

North Dakota Electronics Standards

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North Dakota Department of Career and Technical Education

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www.state.nd.us/cte

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INTRODUCTION TO CTE STANDARDS

CTE Mission

The mission of the State Board for Career and Technical Education is to work with others to provide all North Dakota citizens with the technical skills, knowledge, and attitudes necessary for successful performance in a globally competitive workplace.

Program Mission and Vision Statements

To provide a technical foundation in Electronics with specific job skills for employment in the Electronics Industry and/or pursue additional technical education in a related postsecondary program.

Goal

Career and Technical Education (CTE) is a series of educational programs organized to prepare students for careers in their chosen fields, to take leadership roles, and to balance their multiple roles in life. The CTE goal is to create a competitive and knowledgeable work force. CTE programs prepare students with the knowledge and skills to make informed career choices, to integrate and apply academic concepts, to prepare for successful participation in a global society, and to engage in lifelong learning.

The North Dakota standards for each CTE program define expectations for student learning. These expectations guide the development of high-quality and relevant career-focused programs that are consistent across the state.

Process

Writing standards is a multi-phase process. Existing national and/or industry standards are the basis for the North Dakota program standards. In addition, standards from other states are reviewed for essential content. A team of expert secondary and postsecondary teachers, business and industry representatives, and the state program supervisor(s) draft the standards document. Once the document is finalized, the State Board of Career and Technical Education approves and adopts the standards. The standards documents are reviewed and updated on a four-year cycle. Further information on the standards can be found at:

<http://www.nd.gov/cte/standards/>

Academic Integration

The Department of Career and Technical Education strongly believes in the importance of academic integration within each program. CTE courses are a vehicle by which students can apply academic knowledge to everyday life. Each standards document includes an academic cross-walk that identifies the standards in English/Language Arts, Mathematics, and Science that relate to CTE standards and can be taught or reinforced in the CTE program.

Using the Standards

Districts will use the standards as guides for developing curriculum that reflects local needs and are also tailored to prepare young people for the opportunities that exist in North Dakota and elsewhere.

Standards and Topics at a Glance

Standard 1: INTRODUCTION TO ELECTRICITY

Topic 1: Electrical Theory Automotive Tool Applications and Proper Usage

Topic 2: Electronic Components

STANDARD 2: CIRCUIT DESIGN AND FABRICATION

Topic 1: Soldering-Desoldering and Tools

Topic 2: Block Diagrams-Schematics Wiring Diagrams

Topic 3: Cabling

STANDARD 3: POWER SOURCES

Topic 1: Power Supplies

STANDARD 4: CIRCUIT ANALYSIS

Topic 1: Test Equipment and Measurements

STANDARD 5: SAFETY

Topic 1: Safety Precautions

STANDARD 6: TECHNICAL MATHEMATICS

Topic 1: Formulas and Applications

STANDARD 7: ELECTRICAL CIRCUITS

Topic 1: Series and Parallel

STANDARD 8: SYSTEM INTEGRATION AND AMPLIFICATION

Topic 1: Amplifiers

Topic 2: Interfacing of Electronic Products

STANDARD 9: DIGITAL SYSTEMS AND APPLICATIONS

Topic 1: Digital Concepts and Circuitry

Topic 2: Computer Electronics

Topic 3: Computer Applications

STANDARD 10: COMMUNICATION SYSTEMS

Topic 1: Audio and Video Systems

Topic 2: Optical Electronics

Topic 3: Telecommunications Basics

STANDARD 11: LEADERSHIP

Topic 1: Technician Work Procedures

Organization of the Standards Document

Standard: provides a broad overview or general description of the content.

Topics: describe in general terms what students should know and be able to do.

Competencies: more specifically define the knowledge, skills, and practices of topics and provide the basis for measuring student learning.

Standard 1: Career, Community and Family Connections – Integrate multiple life roles and responsibilities in family, work, and community settings. <i>(Based on National Standard # 1)</i>		
Topic 1: Analyze strategies to manage multiple life roles and responsibilities.		
Introductory	Core	Advanced
	1.1.1 List and describe trends in the workplace and community that impact individuals and families (e.g., policies, issues, ethics, worker benefits, etc.) 1.1.2 Describe how individual career goals can affect the family 1.1.3 Set personal goals for learning and leisure. 1.1.4 Predict the potential impact of career path decisions on balancing work and family.	1.1.5 Analyze the impact of social, economic, and technological change on work and family dynamics 1.1.6 Develop a life plan for achieving individual, family, and career goals
Topic 2: Identify transferable and employability skills		
Introductory	Core	Advanced
1.2.1 Apply communication skills (e.g., reading, writing, speaking, etc.)	1.2.2 Explore a variety of careers with emphasis on those requiring Family and Consumer Sciences skills (e.g., Textiles and Clothing, Food Production, Hospitality and Tourism, Interior Design, Food Science, etc.) 1.2.3 List job seeking and job keeping skills 1.2.4 Demonstrate teamwork and leadership “skills” 1.2.5 Examine work ethics and professionalism (e.g., dress, emails at work, gossip, theft, etc.)	1.2.6 Develop strategies to manage the impact of changing technologies in workplace settings. 1.2.7 Examine factors that contribute to maintaining safe and healthy work and community environments

Electronic Competency Categories

The competencies are further categorized into three divisions: Introductory, Core, and Advanced.

Learners at this level analyze, synthesize, judge, assess and evaluate knowledge in accord with their own goals, values and beliefs, and/or real situations.
Advanced
Learners at this level experience acquired knowledge by applying it to familiar situations and to themselves.
Core
Learners at this level explore and become more aware of the content within the subject.
Introductory

Keys to Employability

The eight skills are based on materials gathered from the North Dakota Career Resource Network and the National Career Development Guidelines. These national skills standards, developed by industry groups and sponsored by the U.S. Department of Education and Labor, provide career and technical educators with the expectations of employers across the United States.
<p>Basic Skills</p> <ul style="list-style-type: none"> • Reading-locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules. • Writing-communicates thoughts ideas, information, and messages in writing; creates documents such as letters, directions, manuals, reports, graphs, and flow charts. • Arithmetic/Mathematic – Performs basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques. • Listening – Receives, attends to, interprets, responds to verbal messages and other cues. • Speaking – Organizes ideas and communicates orally.
<p>Personal Qualities</p> <ul style="list-style-type: none"> • Responsibility – Exerts a high level of effort and preserves towards goal attainment. • Self-Esteem – Believes in own self worth and maintains a positive view of self. • Sociability – Demonstrates understanding, friendliness, adaptability, empathy and politeness in group setting. • Self Management – Assess self accurately, sets personal goals, monitors progress, and exhibits self-control. • Integrity/Honesty – Chooses ethical courses of action.

Keys to Employability (Continued)

Technology

- Selects Technology – Chooses procedures, tools or equipment including computers and related technologies.
- Applies Technology – Understands overall intent and proper procedures for setup and operation of equipment.
- Maintains and Troubleshoots Equipment – Prevents, identifies, or solves problems with equipment, including computers and other technologies.

Systems

- Understands Systems - Knows how social, organizational, and technological systems work and operates effectively with them.
- Monitors and Corrects Performance - Distinguishes trends, predicts impacts on system operations, diagnoses deviations in systems' performance and corrects malfunctions.
- Improves or Designs Systems - Suggests modifications to existing systems and develops new or alternative systems to improve performance.

Thinking Skills

- Creative thinking-generates new ideas.
- Decision making-specifies goals.
- Problem Solving – Recognizes problems and devises and implements plan of action.
- Seeing Things in the Mind's Eye – Organizes, processes symbols, pictures, graphs, objects and other information.
- Knowing How to Learn – Uses efficient learning techniques to acquire and apply new knowledge and skills.
- Reasoning – Discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem.

Resources

- Time – Selects goal-relevant activities, ranks them, allocates time, and prepares and follows schedules.
- Money – Uses or prepares budgets, makes forecasts, keeps records, and makes adjustments to meet objectives.
- Material and Facilities – Acquires, stores, allocates, and uses materials or space efficiently.
- Human Resources – Assesses skills and distributes work accordingly, evaluates performance and provides feedback.

Information

- Acquires and Evaluates Information.
- Organizes and Maintains Information.
- Interprets and Communicates Information.
- Uses Computers to Process Information.

Interpersonal

- Participates as a Member of a Team - Contributes to group effort.
- Teaches Others New Skills
- Serves Client/Customers - Works to satisfy customers' expectations.
- Exercises Leadership - Communicates ideas to justify position, persuades and convinces others, responsibly challenges existing procedures and policies.
- Negotiates - Works toward agreements involving exchange of resources; resolves divergent interests.
- Works with Diversity - Works well with men and women from diverse backgrounds.

Standard 1: INTRODUCTION TO ELECTRICITY**Topic 1: Electrical Theory**

Introductory	Core	Advanced
	<p>1.1.1 Describe atomic structure, the components of the atom, their charges and importance to electronics technology</p> <p>1.1.2 List ten uses for magnetism in electronics technology</p> <p>1.1.3 Explain basic uses for electricity</p> <p>1.1.4 Describe the basic methods of using electricity to operate a motor and how mechanical motion causes a generator to produce electrical current</p> <p>1.1.5 Explain the differences between current, voltage and resistance</p> <p>1.1.6 List different types of resistive materials and how resistors are used in electronics</p> <p>1.1.7 Show the different purposes for capacitors and list common types and construction</p> <p>1.1.8 Explain how inductance relates to magnetism and describe coil construction, cores and usages</p> <p>1.1.9 Show a comparison between reactance and resistance and describe current/voltage relationships</p> <p>1.1.10 Compare impedance with reactance and resistance and explain the causes and effects of impedance</p> <p>1.1.11 List voltage sources, AC and DC, batteries and natural generation</p> <p>1.1.12 List ohms law formulas for current, voltage, resistance and power. Solve math problems utilizing each</p>	

Standard 1: INTRODUCTION TO ELECTRICITY**Topic 2: Electronic Components**

Introductory	Core	Advanced
	<p>1.2.1 Identify resistor values from color code or other marks and list composition and reasons for different usages</p> <p>1.2.2 Identify capacitor types; list common usages; methods of varying capacitance and explain the terms charge and coulomb</p> <p>1.2.3 Identify inductor types and reasons for various core materials; how diameter and wire size affects the values</p> <p>1.2.4 Identify common types of transformers and list uses for each; explain step up/down voltage methods; explain why laminations are used</p> <p>1.2.5 Identify diodes as to type and common usage, explain common DC and bias voltage ranges</p> <p>1.2.6 Identify transistors as to type and usage, such as unijunction, FETs and MOSFETS; explain beta and alpha and provide common DC and bias voltage ranges; list common usage</p> <p>1.2.7 Identify other semiconductors and explain their uses: Darlington pairs; unijunction transistors and Gunn diodes</p> <p>1.2.8 Compare thyristors with other semiconductors; identify diacs, triacs and SCRs and explain their operation.</p> <p>1.2.9 Explain zeners diode ratings; describe usage in regulator circuits</p> <p>1.2.10 List common optical devices (LEDs, LCDs, etc.) and describe how photovoltaic cells are activated. Draw symbols for photo resistors, photodiodes and phototransistors; list materials from which these devices are made</p> <p>1.2.11 Describe MOS, CMOS, FET applications</p>	

STANDARD 2: CIRCUIT DESIGN AND FABRICATION**Topic 1: Soldering-Desoldering and Tools**

Introductory	Core	Advanced
	<p>2.1.1 Describe solder safety as it pertains to burns and potential fires or damage to facilities or customer products</p> <p>2.1.2 Explain the cause of solder fumes and the effects of lead poisoning</p> <p>2.1.3 List causes and precautions to prevent or reduce solder splatter</p> <p>2.1.4 Explain the reasons for flux usage and describe types</p> <p>2.1.5 List types of solder and reasons for choosing each</p> <p>2.1.6 Explain heat shunts, why and how they are used</p> <p>2.1.7 Identify cold solder joints and explain causes</p> <p>2.1.8 Describe the differences between good and bad mechanical and electrical solder connections</p> <p>2.1.9 Demonstrate proper care of solder-desolder equipment and aids</p> <p>2.1.10 Explain desoldering principles</p> <p>2.1.11 Describe various types of desoldering equipment and how it is used</p> <p>2.1.12 Demonstrate the use of braid-wick solder removers</p>	

STANDARD 2: CIRCUIT DESIGN AND FABRICATION		
Topic 2: Block Diagrams-Schematics Wiring Diagrams		
Introductory	Core	Advanced
	2.2.1 Draw common electrical/electronic symbols 2.2.2 Explain how block diagrams are used for troubleshooting and maintenance of electronics products 2.2.3 Explain the differences between wiring prints, schematics and block diagrams 2.2.4 Describe the purpose and use of test points. Indicate their likely placement on schematics 2.2.5 Explain how schematics are used to locate component and wiring failures in electronics products 2.2.6 Explain the methods of using flow diagrams/charts	
Topic 3: Cabling		
Introductory	Core	Advanced
	2.3.1 List wire types and construction 2.3.2 List wire gauges used for various purposes 2.3.3 Explain construction of coaxial cable and the impedance characteristics 2.3.4 List common identifications for copper cables, such as #18 and #24, and UTP telephone cable 2.3.5 Explain major differences between copper, coaxial and fiber optic cables 2.3.6 Describe impedance and its causes; explain reasons for maintaining a cable's characteristics 2.3.7 Explain the effects of proper and improper termination 2.3.8 Explain the purposes of grounding and common conventions used in electrical and electronics 2.3.9 Demonstrate splicing knowledge and ability for coaxial and copper cable; explain two types of fiber splices 2.3.10 Demonstrate testing methods for coaxial, copper, and fiber cables and compare loss measurements and techniques	

STANDARD 2: CIRCUIT DESIGN AND FABRICATION		
Topic 3: Cabling (CONTINUED)		
Introductory	Core	Advanced
	2.3.11 Compare the fittings and connectors used in cabling and list potential defects a technician may encounter 2.3.12 Describe proper crimping of communications wiring connectors 2.3.13 Explain how cable prep tools are used and demonstrate proper and improper crimping	

STANDARD 3: POWER SOURCES**Topic 1: Power Supplies**

Introductory	Core	Advanced
	<p>3.1.1 Explain shock hazards when servicing power supplies in electronic equipment</p> <p>3.1.2 Describe the differences between transformer powered supplies and line connected supplies</p> <p>3.1.3 Describe battery supplies and list common usages; also explain recharging principles</p> <p>3.1.4 Explain the reasons for filtering, describe hum, identify common filter types (pi, t, l, etc.)</p> <p>3.1.5 Explain the reasons for power supply regulation and list common components used in regulated supplies</p> <p>3.1.6 Explain where fuses and circuit breakers are commonly and electrically located in circuits; approximate sizes for common circuits; house service box common fuses and circuit breaker configuration and precautions for replacement</p>	

STANDARD 4: CIRCUIT ANALYSIS**Topic 1: Test Equipment and Measurements**

Introductory	Core	Advanced
	4.1.1 Describe how volt-ohm-current meters operate 4.1.2 Identify meter protection, safety and usage 4.1.3 Explain care of equipment and test leads 4.1.4 List the purposes and types of signal generators 4.1.5 Describe meter loading and precautions 4.1.6 Explain what R-C-L substitution equipment is and its purposes; explain ESR Capacitance-measurement equipment 4.1.7 List the uses and precautions for logic test probes 4.1.8 Explain how logic pulsers are used 4.1.9 Describe oscilloscope usage; explain the purposes of each front panel control 4.1.10 Define dummy load; show where and why used 4.1.11 Explain reasons for using rheostats, isolation transformers and variacs and why size matters	

STANDARD 5: SAFETY		
Topic 1: Safety Precautions		
Introductory	Core	Advanced
	5.1.1 Describe the physiological reactions electrical shock causes; list various degrees of current the human body can tolerate 5.1.2 Explain the concept of First Aid and its particular importance to workers in electric and electronics fields; explain precautions for untrained people 5.1.3 Explain what the National Electric Code is and describe various rules technicians must abide by 5.1.4 Describe fusing and circuit breaker rules and reasons for different types of fuses 5.1.5 Explain static causes and CMOS damage prevention straps, mats and grounding 5.1.6 List tools hazards that are associated with technician activities in the workplace and in the field 5.1.7 Describe lockout and tagging rules for potentially unsafe electrical or mechanical hazards 5.1.8 Explain eye and ear protection needed by technicians 5.1.9 List ladder handling and usage and OSHA heights safety rules 5.1.10 List service vehicle safety concerns such as ladder or transporting security and flying objects, driver screens inside the vehicle 5.1.11 Describe the types and usage of fire extinguishers	

STANDARD 6: TECHNICAL MATHEMATICS		
Topic 1: Formulas and Applications		
Introductory	Core	Advanced
	6.1.1 State Ohms law power, voltage, current and resistance formulas and solve for circuit values 6.1.2 List other common basic electronic formulas	

STANDARD 7: ELECTRICAL CIRCUITS		
Topic 1: Series and Parallel		
Introductory	Core	Advanced
	7.1.1 Identify and describe the operation of common DC circuits 7.1.2 Identify and describe the operation of common AC circuits 7.1.3 Explain how R, L, C circuits are used in electronics equipment 7.1.4 Explain the purpose of oscillators 7.1.5 Show how oscillators and multivibrators are similar and how they differ 7.1.6 Describe filter circuits, why and how they are used	

STANDARD 8: SYSTEM INTEGRATION AND AMPLIFICATION**Topic 1: Amplifiers**

Introductory	Core	Advanced
	<p>8.1.1 List common amplifier devices</p> <p>8.1.2 Describe the purpose of each component in an amplifier circuit</p> <p>8.1.3 List the usages and classes of amplifiers</p> <p>8.1.4 Describe biasing and gain characteristics</p> <p>8.1.5 Explain frequency response of an amplifier circuit and why it is important</p> <p>8.1.6 Explain the uses of operational amplifiers and how they differ from other amplifiers</p> <p>8.1.7 List and explain causes of distortion in amplifiers and list ways to reduce or eliminate it</p> <p>8.1.8 Explain how inaccurate measurements can be experienced due to meter or scope loading. List ways to overcome loading problems</p>	

Topic 2: Interfacing of Electronic Products

Introductory	Core	Advanced
	<p>8.2.1 List input circuit signal levels that may be expected for various common electronics products or test equipment</p> <p>8.2.2 List anticipated signal or voltage levels for output circuits in audio and video equipment</p> <p>8.2.3 Explain the importance of impedance matching; list causes of mismatches</p> <p>8.2.4 Explain the purposes of plugs and connectors and why it is necessary to use the proper ones</p> <p>8.2.5 Explain grounding, proper and improper methods, and the results of power source mismatch</p>	

STANDARD 9: DIGITAL SYSTEMS AND APPLICATIONS**Topic 1: Digital Concepts and Circuitry**

Introductory	Core	Advanced
	<p>9.1.1 Describe ASCII code</p> <p>9.1.2 Identify each basic digital gate</p> <p>9.1.3 Construct truth tables for common gates</p> <p>9.1.4 Explain how counters operate</p> <p>9.1.5 Explain the purpose of flip-flops and list common types</p> <p>9.1.6 Explain the purpose of a digital bus and show how it is connected to various sections of a product</p> <p>9.1.7 List types of display circuitry and describe how numbers and letters are activated digitally</p> <p>9.1.8 Show how pulsers are used for digital signal tracing and how logic probes are used to verify states in digital equipment</p> <p>9.1.9 Describe digital clock usage and circuitry</p> <p>9.1.10 Describe how microprocessors function and identify the basic components and pinouts</p>	

Topic 2: Computer Electronics

Introductory	Core	Advanced
	<p>9.2.1 Describe the major sections of a computer</p> <p>9.2.2 Demonstrate how the computer block diagram and flow charts are utilized</p> <p>9.2.3 Describe different types of computer memory and how storage is accomplished</p> <p>9.2.4 Define the word peripheral and list various types</p>	

STANDARD 9: DIGITAL SYSTEMS AND APPLICATIONS		
Topic 3: Computer Applications		
Introductory	Core	Advanced
	9.3.1 Demonstrate knowledge of basic computer operation 9.3.2 List ways to backup data and the importance of doing so 9.3.3 Explain the causes of line surges and viruses and protection procedures against each 9.3.4 Explain major components of the Internet, how it is accessed and common applications 9.3.5 Demonstrate how to download a service or application, data or programs 9.3.6 Explain how to use the Internet to locate parts and service literature	

STANDARD 10: COMMUNICATIONS SYSTEMS		
Topic 1: Audio and Video Systems		
Introductory	Core	Advanced
	10.1.1 Explain major components of the most common home entertainment products 10.1.2 Describe microphone technology and usage 10.1.3 Explain speaker construction and precautions 10.1.4 Describe the differences between good quality and distorted sound and electronic/acoustical reasons for each 10.1.5 Explain how signals may conflict and the symptoms the conflict may produce 10.1.6 Explain how to isolate troubles between discrete equipment units	
Topic 2: Optical Electronics		
Introductory	Core	Advanced
	10.2.1 List common electronics display devices 10.2.2 Explain how LCD displays operate, their advantages and disadvantages 10.2.3 Describe how LED remote hand units work 10.2.4 Explain why and list some locations or circuits in which optical isolators are used 10.2.5 List uses for light activated controls and how photo devices are incorporated	
Topic 3: Telecommunications Basics		
Introductory	Core	Advanced
	10.3.1 Describe major types of two-way radio communications (avionics, land mobile and maritime, etc.)	

STANDARD 11: LEADERSHIP		
Topic 1: Technician Work Procedures		
Introductory	Core	Advanced
	11.1.1 Explain major invoice and billing concepts for service businesses 11.1.2 Describe ways to procure service literature 11.1.3 Demonstrate location/cross referencing of parts and product in catalogs 11.1.4 Explain the purposes and requirements for proper record keeping 11.1.5 Explain estimate concepts for service work 11.1.6 Describe field technician work procedures that may differ from in-shop routines	