performance Standard 1.2: Develop Leadership Skills

1.2.1 Discuss the purpose of parliamentary procedure (L1, L2, C)

1.2.2 Demonstrate the proper use of parliamentary procedure (L1, L2, C)

1.2.3 Differentiate between an office and a committee (L1, L2, C)

1.2.4 Discuss the importance of participation in local, regional, state, and national conferences, events, and competitions (L1, L2, C)

1.2.5 Participate in local, regional, state, or national conferences, events, or competitions (L1, L2, C)

1.2.6 Describe the importance of a constitution and bylaws to the operation of a CTSO chapter (L1, L2, C)

Performance Standard 1.3: Participate in Community Service

1.3.1 Explore opportunities in community service-related work-based learning (WBL) (L1, L2, C)

1.3.2 Participate in a service learning (program related) and/or community service project or activity (L1, L2, C)

1.3.3 Engage with business and industry partners for community service (L1, L2, C)

Performance Standard 1.4: Develop Professional and Career Skills

1.4.1 Demonstrate college and career readiness (e.g., applications, resumes, interview skills, presentation skills) (L1, L2, C)

1.4.2 Describe the appropriate professional/workplace attire and its importance (L1, L2, C)

1.4.3 Investigate industry-standard credentials/certifications available within this Career Cluster™ (L1, L2, C)

1.4.4 Participate in authentic contextualized instructional activities (L1, L2, C)

1.4.5 Demonstrate technical skills in various student organization activities/events (L1, L2, C)

Performance Standard 1.5: Understand the Relevance of Career and Technical Education (CTE)

1.5.1 Make a connection between program standards to career pathway(s) (L1, L2, C)

1.5.2 Explain the importance of participation and completion of a program of study (L1, L2, C)

1.5.3 Promote community awareness of local student organizations associated with CTE programs (L1, L2, C)

CONTENT STANDARD 2.0: IDENTIFY LAB ORGANIZATION AND SAFETY PROCEDURES

Performance Standard 2.1: Demonstrate General Lab Safety Rules and Procedures

2.1.1 Describe general shop safety rules and procedures (L1, L2)

2.1.2 Demonstrate knowledge of Occupational Safety and Health Association (OSHA) and its role in workplace safety (L1, L2)

2.1.3 Introduce other regulatory agencies that relate to different manufacturing processes (L1, L2)

2.1.4 Comply with the required use of personal protective equipment (PPE) during lab/shop activities (L1, L2)

2.1.5 Utilize safe procedures for handling of tools and equipment (L1, L2)

2.1.6 Operate lab equipment according to safety guidelines (L1, L2)

2.1.7 Demonstrate proper lifting procedures and proper use of support equipment (L1, L2)

2.1.8 Utilize proper ventilation procedures for working within the lab/shop area (L1, L2)

2.1.9 Identify marked safety areas (L1, L2)

2.1.10 Identify the location and the types of fire extinguishers and other fire safety equipment; demonstrate knowledge of the procedures for using fire extinguishers and other fire safety equipment (L1, L2)

2.1.11 Identify the location and use of eye wash stations (L1, L2)

2.1.12 Identify the location of the posted evacuation routes (L1, L2)

2.1.13 Identify and wear appropriate clothing for lab/shop activities (L1, L2)

2.1.14 Secure hair and jewelry for lab/shop activities (L1, L2)

2.1.15 Demonstrate knowledge of the safety aspects of high/low voltage circuits (L1, L2)

2.1.16 Locate and interpret safety data sheets (SDS) (L1, L2)

2.1.17 Prepare and interpret time/job cards, reports (incident, hazard checklists), or records (L1, L2)

2.1.18 Demonstrate proper lock-out/tag-out procedures and how to properly identify and log (L1, L2)

2.1.19 Perform workstation/shop housekeeping, including proper time management for duties (6S's - Sort, Straighten, Shine, Standardize, Sustain, and Safety) (L1, L2)

2.1.20 Follow verbal instructions to complete work assignments (L1, L2)

2.1.21 Follow written instructions to complete work assignments (L1, L2)

Performance Standard 2.2: Identify and Utilize Hand Tools

2.2.1 Identify hand tools and their appropriate usage (L1, L2)

2.2.2 Identify standard and metric designations (L1, L2)

2.2.3 Demonstrate the proper techniques when using hand tools (L1, L2)

2.2.4 Demonstrate safe handling and use of appropriate hand tools (L1, L2)

2.2.5 Demonstrate proper cleaning, storage, and maintenance of hand tools (L1, L2)

Performance Standard 2.3: Identify and Utilize Power Tools and Equipment

2.3.1 Identify power tools and their appropriate usage (L1, L2)

2.3.2 Identify equipment and their appropriate usage (L1, L2)

2.3.3 Demonstrate the proper techniques when using power tools and equipment (L1, L2)

2.3.4 Demonstrate safe handling and use of appropriate power tools and equipment (L1, L2)

2.3.5 Demonstrate proper cleaning, storage, and maintenance of power tools and equipment (L1, L2)

CONTENT STANDARD 3.0: ANALYZE PROFESSIONAL PRACTICES

Performance Standard 3.1: Analyze Professional Ethical Practices Ethics in Advanced Manufacturing

3.1.1 Discuss current professional code of ethics (L1, L2)

3.1.2 Explore ethical advanced manufacturing issues (L1, L2)

3.1.3 Describe how ethics influence the advanced manufacturing process (L1, L2)

CONTENT STANDARD 4.0: APPLY FUNDAMENTAL ADVANCED MANUFACTURING SKILLS

Performance Standard 4.1: Utilize Mathematical Operations and Measuring Techniques

- 4.1.1 Identify industry standard units of measure (L1)
- 4.1.2 Convert between customary (i.e., SAE and Imperial) and metric units (L1)
- 4.1.3 Determine and apply the equivalence between fractions and decimals (L1)
- 4.1.4 Demonstrate proper use of precision measuring tools (i.e., micrometer, dial-indicator, and dial-caliper) (L1)
- 4.1.5 Utilize measurement systems to solve real manufacturing problems (L1)
- 4.1.6 Utilize reference material (e.g., data charts, graphs/tables) (L1)

Performance Standard 4.2: Interpret Schematics and Technical Drawings

- 4.2.1 Identify industrial standard symbols (i.e., fluid, power, electrical, mechanical) (L1)
- 4.2.2 Interpret schematics and technical drawings (L1)
- 4.2.3 Create schematic diagrams using proper symbols (L1)
- 4.2.4 Understand the general redline process for changing schematics/drawings (L2)

Performance Standard 4.3: Demonstrate Spatial Reasoning and 3D Modeling Techniques

- 4.3.1 Define spatial reasoning (L1)
- 4.3.2 Identify spatial reasoning techniques (e.g., mapping, rotating, matching, patterning, counting) (L1)
- 4.3.3 Utilize spatial reasoning techniques to solve design problems (L1)
- 4.3.4 Prepare freehand sketches utilizing appropriate proportions (L1)
- 4.3.5 Utilize 3D modeling software to solve manufacturing design problems (L1)

Performance Standard 4.4: Investigate Materials Used in Advanced Manufacturing

- 4.4.1 Discuss the importance of material selection used in advanced manufacturing processes (L1)
- 4.4.2 Identify the major material families (e.g., woods, glass, metals, plastics, polymers) (L1)
- 4.4.3 Differentiate between the various types of materials, their properties, and applications (e.g., mechanical, physical, chemical) (L2)
- 4.4.4 Discuss the impact of material usage on the environment (L2)
- 4.4.5 Explain how production is affected by the availability, quality, and quantity of resources (L2)

Performance Standard 4.5: Investigate the Engineering Design Process

- 4.5.1 Identify the engineering design process (L2)
- 4.5.2 Identify the activities that occur during each phase of the engineering design process (L2)
- 4.5.3 Utilize office software to perform engineering recordkeeping and communication (L2)
- 4.5.4 Describe the importance of engineering teams (L2)
- 4.5.5 Utilize technical writing/reading techniques to communicate (L2)

Performance Standard 4.6: Identify Fundamental Advanced Manufacturing Components and Systems

4.6.1 Identify common systems used in advanced manufacturing (L2)

4.6.2 Identify the basic processes, systems, design processes, and materials used in advanced manufacturing (L2)

4.6.3 Describe the function of components in advanced manufacturing systems (L2)

4.6.4 Examine the functions of an industrial network (e.g., communication transfer) (L2)

4.6.5 Analyze the application of advanced manufacturing in various industries (L2)

CONTENT STANDARD 5.0: APPLY FUNDAMENTAL POWER SYSTEM PRINCIPLES

Performance Standard 5.1: Identify and Utilize Basic Electrical Systems

5.1.1 Define AC and DC electrical systems and terminology (L1)

5.1.2 Describe the principles of generation, transmission, distribution, and storage of electricity (L1)

5.1.3 Compute values of current, resistance, and voltage using Ohm's law (L1)

5.1.4 Identify series, parallel and series-parallel (combination) circuits (L1)

5.1.5 Discuss the safety concerns of working with electricity (e.g., arc flash, electrical burns, electrostatic discharge, grounding needs) (L2)

5.1.6 Solve series and parallel circuits using basic laws of electricity including Kirchhoff's laws (L2)

5.1.7 Introduce single-phase and three-phase AC power (L2)

5.1.8 Construct and test simple electrical circuits from a schematic (L2)

Performance Standard 5.2: Identify and Utilize Basic Mechanical Systems

5.2.1 Locate and explain examples of the six simple machines, their attributes, and components (e.g., gears, compressors, gear boxes, pully systems) (L1)

5.2.2 Measure forces and distances related to mechanisms (L2)

5.2.3 Calculate mechanical advantage (L2)

5.2.4 Design, construct, and test various basic mechanical systems (L2)

Performance Standard 5.3: Identify Power Systems

5.3.1 Define terms used in power systems (e.g., power, work, horsepower, watts) (L2)

5.3.2 Identify the basic power systems (L2)

5.3.3 List the basic elements of power systems (L2)

5.3.4 Summarize the advantages and disadvantages of various forms of power (L2)

5.3.5 Define potential and kinetic energy (L2)

5.3.6 Identify forms of potential and kinetic energy (L2)

5.3.7 Calculate the efficiency of power systems and conversion devices (L2)

5.3.8 Demonstrate the use of an energy conversion device (L2)

Performance Standard 5.4: Identify and Utilize Basic Fluid Systems

5.4.1 Define fluid systems (e.g., hydraulic, pneumatic, vacuum) (L2)

5.4.2 Identify and define the components of fluid systems (L2)

5.4.3 Compare and contrast hydraulic and pneumatic systems (L2)

5.4.4 Identify the advantages and disadvantages of using fluid power systems (L2)

5.4.5 Explain the difference between gauge pressure and absolute pressure (L2)

5.4.6 Discuss the safety concerns of working with liquids and gases under pressure (L2)

5.4.7 Identify different control components used in pneumatic systems (e.g., double check valves [DCVs], flow control, solenoids) (L2)

5.4.8 Construct and test a simple fluid power system (L2)

CONTENT STANDARD 6.0: CHARACTERIZE ADVANCED MANUFACTURING CONTROL DEVICES

Performance Standard 6.1: Investigate Motors in Advanced Manufacturing Systems

- 6.1.1 Identify the function of an electric motor (L1)
- 6.1.2 Construct and test a simple motor application (L1)
- 6.1.3 Identify the various types of motors and their designated uses (e.g., 1 phase AC, 3 phase AC, DC, servo, linear motor) (L2)
- 6.1.4 Describe various motor applications in advanced manufacturing systems (L2)
- 6.1.5 Define the functions of variable frequency drives (L2)

Performance Standard 6.2: Apply Fundamentals of Electronics

- 6.2.1 Understand and demonstrate basic electrical theory (L1)
- 6.2.2 Utilize tools and test equipment, such as multimeters, appropriately and safely (L1)
- 6.2.3 Measure electrical characteristics of voltage, current, and resistance in basic electronic circuits (L1)
- 6.2.4 Demonstrate appropriate use of various connectors (L1)
- 6.2.5 Identify electronic components and their applications (e.g., resistors, capacitors, inductors, transformers) (L2)
- 6.2.6 Demonstrate appropriate soldering and de-soldering techniques for electronic circuits (L2)
- 6.2.7 Construct, measure, and analyze, simple series, parallel, and series-parallel (combination) circuits (L2)

Performance Standard 6.3: Investigate Switches and Relays

- 6.3.1 Differentiate between switches and relays (L1)
- 6.3.2 Explain the characteristics and operations of switches and relays (L2)
- 6.3.3 Explain the role of electromagnetic relays (L2)
- 6.3.4 Construct and test a simple circuit utilizing switches and relays (L2)

Performance Standard 6.4: Investigate Sensors and Actuators

- 6.4.1 Differentiate between sensors and actuators (L2)
- 6.4.2 Describe the functions of sensors and actuators used in advanced manufacturing systems (L2)
- 6.4.3 Construct and test a circuit utilizing sensors and actuators (L2)
- 6.4.4 Define analog and binary sensors (L2)
- 6.4.5 Differentiate between different binary sensors and what they detect (e.g., inductive, capacitive, photoelectric) (L2)
- 6.4.6 Identify different identification and vision systems used in advanced manufacturing systems (L2)
- 6.4.7 Define the function of different Identification and vision systems (i.e., barcode, radio frequency Identification [RFID], QR codes, machine vision systems, applications of ID systems) (L2)

Performance Standard 6.5: Explore Programmable Logic Controllers

- 6.5.1 Investigate the basic components of a programmable logic controller (PLC) (L2)
- 6.5.2 Identify the major advantages in the use of PLCs in advance manufacturing (L2)

6.5.3 Identify the various programming devices used to program a PLC (L2)

6.5.4 Explain the various modes of operations of a PLC (L2)

CONTENT STANDARD 7.0: IDENTIFY AND APPLY MANUFACTURING PROCESSES

Performance Standard 7.1: Apply Additive Manufacturing Processes

7.1.1 Identify and describe additive manufacturing processes (e.g., casting, molding, 3D printing) (L1)

7.1.2 Construct a 3D model utilizing a design software (L1)

7.1.3 Print a 3D model utilizing the additive process (L1)

7.1.4 Develop a list of additive operations and identify the sequence needed to make a specific product (L1)

Performance Standard 7.2: Demonstrate Subtractive Manufacturing Processes

7.2.1 Identify and describe subtractive manufacturing processes (L1)

7.2.2 Explain the computer numerical control (CNC) processes and software requirements (e.g., Cartesian coordinates, numeric code, machine code, import/export programs) (L1)

7.2.3 Utilize a model or drawing to develop and adjust a CNC tool path (L1)

7.2.4 Perform safety inspections of subtractive equipment and accessories

7.2.5 Demonstrate the ability to use manual and computer numerical control subtractive equipment (e.g., oxyfuel cutting, plasma cutting, mills, lathes, drill presses, saws, routers, grinders) (L2)

7.2.6 Determine appropriate tooling, cutting speeds, and feed rates with use of cutting fluids to manage tool life and product quality (L2)

7.2.7 Develop a list of manual material-cutting operations and identify the sequence needed to make a specific product (L2)

7.2.8 Utilize manual subtractive equipment to produce a specific product (L2)

7.2.9 Develop a list of CNC material-cutting operations and identify the sequence needed to make a specific product (L2)

7.2.10 Utilize CNC subtractive equipment to produce a specific product (L2)

Performance Standard 7.3: Investigate Joining and Fastening Processes

7.3.1 Identify and describe joining processes (e.g., forming, forging, welding) (L1)

7.3.2 Identify various fastening methods (e.g., rivets, adhesive, screws, seams, spot welds) (L1)

7.3.3 Categorize fastening methods by appropriate applications (L1)

7.3.4 Demonstrate fastening methods on various materials (L1)

Performance Standard 7.4: Research Business Operations and Quality Control

7.4.1 Discuss the importance of management of change (e.g., process change, procedure changes, machine settings, quality control requirements) (L1)

7.4.2 Identify and describe the importance of shift-to-shift communications (e.g., documented work progress/status report) (L2)

7.4.3 Investigate the importance of quality assurance systems (L2)

7.4.4 Research quality control testing methods (e.g., destructive, nondestructive) (L2)

CONTENT STANDARD 8.0: INTRODUCTION TO ROBOTIC SYSTEMS

Performance Standard 8.1: Explore Robotic Systems in Advanced Manufacturing

- 8.1.1 Research the history of robotics (i.e., industrial, non-industrial) (L1)
- 8.1.2 Identify Isaac Asimov's three laws of robotics (L1, L2)
- 8.1.3 Investigate the societal impact of robotics (L1, L2)
- 8.1.4 Apply robotic vocabulary (e.g., degrees of freedom, axis, work envelope, tool point, tool tip) (L1, L2)
- 8.1.5 Identify main components of a robot (L1)
- 8.1.6 Investigate robotic specifications (e.g., payload, repeatability, environmental requirements, power sources) (L2)
- 8.1.7 Identify robot control systems (L2)
- 8.1.8 Describe end effectors utilized by robots (L2)
- 8.1.9 Identify teaching and programming interfaces for robots (L2)

Performance Standard 8.2: Construct a Robotic System for Advanced Manufacturing

- 8.2.1 Identify programming languages for robotics applications (L2)
- 8.2.2 Identify path control techniques used by robots (L2)
- 8.2.3 Create a robotic control program (L2)

Complementary Courses

State Complementary Skill Standards

State complementary skill standards are designed to clearly state what the student should know and be able to do upon completion of a **one-year** complementary course related to their career and technical education (CTE) program of study. **Completion of the qualifying Program of Study is required prior to enrollment in a complementary course.**

Employability Skills for Career Readiness Standards

Students have completed all program content standards and will pursue advanced study through investigation and in-depth research.

Complementary Course Standards Contributing Members

Course Contribution(s)	Name	Occupation/Title	Stakeholder Affiliation	School/Organization
Advanced Manufacturing Practices	Tim Conley	Instructor	Secondary Educator	Edward C. Reed High School, Washoe County School District
Advanced Manufacturing Practices	Sanjib Das	Senior Lab Engineer	Business and Industry Representative	Tesla, Sparks, NV
Advanced Manufacturing Practices	Daniel Flick	Director of Manufacturing Instructor	Postsecondary Educator	College of Southern Nevada, Las Vegas, NV
Advanced Manufacturing Practices	Diana Ramirez	Community Relations Director	Business and Industry Representative	Reborn Cabinets, Las Vegas NV
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The Advanced Manufacturing Practices complementary standards for Advanced Manufacturing Technologies program of study were validated through active participation of business and industry representatives on the development team.

Complementary Course Information for Advanced Manufacturing Technologies

Program Information

Qualifying Program of Study: **Advanced Manufacturing Technologies**
Career Cluster: **Manufacturing**
Career Pathway(s): **Manufacturing Production Process Development / Production**
CTSO: **SkillsUSA**
Grade Level: **11-12**

Program Structure for Complementary Courses

The complementary courses are provided in the following table. **The qualifying program of study must be completed prior to enrolling in the complementary courses** (except labs that are done concurrently with the second-year course). A program does not have to utilize the complementary courses for students to complete their program of study.

Complementary Courses

Required/ Complementary	Course Title	Abbreviated Name
C	Advanced Manufacturing Practices	ADV MFG PRAC
C	Advanced Manufacturing Technologies Advanced Studies	AMT AS
C	Industry-Recognized Credential – Advanced Manufacturing Technologies	IRC AMT
C	CTE Work Experience – Manufacturing	WORK EXPER MANUF

Complementary Course Standards
Advanced Manufacturing Practices

CONTENT STANDARD 1.0: CHARACTERIZE AUTOMATION CONTROL DEVICES

Performance Standard 1.1: Investigate Sensors and Actuators

1.1.1 Investigate the applications of different identification and vision systems (i.e., barcode, RFID, QR codes, machine vision systems, applications of ID systems)

CONTENT STANDARD 2.0: MODEL CONTROL SYSTEMS

Performance Standard 2.1: Demonstrate Control Technology and Automation Principles

2.1.1 Distinguish between standard and safety programmable controllers, their components, and their functions
2.1.2 Interpret programming diagrams (e.g., flow charts)
2.1.3 Sketch programming diagrams for real world applications
2.1.4 Compare and contrast open and closed loop control systems
2.1.5 Initialize a programmable logic controller (PLC)
2.1.6 Understand and select proper communication drivers to interface with a PLC system
2.1.7 Apply suitable commands for PLC circuits
2.1.8 Apply timer and counter principles to industry-related problems
2.1.9 Program ladder logic statements to perform a specific task
2.1.10 Develop ladder/relay logic application use for a PLC to control industry specific processes
2.1.11 Select the most appropriate type of circuit logic for each application
2.1.12 Understand varying types of hardware used throughout the industry
2.1.13 Apply suitable commands for PLC circuits
2.1.14 Apply timer and counter principles to industry-related problems
2.1.15 Setup and test PLCs
2.1.16 Understand and select proper communication drivers to interface with a PLC system
2.1.17 Troubleshoot issues with PLCs
2.1.18 Perform basic maintenance with PLCs
2.1.19 Design, construct, and test an automated system

Performance Standard 2.2: Demonstrate Diagnostic and Troubleshooting Practices

2.2.1 Explore diagnostic procedures
2.2.2 Identify components of a safety procedure checklist
2.2.3 Utilize all safety procedures necessary before performing a repair (e.g., lock-out/tag-out)
2.2.4 Navigate through user software
2.2.5 Understand and use software instructions offered in user software
2.2.6 Use manufacturer’s documentation for troubleshooting
2.2.7 Create a detailed troubleshooting checklist
2.2.8 Utilize diagnostic tools appropriately

2.2.9 Troubleshoot and repair common problems in control systems

2.2.10 Complete a troubleshooting work order

2.2.11 Demonstrate Maintenance Fundamentals

2.2.12 Explore mechanical fundamentals (e.g., alignment, wear, lubrication)

2.2.13 Distinguish between preventative and predictive maintenance

2.2.14 Develop a routine maintenance plan

2.2.15 Utilize various repair, maintenance, and troubleshooting resources (e.g., print media, electronic, tech support, and local experts)

CONTENT STANDARD 3.0: INTRODUCTION TO ROBOTIC SYSTEMS

Performance Standard 3.1: Construct a Robotic System for Automation

3.1.1 Construct a simple automated system utilizing HMI interfaces

3.1.2 Construct a robotic control system combining several automation components (e.g., electrical, pneumatic, conveyance, VFDs, PLCs, and HMIs)

CONTENT STANDARD 4.0: APPLY FUNDAMENTAL ENGINEERING SKILLS

Performance Standard 4.1: Investigate the Engineering Design Process

4.1.1 Apply the steps of the engineering design process to solve a variety of design problems employing a core physics perspective

Performance Standard 4.2: Utilize Advanced Manufacturing Communication Tools

4.2.1 Utilize informational resources useful in manufacturing

CONTENT STANDARD 5.0: APPLY FUNDAMENTAL POWER SYSTEM PRINCIPLES

Performance Standard 5.1: Identify and Utilize Basic Fluid Systems

5.1.1 Calculate mechanical advantage using Pascal's law

5.1.2 Calculate values in a pneumatic system, using the ideal gas laws

CONTENT STANDARD 6.0: IDENTIFY AND APPLY ADVANCED MANUFACTURING PROCESSES

Performance Standard 6.1: Identify Basic Manufacturing Systems

6.1.1 Conduct reverse engineering processes to describe the process and materials used to manufacture a given product

6.1.2 Describe how different manufacturing processes can be used to produce similar products

Performance Standard 6.2: Identify Material Properties and Science

6.2.1 Discuss the impact of material usage on the environment

6.2.2 Differentiate among a raw material standard stock and finished products

6.2.3 Analyze the effects of the environmental conditions and manufacturing processes on material properties

Performance Standard 6.3: Apply Additive Manufacturing Processes

6.3.1 Research plating and finishing techniques and their uses as an additive process

Performance Standard 6.4: Utilize Joining and Fastening Manufacturing Processes

6.4.1 Demonstrate the ability to utilize various mechanical and permanent joining processes

6.4.2 Perform safety inspections of welding equipment and accessories

6.4.3 Demonstrate the ability to set-up and operate welding equipment (i.e., SMAW and GMAW)

6.4.4 Demonstrate proper fit-up and completion of a welded joint

6.4.5 Manufacture a product utilizing joining and fastening processes

Performance Standard 6.5: Research Business Operations and Quality Control

6.5.1 Describe the business cycle of manufacturing operations

6.5.2 Discuss the different types of production systems

6.5.3 Discuss the various manufacturing markets (e.g., local, domestic, and global)

6.5.4 Describe Lean manufacturing and explain its importance

6.5.5 Describe Just-in-Time systems